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Contents

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FOCUS is a triannual journal devoted to the promotion of best practises in aviation safety. It includes articles, either original or reprinted from other sources, related to safety issues throughout all areas of air transport operations. Besides providing information on safety related matters, **FOCUS** aims to promote debate and improve networking within the industry. It must be emphasised that **FOCUS** is not intended as a substitute for regulatory information or company publications and procedures.

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Front Cover Picture: Irish wet-lessor CityJet, part of the SARA Group, operates a fleet of 22 CRJ900 and CRJ1000 (pictured) aircraft on behalf of European customer airlines. CityJet's CRJ900s fly on behalf of SAS Scandinavian Airlines with its CRJ1000 fleet, introduced in 2023, currently operating on behalf of Lufthansa. www.cityjet.com

Closing Remarks

by Dai Whittingham, Chief Executive UKFSC

I find myself today writing my 40th Editorial, the first for the solely online edition and my last editorial contribution to FOCUS. A few days ago, I was taking notes from the last AGM and SIE I would be involved as Chief Executive, as I will very shortly be handing over to Rob Holliday after 12 ½ years at the helm of this fantastic organisation. I would like to say at the outset that the generous parting gift from the Committee was equally unexpected and very welcome, so my sincere thanks to you all.

I thought I would look back over the last few years to see if there were any obvious themes, and found there are plenty to think about. I spent the early days in the job learning a new language, following the realisation that commercial aviation left my old world of the Ministry of Defence and NATO trailing in the rear-view mirror when it came to the use of acronyms. The acronym spreadsheet is still prominent on the desktop, but it cuts to one of the themes, namely complexity and the problems that stem from language, ambiguity and the occasional absence of a shared understanding.

Some of those acronyms are either very close to others or can have identical meanings and, as ever, there are people who know the acronym but cannot decode it, so it simply becomes a name. Add to that the problems generated by native English speakers (pace, slang, non-standard phraseology), non-native speakers (pace, accent, local language, etc.) and the plethora of different approaches available to a single runway, and it should not come as a surprise if pilots occasionally miss a detail that proves crucial or get confused as to which type of approach they are flying. Sometimes you can have too much of a good thing.

Complexity also affects our regulations. Acknowledging that EASA and the UK CAA regulations came from the same source and are essentially the same beast despite some of the post-EU Exit divergences, both can be difficult to navigate, and it is telling that 'Easy Access' documents have become necessary. All forms of regulation, aviation or otherwise, have a central aim, namely that of encouraging or enforcing a set of behaviours, so it is unhelpful if regulation is ambiguous, obscure, over-prescriptive, or a combination thereof. By the time you have added the layer of operating manuals, finding out what you are supposed to be doing can be a real challenge.

Reality also dictates that regulations tend to grow with time as loopholes are closed and new requirements emerge, and there is no denying the truth that many regulations are written in blood. Simplification, or de-regulation, is actually very difficult to achieve unless the rationale for a rule-making task was properly captured at the time the original rule was written. The CAA had a good stab with the 'Red Tape Challenge' recast of the GA regulations, which were seen as onerous and disproportionate, but it was still a step too far for some and not far enough for others. If you are the regulator there is always danger in de-regulating, lest the baby leaves with the bath water – damned if you do, and damned if you don't.

On new requirements, knee-jerk responses to a particular event are not always helpful. The awful Germanwings pilot murder-suicide of 2015 is a case in point. The sight of two visibly shocked heads of state looking at a mountainside covered in debris meant that some form of action was inevitable, but the imposition of psychological screening has not solved the problem. Nor was it likely to, as suicidal ideation does not necessarily present at an initial or recurrent medical examination. Episodes of poor mental health can be unpredictable, though some of the precipitating factors are readily identifiable. As the insurance industry pointed out in a contribution to a recent RAeS paper on psychosocial risk management and mental health[1], fatalities from pilot murder-suicide (subject to confirmation of one major accident in China) have surpassed all other causes since 2011. The renewed industry focus on wellbeing and mental health is therefore both welcome and necessary.

That said, it is somewhat ironic that one of the biggest stressors with regard to mental wellbeing is fatigue, an issue that has for years consistently featured at the top of the CHIRP reports. The CAA review of Flight Time Limitations (FTL) may offer some future respite in the form of refined guidance but, from a regulatory perspective, fatigue can only be managed by the operator. That means there will always be tension between the business requirement for the highest productivity and the need to avoid costs from fatigue-related accidents or incidents, or from the human cost of burn-out. It is also worth noting that there is an arguable (in the legal sense) case for classifying as an industrial injury a period of sickness that is caused by rostering policies. In other words, if your roster leads to fatigue that ends up with you being declared sick by the company or your AME, you have suffered an industrial injury whether the duties are 'legal' per FTLs or not.

The last theme is that of professional knowledge. There are many highly capable leaders and managers looking after operator interests, but decisions can be targeted at the financial bottom line without understanding of the wider implications, especially where safety is concerned – i.e. the production/protection equation is usually skewed in favour of production. This is not to say people are at fault, rather that it is a symptom of an industry with no culture of continuous professional development and an education system that pays scant attention to safety when it comes to business degrees. There needs to be serious investment in education and training, not only at the executive level but also for all managers and supervisors. It is not acceptable to promote someone to be, say, a supervisor in a maintenance organisation and then expect them to be effective without suitable training in how to supervise. Why is it acceptable to appoint someone as a management pilot without any guidance or training in how to do the job? There are of course pockets of excellence but there is a systemic weakness that needs to be addressed. My part in that is working with colleagues on a knowledge framework that we hope will give the industry a baseline from which to work. You will be hearing more about KALM (Knowledge for all Leaders and Managers) in the coming months.

Let me close by stating that my time with UKFSC has been a privilege that I have really enjoyed. I hope that I have been able to make a difference here and there, regardless of how much remains to be done in a constant battle to keep safe all those who fly. My thanks to June and Lisa, who have kept the Fairoaks flag flying and done their very best to keep me on time and on track – it would not have been possible without your support. And my thanks to all of you who have contributed to this great enterprise by turning out for the SIEs and sharing information that would otherwise have stayed in house. We will never know if we prevented an accident, because that is the nature of the beast, but at least we tried. I wish Rob every success as he takes the UKFSC into new waters.

[1] https://www.aerosociety.com/media/23684/mental-health-and-wellbeing

Breaking The Habit

by Rob Holliday, Chairman UKFSC

In both professional and daily life, humans often perform tasks by rote, relying on habitual actions and routines. This tendency to operate on autopilot can be efficient, but it also carries significant risks, particularly in high-stakes environments like aviation, medicine, and industrial settings. Understanding why humans do this and recognizing the associated pitfalls is crucial for enhancing safety and performance.

The longstanding NTSB Safety Alert 'Preventing Rote Callouts - Confirm Cockpit Indications Before Making Callouts', cites accidents where the pilots acted out of habit and made callouts based on what they expected to see regarding the cockpit indication but did not take the time to verify it.

A Boeing 757 overran the end of the runway while landing in Jackson Hole, Wyoming. The captain called out "deployed" even though the speedbrakes were not deployed and "two in reverse" even though neither reverser was fully deployed. Both the speedbrakes and the thrust reversers had mechanical defects

An MD-82 crashed after taking off with the flaps retracted in Madrid, Spain. The first officer called out the proper flap setting (not the indicated setting), but the flaps were not properly set for take-off.

Cross-checking repetitive tasks is essential in many high-stakes environments to ensure safety and accuracy. However, when such tasks rarely result in finding anomalies, several potential problems can arise.

Individuals may become less vigilant over time. The assumption that everything is always correct can lead to a relaxed attitude towards the task, increasing the likelihood of missing the rare but critical errors (Dekker, 2011).

Over time, the task of cross-checking can become just as rote as the original task, with individuals going through the motions without genuinely scrutinizing the details (Reason, 2008).

Other factors that may cause pilots to miss cross-checks are high workload situations resulting in cognitive overload or time pressure, stress, fatigue, complexity, and inadequate training.

Yeti Airlines Flight 691, a scheduled domestic passenger flight from Kathmandu to Pokhara in Nepal, crashed on January 15, 2023, just before landing at Pokhara International Airport. Performing a circling approach, to a new runway, on a training flight, the Pilot Monitoring responded to the Pilot Flying's call for 'Flap 30' by selecting both Condition Levers to Feather. In this case there was no call out recorded, just an apparent lack of cross-checking of the requested configuration change.

Flight Data Monitoring could be used for assessing the effectiveness of pilots' cross-checking procedures. Any time the aircraft configuration is not as it should for the phase of flight may indicate a breakdown in monitoring or cross-checking.

The NTSB's recommendations for avoiding rote call outs are: -

- Take the time you need to ensure that you see and verify each cockpit indication. Adopt a methodical pace when reading or responding to checklist items.
- Train yourself to direct your attention on the indicator or display long enough to be sure of what the indicator is telling you every time. Physically touching a control or pointing to an indicator can be a useful technique.
- Be aware of the change in the aircraft's performance to a configuration change. For example, a callout of "flaps fifteen" may be accompanied by a characteristic change in pitch attitude and airspeed, so know what to expect, not just the flap position indicator.
- Be attentive to an indicator's colour and do not anticipate a colour change before it occurs. For example, a thrust reverse indicator is often amber when reversers are in transit but green when reversers are fully deployed.
- Articulate a response clearly and always challenge if not receiving a proper response to checklist callouts. Improper or nonstandard phraseology, nods, mumbles, and nonverbal signals are unacceptable.
- Prevent non-operational distractions, such as cockpit conversations, by implementing a "sterile cockpit" where callouts are expected. Operational distractions, such as radio calls, can interrupt or drown out a callout. Stay focused and assertive and repeat the callout if needed.
- Set an example. Make your callouts crisp and catch any missed indications, your fellow pilot will likely follow suit.
- Add callout awareness to your preflight briefings and be ready to verbalise each and every discrepancy. Awareness is a large part of the solution.

Performing actions by rote is a natural human tendency that offers efficiency and consistency in routine tasks. However, the pitfalls associated with automatic behaviours, particularly in critical environments, necessitate strategies to enhance awareness, adaptability, and safety. By understanding the human factors involved and implementing appropriate safeguards, we can mitigate the risks and ensure that routine actions do not lead to unintended consequences.

Level busts – How much of an impact do they really have on Air Traffic Control?

by Vanessa Hipperson, NATS

It's just a couple of hundred feet, right?

Unfortunately, not. Any deviation from a cleared flight level is never a good idea, especially in the crowded skies above the United Kingdom. In the UK, level busts are a persistent issue that not only endanger flights, but also place significant stress on Air Traffic Controllers (ATCOs) who are responsible for managing air traffic safely and efficiently.

In 2023, NATS reported 627 level busts and of these, 41 resulted in a loss of separation with another aircraft. Understandably, this number has steadily risen post-Covid, in line with traffic levels. The reasons for the level busts varied from incorrect readbacks to aircraft auto pilot malfunction. However, the predominant causal factor was incorrect pressure settings. This took the form of either correct pilot readback followed by incorrect action or simply an altimeter setting error.

Impact on ATCOs

The occurrence of level busts places a significant burden on Air Traffic Controllers. The primary responsibilities of ATCOs include maintaining safe separation between aircraft, managing air traffic flow, and ensuring that aircraft adhere to their assigned flight paths. Level busts complicate these tasks in several ways:

1. **Safety:** The primary concern for ATCOs is maintaining safety. Level busts increase the risk of loss of separation between aircraft, which can lead to dangerous situations requiring immediate intervention.

2. **Increased Workload:** When a level bust occurs, ATCOs must quickly identify the deviation and issue corrective instructions to the affected aircraft. This requires immediate attention and swift decision-making, adding to the controllers' workload.

3. **Stress and Pressure:** The potential consequences of a level bust can be severe, including mid-air collisions or near-misses. This places immense pressure on ATCOs to resolve the situation quickly and effectively, contributing to high stress levels.

4. **Operational Disruptions:** Level busts can disrupt the normal flow of air traffic, necessitating changes in flight paths and altitudes for other aircraft to maintain safe separation. This can lead to delays and increased complexity in air traffic management.

Over the years, NATS has made significant steps in the reduction of risk by installing technology like Mode-S radars and most recently the Biometric pressure setting Advisory Tool (BAT) within the London Terminal Manoeuvring Area. BAT uses Mode-S technology to down-link the altimeter sub-scale setting being used on the flight deck of an aircraft. There are three versions of BAT: BAT for arrivals, BAT for departures and the most recent addition BAT_TL, which is for aircraft operating above the transition level. When an aircraft has an incorrect pressure setting on their barometric altimeter it will highlight this to the air traffic controller on the radar. The ATCO will highlight this discrepancy with the flight crew to correct the barometer.

To address the issue of level busts and mitigate their impact on ATCOs, several strategies have been implemented by both NATS and the wider aviation industry:

1. **Level Bust Working Group:** NATS and the Civil Aviation Authority (CAA) have established the Level Bust Working Group. This is a combined effort to establish what the risk is now and how we can mitigate it even further. The group hopes to identify trends, which will allow for the possibility of remedial actions through the appropriate regulatory or industry organisations. The Working Group will also endeavour to conduct and facilitate activities that will lead to a sustained and demonstrable reduction in the risks associated with the number of level busts in the UK. Any lessons learned from investigations and analysis of level bust incidents can then be disseminated to appropriate parties to educate aviators and hopefully contribute to minimising the occurrence of level busts in the future.

2. **Enhanced Training:** Both pilots and ATCOs undergo regular training to improve communication, decision-making, and understanding of procedures related to altitude assignments. Simulated level bust scenarios in ATCOs emergency training are used to prepare for real-world incidents.

3. **Technological Solutions:** As mentioned previously, air traffic management systems are being deployed to reduce the risk of level busts. Airlines are also adding technological solutions. These include improved autopilot systems, enhanced altimeter accuracy, and automated alert systems for altitude deviations.

4. **Procedural Changes:** Air traffic control procedures are continuously reviewed and updated to minimise the risk of level busts. This includes clearer altitude instructions, standardised communication protocols, and the use of step-climbs and descents to reduce workload.

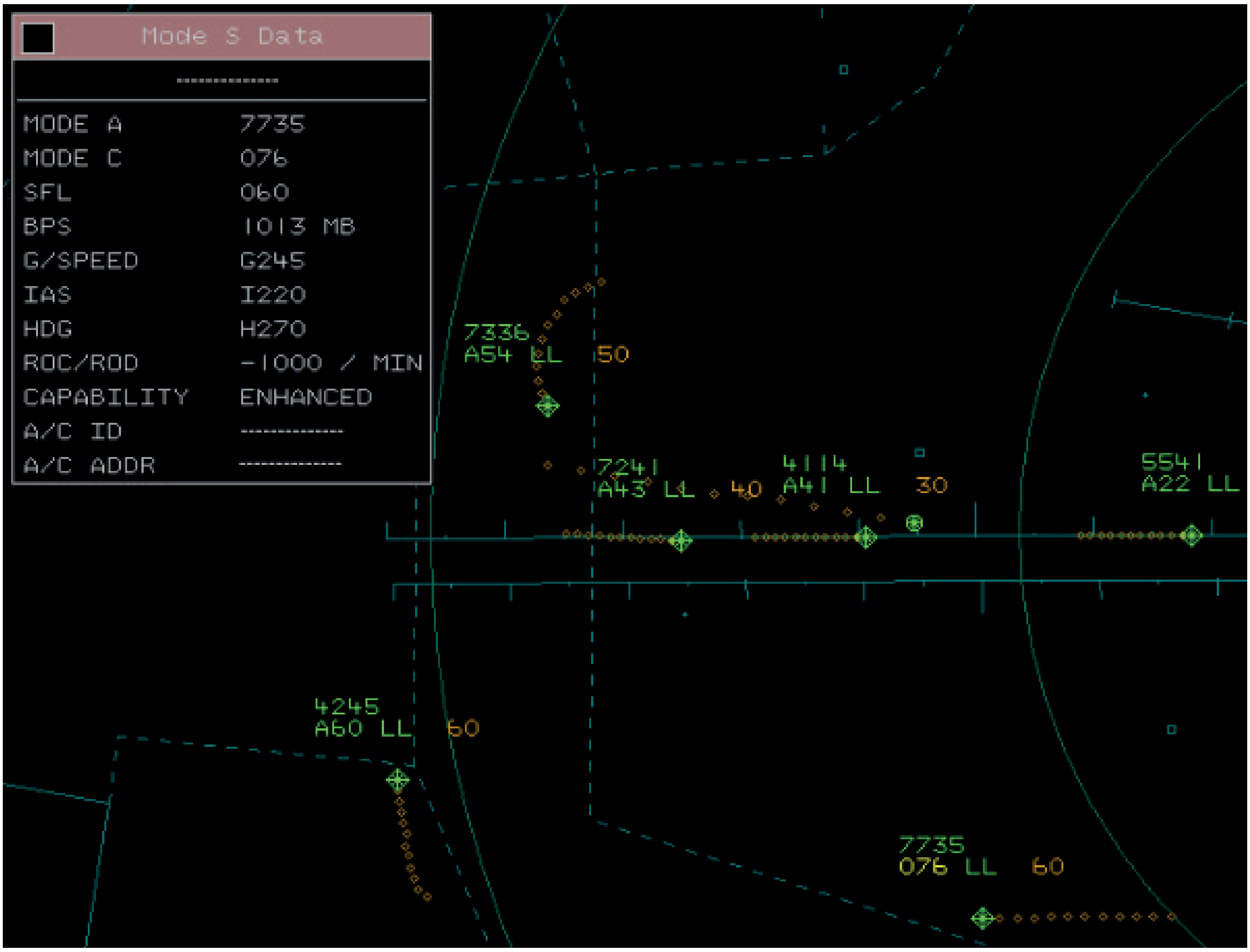
5. **Safety Reporting and Analysis:** The Civil Aviation Authority encourages the reporting of level bust incidents to analyse trends and identify common causes. This data-driven approach helps in developing targeted interventions to prevent future occurrences.

Conclusion

Level busts represent a significant safety challenge in UK airspace, with serious implications for Air Traffic Controllers and flight crew. Deviation from assigned altitudes not only endangers flights but also places considerable stress on Air Traffic Controllers. By implementing enhanced training, leveraging technological advancements, and refining procedural practices, the aviation industry aims to reduce the incidence of level busts and ensure a safer flying environment. Continuous efforts to address this issue are crucial in safeguarding both passengers and air traffic professionals.

NATS is making every effort to reduce the risk from a technological, procedural and training perspective – we're asking airspace users to do the same.

Our request to flight crew: pay close attention to your altimeter setting, especially on low pressure days.



Example of an altimeter setting error on 7735

Legal liability for injuries caused by turbulence

by Ashleigh Ovland, Knowledge Counsel (Aerospace), HFW

Severe turbulence has hit the headlines recently after the very serious incident experienced by Singapore Airlines. A 2023 study by Reading University concluded that turbulence is on the rise, finding that clear air turbulence had increased 55% between 1979 and 2020 on one North Atlantic route[1]. This raises some interesting questions about the way the law approaches liability to passengers and crew who are injured as a result of turbulence.

To go back to first principles, the liability of an airline to its passengers on the vast majority of international flights will be governed by the framework set out in the Montreal Convention, commonly known as MC99. The key wording of MC99 is that:

"the carrier is liable for damage sustained in case of death or bodily injury of a passenger on condition only that the accident took place on board the aircraft or on the course of any of the operations of embarking or disembarking".

At first blush, this looks simple. Turbulence injuries always happen on board the aircraft, so fulfilling the location requirement is straightforward. On its face, the wording does not seem to require the passenger to prove that the airline was negligent or otherwise at fault.

However, over decades, a huge body of international case law has evolved which attempts to define the word "accident", in order to enable airlines to deny liability in some circumstances. The definition most frequently relied upon is that in *Air France v Saks*, a case which was heard by the US Supreme Court in 1985. They held that liability would only arise if the injury was caused by *"an unexpected and unusual event or happening that is external to the passenger"*. If the operation of the aircraft is *"usual, normal and expected"* then no accident has occurred. In *Saks*, the passenger suffered a burst eardrum due to changes in pressure, but there was no evidence of any malfunction of the cabin pressure system and no other passengers suffered the same injury; she simply had a physical sensitivity to the normal changes. The English Court of Appeal applied the same test to a different scenario in *Barclay v British Airways* in 2010, when a passenger slipped on a piece of plastic on the floor of the aircraft and injured her knee. By showing that the plastic was a standard feature of the cabin configuration the airline was able to deny liability.

So, where does this leave us where turbulence is concerned? Is it "unexpected and unusual" or "normal and expected"? A question that has also been asked in court is from whose perspective must we determine the nature of the event? Is it technically objective, or is it subjective? If subjective, from whose point of view must we approach the analysis? That of the first-time nervous flyer, the seasoned traveller or the staff of the airline with their long experience and specialist technical knowledge?

This was looked at in the English High Court fairly recently, in a claim brought by a passenger who slipped on de-icing fluid tracked in on shoes and left on the floor. The answer (arrived at by looking at cases from all over the world) was something of a middle ground, in that the appropriate perspective was held to be that of a passenger, but one with *"with experience of commercial air travel and with reasonable knowledge of established or common airline practice."*

On the other hand, when a case involving a hard landing was heard in the Court of Justice of the European Union (CJEU) in 2021, they which concluded on the basis of evidence from the flight data recorder that there was no liability because the landing was well within the maximum tolerance of the aircraft pursuant to the manufacturer's specifications, in other words more of a subjective technical view than an objective human one. This was in spite of the passenger's evidence that she had flown frequently and never experienced such a landing.

Although the approaches are slightly different, both require the airline to compile evidence of how an incident compares against normal industry practice and tolerances in the context of ordinary air travel.

Airlines are, of course, very well-versed in dealing with turbulence and consider it to be fairly routine. Advice to keep seatbelts loosely fastened while in your seat is standard, and every passenger is aware from those warnings of the possibility of a bumpy flight. Flight crew tend to manage risk conservatively with warnings to return to seats and secure loose items when turbulence is anticipated.

Each turbulence incident must be assessed on its own facts – broadly (and probably unsurprisingly) the more severe and unpredictable the turbulence, the more likely it is to be an accident. There will be a few different elements to consider when – how likely was it for that flight to experience turbulence, to what extent could the particular turbulence have been predicted, should steps have been taken to avoid it, and did the crew follow the standard procedures for protecting passengers against injury?

A 1994 Canadian case, *Quinn v Canadian Airlines International Ltd* drew the accident/not accident dividing line by saying that "light" or "moderate" turbulence would not be an accident but "severe" turbulence would. The classification they used was approved by Transport Canada and used the following criteria:

Intensity	Aircraft Reaction	Reaction inside aircraft
Light	Momentarily causes slight, erratic changes in altitude and/or attitude (pitch, roll, yaw).	Occupants may feel a slight strain against seat belts or shoulder straps. Unsecured objects may be displaced slightly. Food service may be conducted and little or no difficulty is encountered in walking.
Moderate	Similar to Light Turbulence but of greater intensity. Changes in altitude and/or attitude occur but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed.	Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult.
Severe	Causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control.	Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food service and walking impossible.
Extreme	The aircraft is violently tossed about and is impossible to control. It may cause structural damage.	[No criteria stated]

However this does not deal specifically with the "expected" question, which is important because the more sudden and unexpected the turbulence, the less time the crew have to put in place all the usual safety measures, such as seatbelt warnings.

Given the documented increase in turbulence, particularly clear air turbulence, and the accompanying news reports, one argument might be that even its more severe forms are becoming less unusual and more expected from the experienced passenger's perspective. However an airline would have to think carefully about potential reputational risk in pursuing such a line of argument in defence.

The seatbelt question

A common question is whether or not it makes a difference if the passenger ignored a warning to put on their seatbelt. The answer is that it does not change the analysis that an accident occurred, but it allows the airline to defend the claim on the basis of contributory negligence. This could be a complete defence or could reduce the damages by the notional percentage by which the court holds that the passenger's own actions contributed to their injuries. However an airline pleading this will have to be extremely certain that they can prove that sufficient warning was given in clear terms and in sufficient time.

Psychological damages

Thankfully, most turbulence incidents do not result in injuries because of the swift actions of the crew. However, severe ones could well have a lasting impact on the mental health of uninjured passengers. We have written previously on the impact of the 2022 *Laudamotion* case which now permits recovery of damages for standalone psychological injury where previously none were available. That case is binding across the EU and persuasive worldwide.

Crew

Crew members are injured by turbulence far more frequently than passengers. Their claims will be determined not by MC99 but in accordance with the domestic employment law applicable to their contract. Factors such as the degree to which the crew were warned and trained will be highly relevant.

Delay compensation

Where a flight is diverted as a result of a medical emergency or mechanical safety concern caused by turbulence, passengers may have the right to claim compensation under UK261 or EU261. The compensation bill could be substantial for a fully-occupied wide-bodied aircraft. Those claims can be defended if the delay was caused by "extraordinary circumstances which could not have been avoided even if all reasonable measures had been taken." Weather events are generally considered to be extraordinary circumstances but the frequency of turbulence on the particular route may be relevant and, in order to satisfy the second limb of the test, the airline may have to be prepared for a close examination of the steps it took to avoid the turbulence if it wishes to defend the claims.

1. Flight turbulence increasing as planet heats up - study - BBC News

Dirty plus thirty

by Robert Wilson

A 12-factor classification of maintenance hazards remains as relevant as it was in 1993.

Gordon Dupont's aviation career began in the mountain passes of Papua New Guinea (PNG). But its high point took place in a government office containing a large cardboard box. When he opened it, he advanced aviation safety.

Dupont brought a distinctive combination of experience to that government office, beginning as a missionary pilot in PNG. 'The maps we used were from the war and marked "not for navigation",' he recalls. On leave he would fly to Australia, as far south as Bankstown, and he remembers being both irritated and impressed by the precision and zeal of Australian ATC.

Returning to Canada in the late 1960s, he faced the decision that every professional pilot eventually confronts. 'I didn't want to become an airline pilot because I wanted to come home at night,' he says, from Richmond, British Columbia, where he still consults on aviation safety.

He became an engineer, then principal of an aviation maintenance training college, then served 7 years as a Transportation Safety Board accident investigator. In 1993, Transport Canada hired him as a maintenance safety expert in the wake of the 1989 Dryden, Ontario, airline crash, which had led to a wide-ranging judicial inquiry.

'I was called special safety program coordinator which was a fancy title for, "We don't know what to call you",' he says. 'I was trying to develop proactive training to lower the accident rate. Working as an investigator had been reactive – we couldn't say anything until after an accident.'

Insight came in an unlikely package – the cardboard box mentioned above. It arrived full of maintenance incident reports from the Canadian Forces. 'They were the only ones who kept that sort of information,' Dupont says. 'I pulled the ones that said, "careless, stupid or lazy" out of the box and I went through them a second time.'

After many cycles of sorting, and a colossal mess of old-style folding computer paper on the office floor, themes began to emerge. Incidents and accidents were not the result of random carelessness, stupidity or laziness, but emerged from a complex interaction between personal qualities, personal limitations and organisational characteristics.

This had been proposed before, notably by James Reason's Swiss cheese model. Dupont's contribution, which he called 'The dirty dozen', was to identify manageable distinct safety problems that could be addressed, breaking this huge vague challenge into 12 smaller ones. The concept has since been applied in maintenance, flight operations and health care.

Why 12? 'It's an easy number to remember, a snappy title and it fitted into the data,' Dupont says. 'Some people have said I should have a baker's dozen [13] or a top 10, [the filthy 15 is another classification doing the rounds of some training programs] but I said a dozen would take care of 99.9% of incidents.'

The dirty dozen

The 12 elements can be thought of as a matrix; they reinforce and overlap each other. 'Don't think there's just one – the dirty dozen like to get together and gang up on you,' Dupont says. Conversely, well managed elements can mitigate the dangerous effects of the others.

Originally there was no hierarchy but Dupont now considers fatigue to be the most acutely dangerous hazard. The dirty dozen are:

1. lack of communication
2. distraction
3. lack of resources
4. stress
5. complacency
6. lack of teamwork
7. pressure
8. lack of awareness
9. lack of knowledge
10. fatigue
11. lack of assertiveness
12. norms.

1. Lack of communication

Communication has many enemies in the hangar: ambient noise, obscure jargon, unstated assumptions, time pressure, particularly at shift handover, and imprecise language. 'If generator has not been expended, install shipping cap on firing pin,' was an instruction to maintenance workers at SabreTech engineering, Miami, US, in May 1996. As William Langewiesche wrote in The Atlantic, this required hard-pressed maintenance workers to distinguish between an expended oxygen generator, which could not start a fire, and an expired one, which could. The SabreTech workers solved the dilemma by loosely packing all oxygen generators into a cardboard box and putting it on Valujet flight 592, which caught fire and crashed, killing all 110 on board.

Mitigators for lack of communication include:

- writing down complex instructions
- using logbooks, worksheets, and checklists
- keeping verbal messages short and simple
- emphasising critical elements at the beginning of a message and repeating them at the end
- confirming understanding and encouraging questions.

2. Distraction

Neuroscience has advanced since 1993 and theories of memory are more refined but the link between distractions, interruptions and disastrous lapses of memory remains. 'The brain works faster than the hands,' Dupont says. 'If distracted, you will come back thinking that you are further ahead then you are unless something visual brings you to reality.'

Mitigators for distraction include:

- prioritising the task and completing it before responding
- making incomplete work obvious as a reminder to you or whoever completes the work
- when returning to a task, starting again at least 3 steps from where you finished, to ensure there are no gaps in the task
- having someone else double-check the task
- using a checklist.

3. Lack of resources

Resources for a task include parts, personnel, time, data, tools, skill, experience and knowledge. Lighting for work stands, and hangar temperature also fall under this category: having to stretch or bend uncomfortably to perform a task increases the chances of error.

Mitigators for lack of resources are:

- assessment, planning and investment
- working out what is needed and not scrimping.

4. Stress

Maintenance engineers are people, with full and sometimes complex lives. The stress of these can sometimes impact their work if not managed. Organisations are also impacted by stress, as many were during the COVID-19 pandemic.

Mitigators for stress in individuals include:

- rest, balanced diet and exercise
- speaking out and getting help if stressed
- watch for signs of stress in colleagues.

5. Complacency

While too much pressure and demand causes over-stress and reduced human performance, too little results in, boredom, complacency and reduced human performance. The Oxford English Dictionary defines complacency as, 'A feeling of being satisfied with yourself or with a situation, so that you do not think any change is necessary.' Complacency is linked to reduced vigilance – 'Don't worry, it's OK!' – and susceptibility to confirmation bias, seeing only what you expect to see.

Mitigators for complacency include:

- following standard procedures and checklists every time
- checking your work every time, even if the operation is easy
- always being prepared to find something wrong
- never signing off on anything you haven't fully checked.

6. Lack of teamwork

Aviation maintenance, particularly of heavy aircraft, is a 'team sport'. No one engineer knows everything or can do everything. As sport shows us, great teams have intangible qualities that elevate their performance. They excel in leadership, communication and motivation.

There are many ways to build a team. Some maintenance-specific ones include:

- briefing tasks that require several people to ensure nothing is forgotten
- selecting team members with a broad range of skills and experience
- practice and rehearsal
- dividing tasks appropriately among different team members
- having clearly defined roles and responsibilities
- debriefing.

7. Pressure

Some degree of pressure is inevitable in aviation maintenance. Very expensive machines are expected to be maintained, repaired and overhauled to tight schedules. Pressure can come from clients, management or ourselves. Skybrary says, 'We put pressure on ourselves by taking on more work than we can handle, especially other people's problems, by trying to save face, and by positively promoting superpowers that we do not possess.'

Mitigators for pressure in individuals include:
- speaking up if a task needs more time
- asking for extra support if you don't have enough time.

8. Lack of awareness

This refers to not recognising a situation, and not predicting the possible results. It is analogous to tunnel vision in pilots that comes with task saturation, and is related to stress, pressure and fatigue.

Mitigators to increase awareness include:
- fully understanding the procedures and possible consequences of a task
- asking 'what if?'

9. Lack of knowledge

There's a lot to know. Aircraft and their many systems are complex and require volumes of technical documentation. Added to this are airworthiness directives, airworthiness bulletins and service letters. On the job experience is no substitute for technical training, and after you think you've learnt everything, technological change means your knowledge can go out of date.

Mitigators for lack of knowledge include:
- accepting you don't know it all – no-one does
- seeking and using relevant up-to-date documentation
- RTGDM – read the goddamn manual.

'One of my ex-World War II instructors made us recite that [RTGDM] at the start and end of every class; that may not be politically correct in this day and age but 50 plus years later, I still remember it,' Dupont says.

10. Fatigue

Prolonged stress or lack of sleep will lead to fatigue. Under its influence, concentration and memory fade. Distraction and low mood become more likely.

Mitigators against fatigue include:
- rest
- balanced diet
- not scheduling safety critical tasks in the window of circadian low, between 3 am and 5 am.

11. Lack of assertiveness

Speaking up to highlight problems is essential but difficult. But it is a skill and it can be learnt. Speaking assertively is different from being aggressive. It involves respecting the opinions of others, but not compromising your standards.

Assertiveness can be facilitated by:
- emphasising what is right, not who is right.

12. Norms

'The way we do things round here' – also known as safety culture – are the expected, yet unwritten, rules of behaviour in an organisation. Leadership, or its absence, sets these norms. Unexamined or ill-disciplined norms can lead to normalisation of deviance when an organisation drifts into unsafe practices. People rationalise this because, despite departing from stringent best practice, nothing bad has happened – yet.

Mitigations against bad norms include:
- developing assertiveness
- setting a personal example of best practice.

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CHIRP

Confidential Human Factors Incident Reporting Programme

Report No 1 – ENG737 – Incorrect use of MEL

Report Text: The flight crew arrived at the stand to find the aircraft only just arriving, having been towed over from the maintenance hangars. Crew boarded and commenced checks, shortly followed by line engineers, who were unhappy (but still helpful and working hard) at having had this aircraft dumped on them last minute. The engineers looked through the Tech Log and discovered a [system] deferred defect entry they weren't happy about. The entry was made with a 10-day limitation, using MEL deferment authorisation.

The line engineer explained easily and in detail to the flight crew that this was not the correct MEL entry and that [component] was in fact a "no go" item. He showed on the system displays where the [component] was located and that how the procedure outlined in the MEL would be ineffective with engines running. He explained this would likely lead to a [Flight Deck] message either during take-off roll or in flight, which would then cause the aircraft to be AOG wherever it ended up. The engineers proceeded (under apparent pressure from engineering management over the telephone) to investigate the [defect], which had supposedly already been done in the hangar. They did not have the right steps equipment (due to the height needed to reach) and so had to make use of borescope equipment to try and establish [the source of the defect].

After some time, the engineers returned and explained the following to the flight crew.

They had confirmed the defect. They had looked up the information on this in the maintenance manual, where it explains that a specific piece of equipment is required to test the [system] to determine whether or not the [issue] is within limits for a dispatch or not. If out of limits, nil dispatch. If within limits, dispatch is allowed for a very limited number of sectors. They had then looked up whether [Operator] had that piece of testing equipment in stock, and they did not. Therefore, this required test cannot have been performed in the hangar, and the hangar had also clearly used the incorrect deferment authority and had not followed what the maintenance manual dictates, allows or recommends. This issue now went fully over to the senior engineering management and there was a period of time where everyone at the aircraft waited. The duty engineering manager arrived at the aircraft and requested the Captain operate the flight.

The Captain was aware of the information from the very experienced line engineer who had already said he would not want his signature stating this aircraft was airworthy. The Captain refused the manager's request, who asked him once more, but then accepted the Captain's decision. Service was then cancelled.

Too much pressure and [Aircraft Type] serviceability and parts availability is very concerning. So many ADDs, and worried how many are being correctly applied.

CAA Comment: [Operator] Engineering management have in general (not referring to this event) always stated that the Captain has the final word whether to accept the aircraft or not. The task was poorly planned into the hangar and accepted by the team in the previous shift because neither the test kit was arranged nor the task changed for the replacement of the [Component]; additionally, a replacement [Component] had not been arranged. The LAE who dealt with the input had 3 aircraft to deal with and delivery on time was a prime consideration for him. The engineer did state that he was not put under any pressure from Engineering Management however. He did not raise any issues of missing test kit with the [Maintenance Control] office and proceeded to do a test by an alternate method which was not in the approved data. He recorded the rectification by raising an ADD without any approved data reference. The test kit required had been sent for calibration in the first half of 2022 and returned. It was awaiting paperwork confirmation. Correct planning would have made arrangements for a [defect] tester to be available. Note; [Operator] have put a series of mitigations in place to prevent this happing again and the CAA will review when this is complete.

CHIRP Comment: The report was very comprehensive and detailed with the correct terminology and approved data references that had to be redacted for confidentiality reasons. Deviation from approved data references (AMM & MEL in this case) is a violation whichever way one considers it. The report investigation by the CAA focused on the poor decisions made in the hangar and the possibly perceived time pressure. Why does one fall into this trap? Is it because actual time pressure has now become so commonplace? Or, even though no management pressure was evident, perhaps peer pressure was at work? On the other hand, is perceived time pressure created or increased if colleagues seem to work at a slower rate than the Certifier/ Supervisor would like and therefore tries to compensate for? Happily, the Line Engineer did not line up the last hole in the cheese and, although the outcome was unfortunate, it was correct.

Report No 2 – FC5304 – Flight Crew/Engineer interactions

Report text: This report is published in précis in order to disidentify those involved.

Whilst conducting a pre-flight system check at [Base], it became apparent there was an issue with the aircraft similar to one that I had experienced with it before. Due to the engineers on my previous event in this aircraft being concerned by it I was equally concerned and decided to return to stand.

We were met by an engineer who I feel was putting undue commercial pressure on us to accept the aircraft. He was extremely rude and told us we were basically wrong and that there was no standby aircraft so we were cancelling a service because the aircraft was perfectly serviceable – all this whilst he was outside the aircraft on the headset. I told the engineer to come up and stairs were attached. He came into the flight deck and I demonstrated what I had experienced. Again, significant pressure was put on us to accept the aircraft but we AOG'd it, refused to accept it, and were moved to a standby aircraft which was available all morning. I was quite flustered by the whole event and it took a lot of effort to put it behind me. Several SOP slips were subsequently made and, although not unsafe, there was a noticeable impact on the efficient running of the flight due to the pressure being put on us by the engineer. I felt berated for doing my job as a 'guardian of safety' and 'last line in the defence' and I feel this individual had no thoughts of flight safety or of his actions.

CHIRP Comment: Firstly, CHIRP commends the reporter for doing the right thing; it is for the aircraft commander to decide whether or not they are happy with the state of the aircraft before they fly it and so they were absolutely right to reject pressure from the engineer to ignore their concerns: the old aviation maxim of 'If there's any doubt, there's no doubt' applies. Although the engineer may have considered that their professional abilities were being questioned and were probably under pressure themselves to meet scheduling requirements, advocating that the crew take the aircraft without any real investigation being conducted to determine whether or not there was an issue seems unwise at best. That the Captain had rejected the aircraft before for a similar issue should have raised red flags to everyone so it's disappointing that more caution wasn't exercised. Repetitive defects are a real cause for concern but, that being said, we should also be cautious about confirmation bias in potentially rejecting aircraft simply because we may have experienced problems with that airframe before.

On a Human Factors note, the fact that the crew were then flustered and made mistakes in the subsequent flight should be a warning to all of the negative results that confrontational engagements can have. Ground Handling and Maintenance personnel need to ensure that aircraft crews are not agitated by their interactions (and vice-versa) and, although it's easier said than done, if unsettled and flustered by any event such as this, everyone needs to take a moment to recover their composure before carrying on with their tasks so that they are in the right frame of mind to avoid errors and mistakes.

As a matter of detail, when CHIRP spoke with the company concerned they said that subsequent investigations by the engineering team did result in a component change. Acknowledging this, they agreed that the main lesson from the report was to highlight the Human Factors connotations rather than dwell on the technical aspects.

Report No 3 – FC5297/FC5298/FC5299/FC5308 – Commander's Discretion

CHIRP has received a number of reports in recent months regarding pressure to use Commander's Discretion (CD); allegations of scheduled flight hours and turnround times being manipulated to induce crews to embark on outbound flights such that the real-world result was that return flights required the use of CD; requests to retrospectively submit CD reports where the system discovers that some crew members had exceeded FTL; and overly-robust engagements with management and Duty Pilots when captains have declined to use CD.

The nature of such reports make them largely impossible to disidentify when approaching the associated companies because they contain specific flight details, and many reporters have declined to agree to CHIRP doing so directly anyway for fear of negative consequences. On the other hand, most reporters have given permission for CHIRP to contact the CAA generically about these incidents and the CAA have conducted increased oversight of the companies involved to review their rostering and FTL management processes.

The CAA have concluded that awareness of the reasons and intent behind CD and its use is patchy, and that company processes to ensure sufficient stakeholder knowledge and thus appropriate CD utilisation are not as effective as they might be. A positive outcome was the recently published CAA **Open Letter** *"in response to feedback via various safety forums that the use of Commander's Discretion ('CD') is being inconsistently interpreted by industry stakeholders, leading to inappropriate application (or the perception of inappropriate application) of CD"*. This is tangible evidence that the Regulator is aware of the increased use of CD and has engaged with companies to highlight that its use should only be in exceptional circumstances and for unforeseen situations.

CHIRP Comment: The use of CD is not unsafe in itself provided that a proper assessment of crew capabilities is made, but increasing numbers of CD reports are perhaps indicative of mounting pressures on crews from rostering and scheduling stresses caused by the system not operating as efficiently as it should. Ultimately it is the Captain's responsibility as to whether CD is used, but all crew have a responsibility to make the Captain aware if they might exceed FTL and therefore require the use of CD (on the assumption that they are fit to continue to operate). But sometimes training in FTL is rudimentary (Cabin Crew may only get a single presentation during their training) and so levels of understanding might not be high for some. CHIRP thinks that company training about FTL in some airlines could be more extensive to ensure that all crew members are fully aware of FTL regulations and what CD means. There also needs to be robust processes in place to inform the Captain whether or not crew members might be approaching FTL limits. One would hope that company systems would not roster beyond FTL requirements, that manipulation of flight times was not a reality, and that systems were robust enough to identify when crew members might be approaching FTL limits in real time and warn them and their captains accordingly. With regard to habitual use of CD, the CAA open letter is clear in its statements about the interpretation of 'Unforeseen Circumstances' as below:

> ***CAA interpretation of 'Unforeseen Circumstances' (ORO.FTL.205(f))***
> *Unforeseen circumstances are events on the day of operation that could not reasonably have been predicted and accommodated when the flight duty period was planned, such as adverse weather, equipment malfunction or air traffic delay. These events may result in necessary on-the-day operational adjustments that the operator could reasonably present to the operating Commander on or after report time. This is very similar to the ICAO definition.*
>
> *There should be no expectation that Commanders should, or will, agree to extend the maximum planned flight duty period (as defined in the operator's approved FTL scheme and CD Policy) for events that occur before the crew report for the affected FDP. The Commander must have access to the latest information, including the ability to determine crew condition, to exercise their judgement. This can only practically be assured at report time or during the FDP. Notwithstanding this, operators are expected to have a delay policy that is effective in protecting crew where possible from extended duties when delays are known about in sufficient time.*
>
> *A crew member cannot commit to an extended maximum duty day (using the operators' CD policy) prior to the Commander's report.*
>
> *The operational consequences of the Commander considering it inappropriate to extend the crew duty period after report, including the possibility of a night-stop down-route, has to be accepted and no commercial pressure can be applied at any stage.*

CHIRP is heartened to see that at the end of their note on CD the CAA says that: *"The CAA intends to review existing FTL regulation/amc/gm over the next 24 months as part of its continuous review programme, which will include those areas pertinent to CD"*. We look forward to the outcome of their FTL review given the increasing number of fatigue reports that we've been receiving in the last few months during the post-COVID recovery of aviation.

Report No 4 – FC5300 – FDP start time later than arrival for work

Report text: Definition of FDP commencing starts at gate area in airport rather than when crew member arrives at airport. It is not possible to be resident in the airport gate area so FDP is starting at a later than real start of duty. For those off-site parking who are unable to use public transport, a further mandatory bus journey compounds the issue. Airline manual makes it mandatory to report at the airport terminal commonly 30mins before FDP is begun. This could mean crew members are actually on duty beyond legal limits but it is not caught due to airline policy artificially commencing FDP later than reality.

CHIRP Comment: FDP starts from the point you report for any duty (duty being any activity done as a requirement for the company, including training, positioning or ground duties) and ends at engines off on the last sector. The overall relevant regulation is ORO.FTL.205 'Flight Duty Period (FDP)'. The location at which crews report will be specified within OM-A, and this is when FDP commences. The report location varies for individual airlines but may be before or after security, perhaps in the crew operations area, or another specified point. Regulations acknowledge that there will be commuting time to get from home to the report location and the associated start of FDP but this can differ depending on location and company agreements and is not specifically approved with the CAA as part of the AOC operating licence. GM1 ORO.FTL.205(a)(1) refers, but rather unhelpfully simply provides the bland statement that: *"The operator should specify reporting times taking into account the type of operation, the size and type of aircraft and the reporting airport conditions."*

In all of this, it's important to be aware of the distinction between FDP and FTL. FTL is solely about flight duties whereas FDP encompasses FTL and any other company duties before a flight. From ORO.FTL.105:

(10) 'duty' means any task that a crew member performs for the operator, including flight duty, administrative work, giving or receiving training and checking, positioning, and some elements of standby;

(11) 'duty period' means a period which starts when a crew member is required by an operator to report for or to commence a duty and ends when that person is free of all duties, including post-flight duty;

(12) 'flight duty period ('FDP')' means a period that commences when a crew member is required to report for duty, which includes a sector or a series of sectors, and finishes when the aircraft finally comes to rest and the engines are shut down, at the end of the last sector on which the crew member acts as an operating crew member;

(13) 'flight time' means, for aeroplanes, the time between an aircraft first moving from its parking place for the purpose of taking off until it comes to rest on the designated parking position and all engines or propellers are shut down;

(22) 'rotation' is a duty or a series of duties, including at least one flight duty, and rest periods out of home base, starting at home base and ending when returning to home base for a rest period where the operator is no longer responsible for the accommodation of the crew member;

CHIRP has sympathy with the reporter because as operations have evolved (particularly since the COVID pandemic), some people who may have chosen to live at a certain distance from their base that worked in the past may now face difficulty in meeting current security and screening requirements etc that may significantly add to their commute-to-report time. There is no regulatory time specified for the commute and subsequent passage through the airport terminal to the report point for the obvious reason that every airport's and operator's circumstances are unique; but it is not legal for a company to require people to 'report' 30mins prior to FDP because, by definition, FDP starts at the time people are required to be at the report point or other location where they are required to commence company duties.

Although not now strictly applicable to UK AOCs, EASA has previously published a commentary about when FDP starts in relation to security checkpoints and report points in their document **EASA FAQ n.135897**. The response is clear that duty (and hence FDP) starts at the Report Point unless crew members are required to commence an activity such as passing through a security checkpoint (our underlining/highlighting in the attached text at the end of this newsletter). We have asked CAA whether they have a similar interpretation of when duty commences and they responded by saying that the journey time before report will be looked at as part of their ongoing overall FTL review this year which will consider the associated baseline assumptions and fatigue metrics.

Within this issue, it is often commented that regulations and company processes cannot factor in the nuances of every airport journey from arrival at the airport to the designated report point. Whilst we agree that generic regulations cannot be so specific, we do not think it is beyond companies to determine what the average expected time spent getting to the report point should be for each airport/report point combination and time of day. If companies chose to place the report point airside (either at a common reporting area or gate) then they should ensure that this is factored into the airport arrival-to-report journey duration. At the moment, companies are abrogating this responsibility to the crews who must individually calculate their optimum arrival time at the airport in order to meet their report time; CHIRP thinks that the companies should either make the report point the airport arrival time or should modify FDPs to account for the average time spent getting from airport arrival to the report point. On the other hand, the commute from home to the airport is the crews' responsibility, it is for crews to ensure that they live at a suitable distance from their base airport so as to avoid prolonged commutes, with the exception that if the company subsequently changes their base location then a suitable mitigation may need to be agreed.

Report No 5 – FC5307 – Fatigue vs sickness

I have recently needed to go fatigued, this is something I have never felt I needed to do before but, even though I have been flying commercially many years, never have I experienced more brutal rostering than at [Airline] after COVID. At [Airline], if you go sick they count all days off work (including days off) as total days of absence. However, with fatigue they only count 7 "duty" days towards fatigue, this is because they state that more than 7 days is most likely due to an "underlying" issue. This means that people feel pressured to return to operations earlier than they might otherwise after being fatigued because they don't wish to enter the company's long-term sickness processes. This penalises people because the company won't class anything over 7 days as fatigue. You can't class days fatigued as sick, you're not sick, you're simply following the rules by not operating in an unfit state.

CHIRP Comment: The issue of when long-term fatigue becomes sickness is a pertinent one that there's no easy answer to; as far as we're aware, there's nothing written down that provides guidance as to where the dividing line is between being fatigued and being long-term sick. Science tells us that fatigue is long-term underlying exhaustion as opposed to simple tiredness but, whereas tiredness can be overcome by a few good nights' sleep, there's little scientific material about how long it might take to recover from fatigue. It doesn't seem unreasonable that after a certain period, fatigue should be classed as 'long-term sick' because at some point medical intervention should be sought to address any underlying issues if relevant.

CHIRP approached the CAA for help and they told us that the FOLG 'fitness to fly' subgroup were debating this very issue and that it was recognised that companies needed some form of trigger for reclassifying fatigue as sickness so that other help mechanisms could be invoked that might not otherwise be available – companies have a duty to the fatigued person to recognise that they might be sick so that they could get the proper help. The thinking being that, as a practical measure, if someone was still fatigued after 7 days then they really ought to be seeking medical help and it did not seem unreasonable to change someone's status from 'fatigued' to 'sick' so that underlying issues might be diagnosed by the AME and Occupational Health experts. However, they recognise that it's not easy to cover all individual circumstances with blanket regulations or policies.

As an aside, one interesting employment aspect of this might be that if the company do declare you as long-term sick after being fatigued then there's a good argument that the cause of the long-term sickness was the fatigue induced by the company and so they may have breached their Health & Safety obligations by causing you to become long-term sick due to the work environment. It's uncertain how that would hold up legally, but perhaps companies should be careful what they wish for.

Report No 6 – FC5305 – Runway closures

Report Text: The runway at [Airport] is in desperate need of repairs, full of patches and bumps. In itself, this is little more than mildly annoying. The safety concern arises because these patches frequently breakup during normal operations resulting in immediate runway closure which typically lasts an hour or so while emergency repairs are undertaken. As an occasional occurrence, this would be no more than inconvenient to the diverting traffic. But it is not occasional, these unplanned runway closures are happening a few times a month and seem to be getting more frequent.

As pilots, we look at weather and NOTAMs to carry a safe yet cost-effective fuel load. We cannot plan for unexpected runway closures everyday, which is appropriate when these events are rare. They are no longer rare at [Airport]. Safety margins are eroded significantly when aircraft divert with low fuel and little time to prepare. Not to mention the disruption and delays caused to passengers and crew. Local crews are routinely carrying extra fuel to [Airport], unfamiliar crews have no warning of the problem so cannot learn.

I hope that CHIRP can access data from the airport on the frequency of these closures to assess the scale of the problem. There is concern among pilots that nothing is being done to address the problem and it would be helpful if CHIRP could establish if there is a plan is place.

Airport Comment: We understand the frustration that short notice closures cause flight crews and agree that over the summer period we experienced some breakups. The runway at [Airport] is an aged asset and is due for replacement in [the next couple of years], this programme is in-flight with Airline engagement already started. We have an extensive inspection regime that will identify any breakups quickly with our normal approach being to affect a temporary repair during the day (scheduled to minimise any disruption), followed by a permanent repair through the night.

At [Airport], we schedule two runway rehabilitation periods of engineering works every year, the first is pre-summer with the second executed in November. The scope of these works are determined by a full civil engineering assessment and this is also supported by our CAA Aerodrome Inspector. Since November's rehab we have had 3 runway closures: 2 planned (outwith operational hours); and 1 unplanned (8 min closure and scheduled to avoid any impact to traffic). A NOTAM is a temporary measure which, given the data above, we don't believe is warranted at this time, although we would remain open to the concept should the frequency of breakups increase to a point where regular and consistent diversions were required.

We have added this issue to the agenda of our Local Runway Safety Team meeting which has representation from all parties who use the runway including Airlines, Air Traffic, Operations etc and is a regular and well-attended forum with minutes being issued to all users regardless of attendance.

CHIRP Comment: CHIRP is grateful for the Airport's pro-active response to our enquiries. It's a tricky matter to decide when the frequency of closures might warrant a NOTAM but the key issue is to make sure that all airline users are aware of the problem so that they can take mitigations, which is what the intent of a NOTAM would be. Adding the issue to the agenda of the runway safety team forum meets that requirement to ensure that all users are made aware of the issue, and this represents a positive outcome from this report.

Moving Beyond the Good, the Bad and the Ugly: Just, blame, and no-blame cultures revisited

by Martina Ivaldi, Fabrizio Bracco and Marcello Scala

Navigating the complexities of organisational culture requires a nuanced understanding of just and blame cultures. These cultures often coexist within organisations, with different areas and functions exhibiting different tendencies, as Martina Ivaldi, Fabrizio Bracco and Marcello Scala explain.

Key Points

- Just culture is not synonymous with a no-blame culture. While Just Culture emphasises learning and improvement, it also recognises the importance of accountability and responsibility.

- Just and blame cultures can coexist within an organisation. Different areas or functions may exhibit different tendencies toward just or blame culture, and it's important to consider these nuances rather than applying oversimplified labels to the entire organisation.

- The five commitments of the EUROCONTROL Just Culture Manifesto provide a framework for understanding Just Culture: ensuring freedom to work, speak up, and report without fear; supporting people involved in incidents or accidents; not accepting unacceptable behaviour; taking a systems perspective; and designing systems that facilitate doing the right things.

- Different organisational areas demonstrate different facets of just and blame cultures. This includes near-miss reporting systems, organisational responses after accidents, sanctioning systems, accident investigations, and improvement actions. Each area may prioritise different aspects of just or blame culture.

- While policies and procedures may be oriented toward Just Culture, practices within an organisation can still exhibit elements of blame culture. Understanding the cultural nuances within a company is crucial for promoting a culture that encourages accountability, trust, and improvement.

Just ≠ No-Blame

When things go wrong, questions of justice and blame often quickly come to the surface. Indeed, 'Just Culture' has sometimes been equated with 'no-blame'. This is a mistake, for several reasons. One is that Just Culture is not simply about removing blame. It concerns learning and improvement. Another is that Just Culture remains strongly linked to the concept of responsibility. Incident and accident investigations require that professionals are open about their mistakes and can talk about problems without fear. A final reason is that Just Culture is based on the organisation's ability to draw a clear line between acceptable and unacceptable behaviour.

Just and blame cultures have different characteristics. However, they are often described by taking into consideration only some of these characteristics. Here are some typical examples:

- Just culture is key to increasing trust in reporting. Blame culture makes people unwilling to report mistakes.

- Just culture is about the fair management of accountabilities. Blame culture is a punitive approach to errors.

- Just culture involves a systems approach to unwanted events. Blame culture is a search for culprits.

When we think of an organisation, what aspects of the two cultures are we considering? Since the organisational reality is complex, Just Culture and blame culture are not necessarily mutually exclusive. Rather, they tend to coexist. Within the same company, some organisational areas may be oriented toward Just Culture, and others toward blame culture. Even within the same part of an organisation, there may be facets of just and blame cultures. It is therefore probably better to consider different functions, such as reporting systems, responses after accidents, sanctioning systems, investigations, and improvement actions. How do ideas about justice and blame feature in each of these?

Just Culture (and Blame Culture) Facets

From the five commitments of the EUROCONTROL Just Culture Manifesto, we can consider at least five organisational areas in which Just Culture (and blame culture) manifest.


Just Culture Manifesto

Five Commitments

Near miss reporting systems
Reporting systems can be conceived differently in the two cultures. Just culture pays attention to workers' concerns in reporting, and for this reason confidentiality, feedback, and information on the function of the reporting system, rights, and responsibilities are provided. In a blame culture, managers are less attentive to these aspects. They focus on finding and punishing the person who is responsible for the reported event for not complying with the rules.

Organisational responses after accidents
After accidents, the two orientations can diverge in the degree of care for the needs of those affected by accidents because of their professional role (sometimes called 'second victims'). For some, support programmes may be provided, while for others, there may be scapegoating through the distancing of the operator from the organisation (Dekker, 2017).

Sanctioning systems
In a Just Culture, accountability is defined by considering the physical, social, and organisational context in which errors and violations took place. In a blame culture, any behaviour that violates rules is sanctioned with little or no account of context.

Accident investigations
Just and blame cultures can influence the goals and conduct of accident analyses. Investigations may consider behaviour either as the product of organisational defects or as the result of the free will, aiming to find system contributions or culprits. In a Just Culture, it is important to consult operators to understand the reasons behind their behaviour. In a blame culture, the operator's point of view is overlooked (Reason, 2000).

Improvement actions
In a Just Culture, interventions are evaluated for their impacts at the systemic level, especially on their unwanted effects on workers. In a blame culture, the solutions focus on operators to improve safety, as if they were the only faulty element of the system, for example through training (Hollnagel, 2021).

To avoid applying oversimplified labels of Just Culture and blame culture to the entire organisation, it is important to reflect on how the two cultures can appear side by side; this enables managers and practitioners to be more aware of the nuances of justice and blame.

Can Just and Blame Culture Coexist?

The answer is yes, and as an illustration of this, we present two scenarios from the field of aviation.

Scenario 1: Just and blame cultures in different organisational areas
It would be naïve to think that practices are always guided by the same organisational culture. For example, aviation relies on feedback and lessons learned from accidents and incidents. Translating lessons into practice may require costly and demanding reorganisational processes. Thus, it may be easier for the company to target training at operators rather than intervening on systemic factors. This may not protect from the occurrence of similar incidents (unless competency really is the problem). In this case, investigations may be based on a systems approach (see EUROCONTROL, 2014), but improvement actions, are oriented toward individuals. Thus, going back to the EUROCONTROL Just Culture Manifesto, we can observe the coexistence of a blame (and retrain) approach in one organisational area (improvement actions) with a just approach in another (accident investigations).

Scenario 2: Just and blame cultures in the same organisational area
Just and blame cultures can coexist even within the same organisational area, such as in reporting systems. Reporting, analysis, and dissemination of conclusions regarding safetyrelated occurrences aims to prevent accidents. Occurrences are reported using a mandatory or voluntary reporting system. Mandatory reporting concerns events which may represent a significant risk to aviation safety, while voluntary reporting concerns other safety-

related information. From a Just Culture perspective, instead of attributing accountability to individuals, managers should focus on the five principles of the EUROCONTROL Just Culture Manifesto. Despite this, operators may be reluctant to report due to the teasing or judgemental attitudes and behaviours of peers. This is not aligned with Just Culture, and the reason is not to be found in either the design of the reporting system or in the manager's approach. In this situation, some aspects of blame culture are present in the staff, despite the company investing in building just reporting systems.

A Nuanced Perspective

Aviation is a complex sector, in which practices, policies, and procedures are not always oriented in the same direction. Since work-as-imagined does not reliably coincide with work-as-done (because the organisational reality is much more complex than that which can be planned), policies and procedures on safety culture do not always succeed in creating coherent safety practices. For this reason, procedures and policies may be oriented toward Just Culture, while practices may be oriented toward blame culture. It is even possible to observe facets of just and blame culture within policies and procedures (e.g., from different organisational departments). This is true especially when an organisation is shifting away from a punitive approach.

While it is desirable to have as many policies, procedures and practices oriented toward Just Culture as possible, we cannot apply the label 'Just Culture' only because managers have invested in some of its facets, and neglected others. Instead, we must be aware of the cultural nuances present in a company.

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The EUROCONTROL Just Culture Manifesto can be found on SKYbrary at https://skybrary.aero/enhancing-safety/just-culture/about-just-culture/just-culture-manifesto

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Was there more turbulence in 2023 than previous years, as a result of climate change?

by Bob Lunnon, Royal Meteorological Society representative on UKFSC

1. Introduction

In 2023 there were 21 accidents attributed to turbulence, according to the FSF report for 2023 (FSF,2024). In that year there were no fatal accidents in commercial aviation, so there is accentuated interest in causes of non-fatal accidents, of which turbulence is high on the list. Williams and Joshi (2013) were the first to highlight the probability that turbulence at aircraft cruise level would increase in the future as a result of climate change. Therefore, it is plausible that high frequencies of turbulence encounters in recent years can be attributed to climate change. A summary of some of the issues was presented in Werfelman (2024).

In meteorology we tend to define climate as the average conditions over a period of several years, where "several" is typically 7 or 10. Therefore it is unlikely that a higher than usual occurrence in an individual year would be attributed to climate change. A better question is, therefore, was there more turbulence in the atmosphere in a recent 10-year period than in a 10-year period some decades ago. This is the question we will attempt to answer in this paper.

We will address this question with reference to both in situ measurements by aircraft and retrospective simulations of atmospheric conditions. In section 2 we will address accident statistics for accidents caused by turbulence. In section 3 we will address the subject of in situ measurements, highlighting both their advantages and their shortcomings. In section 4 we will describe the process of meteorological reanalysis and the processing of the data which is done to quantify the frequency of turbulence in the reanalysed atmosphere. Section 5 will give the results of reanalysis; section 6 will give the results of one study using in situ data. The final section will seek to draw conclusions from the data presented earlier.

2. Accidents due to turbulence 2018-2023

The 2023 FSF safety report reported accidents due to turbulence for the years 2018 to 2023. These are shown in figure 1.

In figure 1 there are small numbers of accidents in 2020 and 2021 partly because these were pandemic years in which the number of flights was significantly less than normal. As can be seen, the year with the maximum number of accidents due to turbulence is 2019. 2023 appears to be about average for a year with a typical number of flights.

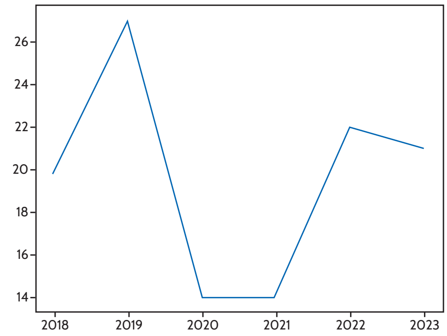

Figure 1. Annual number of accidents caused by turbulence

Note that it is not possible to derive the figures in figure 1 with absolute accuracy from the FSF report.

3. Aircraft measurements of turbulence

For several decades it has been possible for aircrew to report turbulence manually to air traffic control as an "AIREP" or AIrcraft REPort. However for as long as aircraft have been carrying Inertial Reference Systems (IRS), which among other things measure the aircraft acceleration, automated reporting of the aircraft acceleration due to turbulence has been possible. Manual reports are subjective, and therefore the categorisation of turbulence as light, moderate or severe might reflect the impact of the turbulence on an individual member of the flight crew. In addition, a genuinely moderate or severe turbulence encounter might require action by the flight crew to recover from the effects of the encounter, and the event might go unreported or reported with an inaccurate position or time. Therefore, there was a clear preference for those studying turbulence to place considerable reliance on automated reports based on IRS data.

However, it is necessary to list the shortcomings of automated reports so that long term trends derived from automated data can be treated with appropriate caution. An IRS will record the three components of acceleration at the position in the aircraft where the system is located. In some turbulence encounters the maximum acceleration will occur near the front of the aircraft, in other encounters it may occur near the back. This is an example of how determining trends using different types of aircraft, with different locations of IRS, could give rise to misleading results. Clearly the acceleration of an aircraft resulting from turbulence will vary from one aircraft type to another, and this is another issue which should be addressed carefully. Individual designs of IRSs will be different with, for example, different sampling frequencies, and this is another issue requiring attention.

Relying on data from IRSs can give rise to misleading statistics for operational reasons. Occasionally an aircraft manoeuvre can give rise to a large acceleration – for example at the top of ascent as the aircraft levels out – which clearly is not the result of atmospheric turbulence. Some apparent turbulence encounters can actually be encounters with wake vortices created by other aircraft, and although this may reflect atmospheric conditions it would be clearly misleading to attribute such encounters to naturally occurring turbulence.

Another issue is the choice of component of acceleration used to quantify the turbulence. Historically there has been considerable interest in the normal component of acceleration because of its association with the loading on the wings which, if too large, can give rise to structural problems. The current definitions of light, moderate and severe turbulence are a function of normal acceleration. However, if a passenger or flight crew member is standing, then a horizontal acceleration of the aircraft can make a fall very likely. An alternative measure of turbulence, the "dose of discomfort" (Jacobson et al, 1978), applies equal weight to all three components of acceleration.

In conclusion we should recognise that there may be limited correlation between turbulence statistics derived from IRS data and statistics diagnosed from atmospheric data. In addition there may be limited correlation between turbulence statistics derived from IRS data and statistics of accidents attributed to turbulence.

A further comment is that the turbulence encounter experienced by aircraft will reflect the airline's turbulence avoidance strategy. Over a period of decades, airlines will have developed improved turbulence avoidance strategies and a reduction in turbulence encounters will reflect this.

4. Meteorological Reanalysis

Numerical Weather Prediction (NWP) models have been operated globally since the late 1970s. Any NWP model requires a specification of meteorological variables such as wind and temperature for the initial time from which the forecast is to be produced. This initial state is referred to as the analysis, and techniques for performing analyses, as well as forecasts, have advanced considerably since the 1970s. Recently there has been considerable interest in generating reanalyses for the period from the 1970s (and earlier) using current state of the art NWP and analysis techniques. The data that has been generated can be used to assess how the climate has changed in this period: this knowledge is essential if we are to have confidence in how the climate is likely to change in the future.

An example of such a reanalysis is ERA5 (ECMWF Reanalysis version 5, Hersbach et al, 2020) which is currently the best reanalysis data set for the period from the late 1970s. This comprises data on wind and temperature (and other variables) on a 3 dimensional grid at three hour intervals from 1979 to 2020. Turbulence is not one of the variables generated.

Williams and Joshi (2013) took a forecast of the future climate of wind and temperature and applied a basket of aviation turbulence predictors, showing that turbulence, as it affects aviation, can be expected to increase. Prosser et al (2023) show that if a basket of turbulence predictors is applied to ERA5 data, there is an increase in diagnosed turbulence over the period from 1979 to 2020. The turbulence predictors used reflect turbulence associated with jet streams and do not reflect turbulence associated with thunderstorms.

In the data presented in section 5, reference is made to frequencies of moderate or greater clear air turbulence. Moderate or greater turbulence is a measure of the aircraft response to turbulence expressed as a normal acceleration, which in general is aircraft specific. A key aspect of the diagnosis is the concept of Eddy Dissipation Rate (EDR), which is an atmospheric metric, independent of aircraft characteristics. The normal acceleration of an aircraft flying in turbulence depends on aircraft type, aircraft weight, airspeed and altitude as well as EDR. However, in practice the dependencies are such that the characteristics of a "large commercial aircraft" can be used for most modern transport aircraft without significant loss of accuracy. EDR is derived from all of the basket of predictors by relating the probability distribution of the individual predictors to the probability distribution of EDR, as explained in Williams (2017).

5. Results of diagnosis of turbulence from reanalysis data

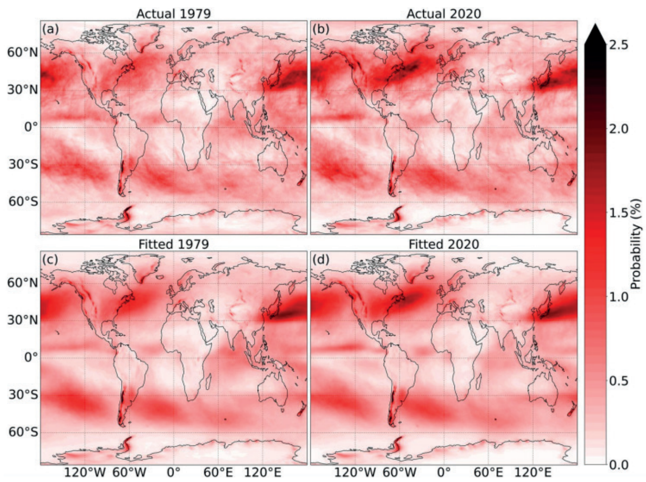

Figure 2. Annual-mean probabilities of encountering moderate-or-greater clear-air turbulence (CAT) in (a) the year 1979, (b) the year 2020, (c) the year 1979 inferred from the linear regression model, and (d) the year 2020 inferred from the linear regression model. The probabilities are calculated from ERA5 at 197 hPa (approximately FL390) and are averaged over the basket of 21 CAT diagnostics

Maps showing the annual mean probabilities of encountering moderate or greater CAT in both 1979 and 2020 are shown in figure 2 above. The maps shown ((a) and (b)) represent both (i) changes in the frequency of CAT as a result of climate change over the 41 year period, and (ii) changes resulting from year-to-year variability. There is interest in separating these two mechanisms, and this has been done by applying a linear regression model to the yearly data for all years in the 41 year period. The results of applying this model are shown in figures 2(c) and (d).

Visually it is clear from figures 2(a) and (b) that there has been a significant increase in CAT when comparing 2020 with 1979, particularly over the North Atlantic but also in other regions. From figures 2(c) and (d) it is clear that the increase is not due simply to year-on-year fluctuations, but is part of a systematic long term change.

It is helpful to illustrate both the long term change and the year-on-year fluctuations in a single plot and for reasons given earlier, we focus on the North Atlantic, defined to be 36–60°N and 55–10°W. Figure 3 shows the year-on-year variations of CAT for this area and also the results of applying the linear regression model.

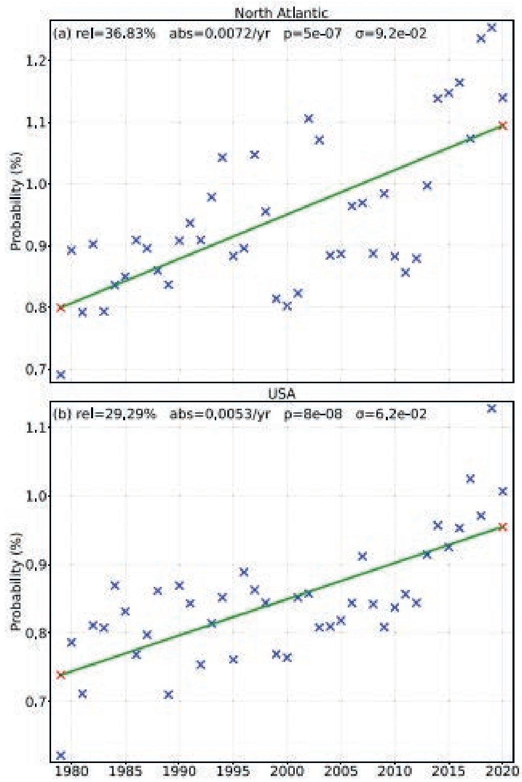

Figure 3. A linear regression analysis conducted on the ERA5 197 hPa annual-mean diagnostic-mean moderate-or-greater clear-air turbulence (CAT) probability for the (a) North Atlantic and (b) USA. The 42 blue crosses in each panel indicate data from the 42 years, whereas the two red crosses show the fitted 1979 and 2020 values. Stated at the top of each panel are the relative change in the fit from 1979 to 2020 (%), the absolute change per year calculated as the slope of the regression line (%/yr), the p value for the slope, and the standard deviation of the residual (σ; %). Here the North Atlantic is specified to be 36-60°N, 55-10°W, and the USA to be 30-55°N, 124-60°W.

It is clear from figure 3 that there are substantial year-to-year variations in the occurrence of CAT in addition to the long-term trend. The year with the greatest frequency of CAT, in both the North Atlantic and USA, was 2019.

6. Results of using in situ measurements

It is of interest to consider a time series of measurements made using BA 747 and 777 data over the North Atlantic. Normal acceleration data from the aircraft are processed automatically to derive Eddy Dissipation Rate data and then from these the frequency of various categories of turbulence are determined. These are shown in figure 4, taken from Tenenbaum et al (2022). The process used to diagnose

EDR from accelerometer data, as reported in Tenenbaum et al (2022), is non-standard. It should be noted that the figures presented include accelerations resulting from, for example, turbulence caused by thunderstorms as well as classical clear air turbulence.

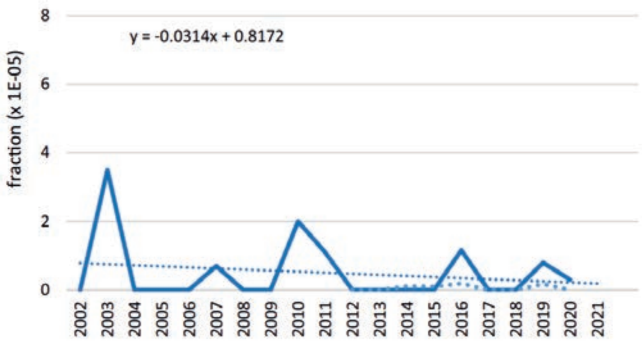

Figure 4. Shows frequency of MOG turbulence encounters for BA 747 (continuous) and 777 (dotted) fleets over N Atlantic at 200hPa (FL 197). Also shown is a regression line for the 747 data. Here the North Atlantic is specified as 47 – 57°N, 40 – 10°W.

In figure 4 the regression line indicates a decreasing trend in the frequency of Moderate or Greater (MOG) encounters, for 747s. Note that the number of such encounters is small – in many of the years sampled there were no such encounters. Also an explanation for the decreasing trend is that BA were getting better at avoiding turbulence encounters during this period. For example, in 2010 the UK Met Office started generating digital forecasts of turbulence (prior to that only charts were available for the North Atlantic). The digital data made it possible for turbulence information to be considered during the flight planning process so the trajectories could be planned which reduced the likelihood of turbulence.

Note also that in 2019 the number of encounters, for both the 747 and 777 fleets, was greater than both the previous and the subsequent years.

7. Conclusions

In all three data sets there is a local maximum in 2019. All data sets also exhibit significant year-on-year variations. The maximum in 2019 may therefore not be statistically significant. The Prosser et al (2023) data show a clear upward trend over the period 1979 to 2020 and the decreasing trend in the Tenenbaum et al (2022) can be explained by improved turbulence avoidance. If concentrations of greenhouse gases in the atmosphere continue to increase over the next decades, then we can expect increasing frequency of turbulence in the atmosphere. However, it is plausible that avoidance procedures can also improve over the coming period.

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Plotting a Training Course

A training management system can be the key to refining flight training programs and enhancing aviation safety.

by Mario Pierobon

Flight training development is a key activity of continuous improvement in aviation safety performance, and it is part of a wider process of training design that also includes the analysis of training needs, the definition of syllabuses, the delivery of training, and its evaluation of training programs. Indeed, flight training development is the cornerstone of training design. The purpose of flight training development is to generate the plan of flight training scenarios, and it is crucial for a positive implementation of the training goals. For a long period, flight training development has revolved around a more or less predetermined list of training items to be accomplished in a simulator or in the aircraft.

Evolving technologies, training concepts and methods, and analytical tools for training design are increasingly affecting flight training development and require specific consideration. We shall review the entire flight training development process, starting from the consideration that to ensure the effectiveness of flight training development, we must focus on both technical skills and behavioral competencies, under the paradigm of evidence-based training (EBT).

Evidence-Based Training

The European Cockpit Association (ECA), in a 2013 document titled "Pilot Training Compass: Back to the Future," emphasizes that in pilot training, both technical skills and non-technical skills (competencies) need to be addressed.[1]

As regards technical skills, training in basic flying skills is essential to build strong fundamentals that will help a pilot when a situation demands that he or she fly the airplane manually, relying on core flying skills and highly developed hand-eye coordination. The outcome of training in basic flying skills will make pilots more confident in their ability to hand-fly the airplane and to escape from upset situations, according to ECA.

Concerning competencies, ECA says that both positive and negative outcomes of many aviation incidents and accidents can be directly traced to critical nontechnical skills. They deal with vague — and, thus, difficult to quantify — concepts, such as motivation, social interaction, leadership and followership, common sense and logic, and communication skills.

To support the development of technical skills and behavioral competencies as part of recurrent flight training, EBT has emerged as a training paradigm.

According to the "Evidence-Based Training Implementation Guide" published by the International Air Transport Association (IATA) in 2013,[2] EBT has emerged as an initiative to improve safety, stemming from an industrywide consensus that reducing aviation accident rates requires a strategic overhaul of pilot training.

EBT is framed on competency-based training and assessment principles, and it requires the development and maintenance of both technical skills and behavioral competencies. EBT programs consist of an assessment phase to identify training needs based on skills and collected data, and a training phase (for skill retention) on skill-based maneuvers (that is, body memory actions). Finally, the scenario-based training phase of an EBT program should focus on identified skills-training needs rather than the repetition of tasks, according to the European Union Aviation Safety Agency (EASA)in EASA AIR OPS AMC1 ORO.FC.231(a).

EBT's relevance and impact are such that its principles should not be ignored in flight training development, even by operators that do not implement a formal EBT program. Flight training development must necessarily consider technical skills as well as the behavioral competencies of pilots.

Training Management System

For flight training development to be effective, it is important to implement a training management system (TMS) that is data driven and provides structure to flight training development efforts.

According to ECA, a TMS enables oversight of a well-defined process that ensures compliance and quality and that incorporates a feedback mechanism allowing continuous evaluation of the training program. The objective of TMS is to provide a structured approach to control risk in flight operations. For pilot training programs to be successful, the education, awareness and input of all stakeholders are crucial. TMS starts with the design and implementation of organizational processes.

Within TMS, an important role is played by training needs analysis (TNA), an analytical tool that is well known in industry and that must be constantly renewed. According to the University of Technology Sydney (UTS), TNA is a process used to identify what training is needed to give participants the desired knowledge, skills and abilities.[3]

Training Needs Analysis

According to the Japan International Cooperation Agency (JICA), training may be needed when there is a gap between desired performance and current performance because of the lack of skill or knowledge.[4] If training is necessary, there is a need to define the objective of the training and how it will help the participants become more effective. All of these make up the TNA process. There are many reasons one would want to accomplish TNA: to identify skills gaps, to ensure new technological developments are embraced, to prioritize training, to plan future training, to determine who will be trained, and to ensure there is a shared direction. The TNA process is composed of five steps: identifying problems and needs, determining design of needs analysis, collecting data, analyzing data and providing feedback, according to JICA.

Before TNA is conducted, it should be determined whether training is needed and the overall objectives of a training course should be determined. The second step is to identify the target groups to be trained; interviewees; survey methods; survey plans, including schedules to gather data; and people in charge of TNA. These activities are oriented to either create a new training course, identify an existing one that can fulfill the need, or obtain one externally. The third step in TNA is to collect data by reviewing documents on existing training (secondary data) and conducting surveys, including interviews and observations at work (primary data). It is important to collect and review secondary and primary data prior to conducting interviews with subject matter experts, JICA says.

Because the initial scan will have revealed a considerable amount of information, it should be possible now to identify what additional information is needed.[5] The data collection stage involves a more formal interview process because the decisions to be subsequently made must be justified. The following step is analyzing data, which only becomes meaningful information once it has been organized according to relevant patterns. At this stage, the significance of the data previously gathered needs to be determined to assist judgment and aid decision making in terms of a possible way forward with the training plan.

The final step of TNA is to provide feedback, to develop a better idea of where improvements are needed and to make a training plan. When the entire TNA is complete, the final step is to put it into practice, according to UTS.

Training Methods

Data collected via TNA can aid in development of a flight training program. In terms of training methods, current simulation technology and training regulations require that at least a part of the training be done on a simulator.

Simulators are particularly useful for emergency training. The Government Aviation Training Institute (GATI) in India said that in impromptu situations, pilots need to make decisions that are pragmatic and calculated.[6]

"Simulation training gives the opportunity to train pilots for complex situations and emergencies without risking their lives. The simulator gives the trainee space for a certain limit of errors or lapses. The simulators are also designed to enact flight manoeuvres and regimes such as degraded visual environment, vortex ring, dynamic roll over, unpredictable yaw, auto correction and so on," says GATI.

"Simulators give an acute experience of reality to the trainee. This helps enhance their skills and visions and inculcates better decision-making skills. The realism factor of simulators is what makes the procedure more effective. It enables the pilot to practice diagnostic procedures, troubleshooting processes, [while] keeping them safe and sound."

A 2022 report by Austrian researchers said that training methods in aviation still heavily rely on synchronous learning and on-site training.[7] On the other hand, current and future developments in mixed reality (MR) technology generate new opportunities for pilot training. The report says that new technological advances such as off-the-shelf MR devices provide promising possibilities to improve and innovate pilot training.

The availability of and the possibilities offered by these training methods should be accounted for as a part of flight training development. For example, in addition to the use of certified simulators, practical training could be complemented by immersive learning experiences that may not lead to credits in terms of simulator time but may speed up the overall learning process because of the engaged learning environment they provide.

Scenario-Based Training

In addition to selecting the appropriate training tools such as flight and navigation procedures trainers, flight training devices, full flight simulators or even MR tools, the input collected via TNA needs to be organized according to the principles of scenario-based training (SBT) — that is, according to a series of scenario-based exercises developed to improve crews' core competencies in the training environment.

According to EASA AIR OPS, SBT, as the largest phase in the EBT program, should be designed to maximize crews' exposure to a variety of situations that develop and sustain a high level of competence and resilience. The scenario for this phase should include critical external and environmental threats to build effective crew interaction and coordination; briefings are needed to identify, manage and mitigate threats, errors and undesired aircraft states.

The purpose of SBT is to emphasize the development of critical thinking, flight management and flying skills during line operations. The goal is to accelerate the acquisition of higher-level decision-making skills and airmanship by requiring the pilots to apply their entire acquired training knowledge and skill sets. SBT is normally used during later stages of type training courses and during recurrent training, according to ECA.

While SBT derives directly from EBT theory, which is more recent, there is also line-oriented flight training (LOFT), which could lead to flight training development similar to that required for SBT. LOFT is associated with crew resource management, which has a longer history of application in the domain of crew training, but it is more focused on group performance, compared to EBT.

A 2016 Brazilian study described LOFT as a group performance training exercise to provide practice and feedback in crew coordination.[8]

"LOFT provides a way to train for normal situations — not in the sense of desired or expected situations, but those that can occur during the flight — and allows pilots to better manage their flight resources, thus avoiding surprises," the study says. "The LOFT design principles developed by ICAO [the International Civil Aviation Organization] allow crews the opportunity to self-analyse their behaviour, through facilitators, considering the flight management resources available. LOFT provides preventive and proactive training on flight safety, carried out as part of initial or recurrent flight crew training in a simulator."

In LOFT, a crew flies representative flight segments that may contain normal, abnormal and emergency situations expected in line operations, according to the study.

"An instructor monitors the crew's performance and reviews the simulated flight(s) with the crew afterward, to assess the effectiveness of each decision made, especially after the occurrence of unexpected situations," the study says. "LOFT involves detailed, real-time, normal operational routines and procedures that represent flight operations of airline companies. The emphasis is on abnormal situations involving communications, management and leadership, as well as other cognitive functions necessary to cope with these situations. To do so, the abnormalities included in the scenario simulation are not pre-briefed and therefore can be viewed as unexpected situations."

Multiple sources, including accident reports, may be used to develop scenarios. However, a more realistic and appropriate starting point is to develop scenarios is based on current operations and experiences, according to the report.

"Part of the benefit of LOFT comes from providing an individual or a crew the ability to quickly grasp the results (positive or negative) about decision-making and actions," the report says. "At the end of each scenario, a thorough debriefing should be conducted. [A] debrief session introduces some notable issues aiming at the assimilation process by the participants. Hence, debriefing should not be a rapid formalism, but a guided review of those notable issues. The dynamic begins with the crew self-debriefing, followed by the LOFT facilitator debriefing. Debriefing should include the use of available recorders, from nonlinear video recorders to written notes."

While LOFT is focused on group performance and is not appropriately used to evaluate individual performance, it maintains, the same scenario-based orientation as SBT. The principles and the organization of LOFT may well be used for SBT, which is the main phase of an EBT program.

Flight training development is key to ensuring the continuous improvement of aviation safety. To ensure that flight training development efforts account for both technical skills and behavioral competencies, which are increasingly significant under the ever more important EBT paradigm, a data-driven training management system needs to be implemented with solid training needs analysis processes. TNA inputs should lead to the selection of appropriate training methods, including MR tools that provide increasing possibilities for engaged learning experiences, and a training plan consisting of scenarios in which crew competencies can be developed, debriefed and evaluated.

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