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INVITATION FROM NATS

Scenario Training for Aircrew and Controllers [STAC]- General information

As part of ongoing training undertaken throughout NATS, there is a desire to expand the content of Training for Unusual Circumstances and Emergencies, [NATS version of LOE] and the continuous professional development of their operational staff. As part of this development, SARG have approved an activity in which controllers join with pilots to discuss their experiences, particularly during both ground and airborne emergencies.

This activity, known as STAC, offers pilots and controllers an arena to jointly explore the risks and hazards encountered in emergency situations and, to promote mutual awareness of the protocols and options to be observed or considered .

The workshops are facilitated by NATS TRM Specialists & airline CRM instructors and will follow structured discussions relating to:

- Communication issues within the flight-deck and externally with ATC agencies,
- Sharing situation awareness in an emergency scenario within and between the two groups,
- Issues of overload and decision making for both parties,
- Handover issues between controllers, and sharing the situation within and between the aircraft crews,
- The use of SOPs, including emergency quick reference checklists by both groups.

The workshops use actual emergency scenarios to help promote increased awareness by all participants of the separate. and differing perspectives we have of emergency situations.

The workshops are usually held at the Swanwick Operation Centre in Southampton. NATS will make a contribution towards your travel costs and also provide lunch and coffee throughout the day. Proceedings will normally commence at 09:30 and should finish at between 15:30-16:00 having had the opportunity to sit with a controller on a sector (however this can not always be guaranteed].

This is an excellent opportunity to enhance your understanding of how NATS Controllers try to support you when you're involved in an emergency situation.

Dates for 2016 are as follows:
September 8th, 22nd and 26th
October 4th 10th and 18th
November 15th, 21st and 29th
December 7th 13th and 15th

Dates for 2017 are as follows:
January 10th, 18th and 26th
February 3rd, 17th and 21st
March 7th 13th and 21st
April 14th, 18th and 26th
May 2nd, 10th and 24th

All enquiries about attending these workshops should be directed to Anne Isaac at anne.isaac@nats.co.uk

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Front Cover Picture: Dash 7 over Rothera Research Station, Antarctica
Adam Bradley (British Antarctic Survey)

FOCUS is a quarterly subscription 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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A Time for Change

by Dai Whittingham, Chief Executive UKFSC

Change can often be difficult, whether through the need to manage it or as personal experience. However, some changes are easier to accomplish and more welcome than others. For the UKFSC, the most recent change is that we elected a new Chair at our AGM in May. Many congratulations to Jacky Mills, who is the first woman to fill the post in the 57-year history of the Committee. Jacky has long been associated with the UKFSC, initially representing Eastern, then as a member of the CAA flight operations staff, and most recently in her new role with Jet2.com. We look forward to working with her and wish her every success during her time in office.

When the last editorial was being written, the UK was a month away from a referendum on membership of the European Union and few would have bet on the result. In the political and media frenzy that followed the announcement it became clear that the 'out' campaigners had not given much thought to a post-referendum plan. It was also apparent that many of the assumptions about post-Brexit trading did not involve a requirement for the free movement of goods and people. The problem for aviation is of course that there are no real boundaries in the sky and that the free movement of goods and people is indispensable - a genuine sine qua non.

Matters become more complex when we bring EASA into the equation along with the fact that many of our colleagues in the industry are either EU citizens working in the UK or Brits working in other EU states. There are operators in the UK who would struggle to meet existing commitments without the use of EU manpower, though it is probable that expats on both sides of the fence will be permitted to remain where they are. There are also many questions to be answered about the air traffic environment, Eurocontrol and funding for the UK element of the SESAR. Chris Smith of Holman Fenwick Willan looks further at Brexit in his article on page 10.

Not all European legislation has helped on the safety front. Or, to be more accurate, the interpretation of some legislation has been singularly unhelpful. For example, passenger rights to compensation in the event of cancellation or delay are enshrined in Regulation (EC) No 261/2004 and all operators will be familiar with the provisions therein. The Regulation states at Article 5 (3) that: "An operating air carrier shall not be obliged to pay compensation in accordance with Article 7, if it can prove that the cancellation is caused by extraordinary circumstances which could not have been avoided even if all reasonable measures had been taken." Recent judgments have found that technical malfunctions do not constitute extraordinary circumstances, as an operator could reasonably expect to have such occurrences; the onus is now on the operator to prove that a technical problem was 'beyond its actual control'.

Flight crew should not have to consider the commercial implications of actions taken in the interests of safety of flight. If a technical arising falls foul of the MEL, the situation is clear – you cannot lawfully operate a CAT flight. But what if, although the failure could be carried, it is potentially going to give you problems en route or at destination? Do you get it fixed and perhaps trip the 216/2004 threshold for delay compensation, or do you accept the additional risk?

Unfortunately, we are now starting to see different behaviours emerging in response to the increased commercial pressures. There is some evidence to suggest a small minority of crews are calling for maintenance to rectify snags provided the work can be achieved before the window closes and that proximity to the window will determine whether the maintenance activity will be conducted on or off the books. In other words, people are beginning to find it acceptable to allow unrecorded maintenance to be carried out on an aircraft just to avoid the possibility of the operator having to pay compensation for a delay.

It is unclear whether this is crew deviation for (perceived) organisational gain, or is being driven by the operators concerned, or is simply being condoned to gain a small commercial advantage. What is certainly clear is that unrecorded maintenance, especially when conducted under pressure of time, is a recipe for disaster. It is also apparent that such practices, which inevitably erode safety standards, are the unintended consequence of legal decisions taken by people who often have no background or professional understanding of the industry and who therefore may arrive at a different conclusion from that expected with an aviator's perspective.

This points again to the requirement for the intent behind any piece of regulation to be properly captured at the outset, whether the regulation is being written at state, NAA or company-level. It is doubtful the original drafters of EC 261/2004 would have considered that "reasonable measures" might be later interpreted as excluding operation of a suitably certified and maintained aircraft with crucial components selected for their reliability, or that "extraordinary circumstances" would not include random technical failures, or that bird-strikes would be seen as being within the actual control of the operator.

Although operators have no control over the way regulation is drafted, enacted and subsequently interpreted, they do have control over their own documents, manuals, SOPs, instructions etc. When you institute a new procedure that requires staff compliance, think about recording not only the reason the procedure is required but also how you arrived at the decision, and then perhaps run a quick check of understanding with others to ensure that there is no ambiguity or room for interpretation. Capturing intent and rationale also means that those who succeed you are far less likely to inadvertently throw out the baby with the bathwater in the years to come.

To Err Is To Be Human

by Jacky Mills, Chairman UKFSC

This is my first opportunity to contribute to the editorial in FOCUS magazine as Chair of the UKFSC, and whilst, sadly, I have no brand new answers to the threats experienced by aviators every day, I do have some thoughts to share. Sharing our stories and ideas are amongst the best safety tools and I learn from others every single day. Sometimes by just stating what may seem, on the face of it, to be obvious starts the right conversation. Awareness of those things that try to trip us up on a daily basis is the best starting place to improve our Threat and Error Management. During the latter years that I was operating as flight crew I remember regretting that I had not kept a Big Black Book full of the little lessons I had learned each and every day. Even though flying the same type of aircraft on similar routes may to an outsider seem privileged, but repetitive, every day something happened to increase my knowledge base, even if it was sometimes just something that I had forgotten I knew. But usually it was a new lesson, and often that lesson came from the least likely source. Something can be learned from every situation and every person we come across. I digress...

Members of the UKFSC meet primarily to share flight safety information through the Safety Information Exchange. What has fascinated me over many years of attending these meetings is that although safety professionals from all sectors of industry, fixed wing, rotary, CAT, Business Jet operators, civil, military, Police, Air Ambulance and many others, share their stories, the issues are broadly similar. In some areas this is to be expected, however, in some others, when it comes to operating different types, jet or turboprop, large or smaller, you would expect significant differences. Sophisticated systems and technical expertise have evolved, and continue to, but although these can improve performance and reduce risks, they will never eliminate it. Why? Human beings – who for our lifetime at least - will play a large part in aircraft operations. Human error is constantly referred to when undertaking any safety investigation and although a very impressive amount of research has been carried out, lessons have been learned and shared, but elimination has not even begun. All airline operators explore human frailties daily so why has so little progress been made in eliminating this threat?

It was human error... and I have been assured it won't happen again...

I have personally been fascinated with human error in flight operations from the first CRM course I attended back in the early 1990s. CRM courses have changed considerably since their inception and great progress has been made. Back then Fatigue was quite literally the F word, it was discussed in the classroom, how to spot the signs and how to avoid it, but dare to call your Crewing office and mention Fatigue and suggestions of visiting the Company Doctor would be made. Great strides have been made in this area, mostly thanks to the introduction of legislation. All European AOC operators are now mandated to put in place a Fatigue Management System to compliment their EASA FTL scheme. Suddenly airlines find that they have a plethora of Fatigue reports to investigate. How were all these crew members coping with their lives before Fatigue reporting was introduced? Were the previous FTL rules far more lax previously so fatigue was not an issue? (Definitely not) Were roster changes and their fatiguing effects a rarity? (No) Or did crew members continue operating albeit far from feeling 'fresh'? Perhaps different reasons for absence were cited. However it was previously managed it is a great stride forward that fatigue is now recognised, and analysed with scientific and bio-mathematical tools used routinely to gain insight and necessary alleviation from this insidious danger. Data is now widely being collected to investigate patterns and effects on the human being. What many crew members knew all along are now recognised facts: human beings are not best suited to getting up at 3am (now widely known as during the Window Of Circadian Low – the WOCL), trying to take 30 hours rest and come back on duty bright eyed for the next duty is difficult; nor can humans operate at their best when they are quite simply very tired. Mistakes creep in uninvited.

However, fatigue is just one of the threats to the human's daily life. Fatigue makes us more prone to making mistakes but we also have workload, distractions, poor or confused communication... the potential list is long. Flight crew are well aware of these risks, and sharing our stories of how just another day turned into an incident may well enable a similar threat to be trapped by our colleagues. None of us like admitting we have made a mistake, however, in my experience, flight crew are generally quite good at doing so. I recently heard it said that not receiving feedback is like trying to improve the accuracy of golf shots by practicing on a driving range in the dark. Without knowing where the shots have landed how can we know what technique works best? Feedback is vital to improve performance. Keeping an open mind and recognising that a task is different on different days; no two days ever being the same is what keeps most pilots turning up for work. Aviation is far ahead of many other sectors in the progression of a sound Safety Culture,

and it is that Culture which makes progress possible. The Culture which allows us to admit our mistakes is that vital feedback which safe operations are predicated on. During the time I have been fortunate enough to spend in the aviation industry I have seen huge changes in reporting cultures. Back in the days when I first operated as flight crew there was no Company Air Safety Report Form available. The only flight safety form ever completed was a Mandatory Occurrence Form when something fairly serious had occurred. Hearsay in the crew room or during night stops was the most widely available feedback. I cringe when I think back to events which I experienced and never reported; never thought about it, it just wasn't done. Then, some years later, we evolved to receiving a call from the Fleet Office asking why we hadn't submitted any reports that month, surely something must have happened! I feel we are in a much better place now although there is undoubtedly still progress to be made. Routine reporting from Ground and Engineering staff has only become common place in recent years, for instance. But now we are starting to learn so much more from this culture. We are beginning to see a picture of what the more minor events are getting together to tell us; what may well happen tomorrow if we don't plug each and every small hole in the Dam.

The Safety Culture is a phrase banded about endlessly; have you got a good safety culture? What does this really mean? Can it be measured by the number of safety reports in your database? How do you know you are receiving the reports that are important to your business? Do you actively encourage and praise reporting? I know some sectors of our industry do, but many others do not. Is lip service paid to the reporting of events? Do we report what we know we have to because it will probably flag up in any case? Or do we actually feel confident enough in our organisation's safety system to put down on paper those little nuggets, those near miss events, the ones which nobody would ever know about. Those are the gaps which may make the difference. But if not, why is your culture not filling you with the confidence to believe that there actually is a real Just Culture alive and well which you can be a vital part of. Why would we offer our human frailties up for examination? Why stick the head above the parapet? Because professionalism kicks in, that desire to give back, to ensure that your colleagues' day, or worse, is not ruined but what you nearly did. The only way to succeed in encouraging this level of reporting is by successfully developing the culture of trust, of course. How do we develop that culture of trust, much easier said than done? Confidential reporting definitely has a great part to play and can help by being promoted and encouraged. And that confidentiality has to be fiercely protected. Trust can be built up from the most precarious of starts. Then we need to ask ourselves whether we are supporting our teams with the best environment to breed success or inadvertently setting them up for failure. Attempting a complicated mathematical calculation whilst being constantly interrupted by everyone who passes by is hardly a recipe for success. Obviously you would choose a peaceful, unhurried environment to carry out detailed calculations wouldn't you? So let's look at our near miss statistics again. This is not complicated, nor a surprise, but the areas that are difficult to solve are so often ignored.

The unique beauty of the UKFSC is the attendance by all sectors of our industry. The inclusion of elements such as training establishments, the Regulator, FDM service providers, the CHIRP programme, they all put the different parts of the jigsaw together. By fostering and protecting the Safety Information Exchange we get to put ideas out there to be considered in maybe a different context.

And at the end of the day we all share the same potential risks, as well as the same sky. It is never too late to start that Big Black Book containing what we have learned each day, and what we can learn from each other.

Cutting Edge SMS

by Wayne Rodenkrans

Best practices within safety management systems (SMS), as implemented for international commercial air transport by the aviation industry and governments, often share a common characteristic, subject matter experts say. Analyzing high volumes of safety data from flight operations and identifying risks are only part of the equation. The information derived from the process also must become integral intelligence in order for an SMS to create, implement and validate the effectiveness of risk mitigations, the experts told the FSF 68th annual International Air Safety Summit (IASS).

Several presenters at IASS, held in November in Miami Beach, Florida, U.S., emphasized that a growing number of industry/government organizations have turned initially far-reaching, high-level aspirations for SMS — as introduced in Canada about 10 years ago — into everyday capabilities that make a measurable difference, and that the trend is continuing.

Delving Deeper in Canada

A current characteristic of a mature SMS is combining proactive/predictive processes that help identify and mitigate hazards with reactive processes to learn safety lessons from accidents and incidents. Even with those processes established, an "SMS can't be expected to predict and deal with every possible occurrence in advance," said Kathy Fox, chair, Transportation Safety Board of Canada (TSB). "When you get right down to it, many — if not most — accidents can be attributed to a breakdown in the way the organization proactively has identified and mitigated hazards and managed risks. [Airline SMS managers now] look at the way that hazards are not just identified but how they are reported to senior management, then how those reports are received and actioned because all of these are things that can have a tremendous impact on the operating context of an occurrence."

As an example of operator SMS performance issues, she recounted a 2011 Boeing 737 NG takeoff incident,[1] in which the flight crew's effective response to erroneous air data indications resulted in no damage or injuries but they downplayed the potential risk of loss of control–in flight. Investigation by TSB — which became aware of the event only because the flight crew had reported the overweight landing as required — found inadequate consideration by the operator's SMS. The airplane manufacturer's prior advice to operators of the aircraft type had been disregarded by this operator, and the operator deemed the event too insignificant to be reportable to TSB or to be fully investigated internally.

Fox said, "This was an example of what some researchers call a 'weak signal.' Even though Boeing was pointing out that such events were occurring more frequently than predicted, the operator — Sunwing [Airlines] — did not consider the notice as a statement of hazard that should be analyzed by a proactive process. Therefore, the advisory was not circulated widely within the company or to flight crews. … Following the occurrence, the operator still did not see any hazards worthy of analysis via SMS, at least initially. The effective performance of the crew masked the [broader issue that] this, in flight, could potentially have serious consequences."

Decision makers within organizations have to ensure that their SMS incorporates a mindful infrastructure, she said, adding, "This involves tracking small failures, resisting oversimplification, taking advantage of shifting locations of expertise in organizations and listening for and heeding those weak signals."

She counts among key factors indicating a strong SMS and safety culture: congruence between tasks and resources, effective and free-flowing communication, clear grasp of what is at stake, and keeping a learning orientation. She added that a robust SMS is "exactly about putting in place a formal process to recognize hazards, to analyze them and to implement mitigating measures to reduce the risk that they hold … not just from the top down but also from the bottom up. "Even the most robust SMS is subject to the same pressures that can affect any other corporate initiative, [such as] corporate attitudes, the level of commitment from senior management, competing priorities, finite budgets, etc. … In the case of the takeoff I described, the operator had an SMS, but hazards weren't initially recognized as worthy of analysis. … TSB is not blaming this operator. Unfortunately, this happens more often than we'd like."

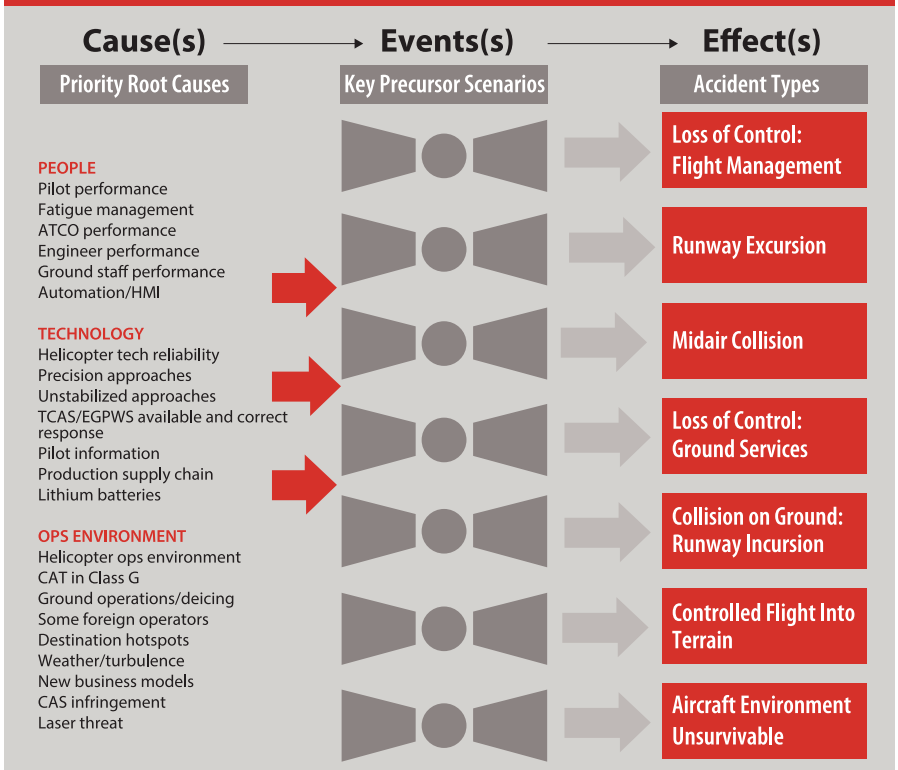
In comparable cases, TSB found managers of airline SMSs to be incapable, unwilling or ineffective at identifying risk and/or dealing with the implications of safety intelligence, she said, citing reasons such as relatively low experience applying SMS concepts or that "an SMS may be something put in place only grudgingly to comply with legislation, in which case, it may exist on paper but not at all in day-to-day operations."

FAA Compliance Philosophy

SMS concepts also began to profoundly influence government safety oversight in the United States about 10 years ago, according to John Allen, vice president, safety, JetBlue Airways, and former director, Flight Standards Service, U.S. Federal Aviation Administration (FAA). He said that early discussions made clear that, for mutual credibility in working with the aviation industry, SMS would have to be adopted by the regulator as well as the regulated. Industry-government transparency also would be necessary for SMS to succeed. He called this "a collaborative effort between the FAA and the airline industry to share data, to analyze risk, to come up with mitigating actions to move forward."

He said that a "pragmatic" director of safety at the time expressed doubts that FAA principal operations inspectors could be reoriented after decades of using safety data to hand down enforcement packages against airlines. "That resonated with me," Allen said, recalling thought processes that ultimately led current FAA Administrator Michael Huerta to announce a compliance philosophy (FAA Order 8000.373) and to issue an updated compliance and enforcement guide for all FAA inspectors (ASW, 11/15, p. 13).

SMS Bowtie Analyses Reveal *Significant Seven* U.K. Safety Issues



ATCO = air traffic control officer; CAS = controlled airspace; CAT = clear air turbulence; EGPWS = enhanced ground-proximity warning system; HMI = human-machine interface; OPS = operations; SMS = safety management system; TCAS = traffic-alert and collision avoidance system; tech = technical

Notes: The U.K. Civil Aviation Authority SMS has conducted bowtie analyses of flight operations risk factors, assessing priority root causes in key precursor scenarios to choose its *Significant Seven* national safety priorities.

Source: U.K. Civil Aviation Authority

Figure 1

We really wanted to look at things that were at highest risk but we couldn't because we knew that we had to fix how we, as inspectors, would address these things because there weren't enough of us," he said. "We were getting diminishing budgets ... but we, as inspectors, felt that the way the compliance and enforcement guide was written, we had to use enforcement as the first course of action ... not realizing that it really hurts safety."

The new documents essentially have formalized mutual responsibility by the FAA and airlines to accommodate the philosophy for the sake of the future of aviation safety, he said. "Under SMS, we're looking for the highest level of safety, to go above and beyond the basic regulatory compliance," Allen said. "Regulatory compliance is a given, we're expected to go higher ... to foster that open and transparent exchange of data. ... There has to be a close partnership."

FAA inspectors had needed clarity about their options to use such alternative responses to correct unintentional deviations or noncompliance caused by factors such as flaws in systems and procedures, simple mistakes, lack of understanding or diminished skills. "That is going to help [airlines] tremendously in the future for SMS. That is going to move our sophistication [to] the new era of safety [going] forward," Allen said.

State-Level SMS Advances

SMS at the state level does not mean a state will take ownership of the risk away from the industry, said Hazel Courteney, head of strategy and safety assurance, U.K. Civil Aviation Authority (CAA). "A national authority is talking to its stakeholders. It's gathering data from all its stakeholders and so is actually uniquely placed to be able to see what the data are telling us, what the patterns are, and what the big picture is. [It] is uniquely placed to drive and coordinate some safety improvements before that [situation] ends in an accident. ... This is really a macro, overarching level of safety management."

The current source of global guidance for state safety programs (SSPs) and related oversight activities is International Civil Aviation Organization (ICAO) Annex 19, *Safety Management*.[2] "Right now, there is a quite complex amendment going through the ICAO system ... adding to [SSP] safety risk management at the state level, continuous improvement measured by safety performance data and emergency response planning," she said. "These kinds of regulations might be scalable for states in different situations."

The SMS of the U.K. CAA has some characteristics and documents comparable with those of other states, as well as a unique general safety model that has applied bowtie analysis (Figure 1, ASW, 6/13, p. 12) to generate its *Significant Seven* risk-reduction priorities, and the Safety Wheel (Figure 2), plus about 14 bowtie analyses of other important issues <www.caa.co.uk/ Safety-initiatives-and-resources/ Workingwith-industry/Bowtie/Bowtie-templates/ How-were-the-bowtie-templates-created-/>.

"The *Safety Wheel* came about because we talked about developing the SSP ... and we decided that what it should do is to protect U.K. citizens from flight safety risks. ... When we put the U.K. citizen in the center of our thinking — and put around them [the question] 'Where does risk exposure to that individual come from?' — what we discovered is that a lot of it comes from sources where we have no oversight," Courteney said. "In some cases, we have no influence or even any relationship. ... [This insight] did get us thinking that perhaps where we see hotspots — events in particular locations or groups of events for particular airlines coming into our airspace — we should be a bit more proactive in addressing that." The first effort was to meet, propose a safety partnership and collaborate with U.K. CAA counterparts from Turkey.

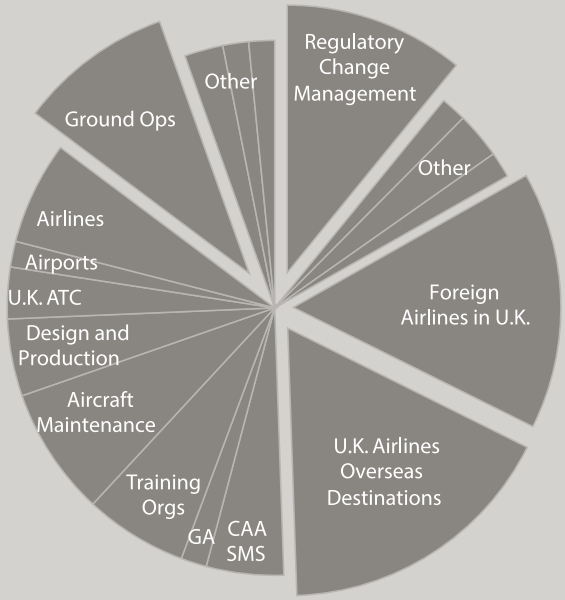
"We all walked away from that with a lot of new insights and quite a lot of actions. In three months, [safety] events were down 85 percent. By the end of a year, they were zero. ... The benefit is we understand each other better, and we actually know each other so when things start to happen, we can pick up the phone and sort it out. Since then, we've started to work with some other states, and we've had some other projects," she said.

The *Significant Seven* emerged from the SMS as a way to get the maximum safety benefit by identifying leading fatal accident types, and the two or three main scenarios that end in those crashes. "We did bowtie analyses on those scenarios ... and they really guided us to where our safety initiatives should be," Courteney said.

Ten years ago, there were no ICAO requirements for states to implement an SMS or an equivalent concept, added co-presenter Amer Younossi, deputy division manager, FAA Safety Management and Research Planning Division.

The United States has had various SMS-relevant notices and policies in place for about a decade, affecting various levels of civil and military aviation, he said. "The secretary of transportation put out a document encouraging all the modes to implement internal safety management systems. ... [The FAA introduced] multiple activities, multiple layers that address safety management for us. At the highest level for us is the U.S. [SSP, completed in January 2015], which essentially documents how we manage safety within the United States. It provides the framework for us. The next level below that is the FAA SMS. It actually is very similar to an SMS for a service provider."

Safety Wheel: Sources of Risk to U.K. Citizens



ATC = air traffic control; CAA = U.K. Civil Aviation Authority; GA = general aviation; Ops = operations; Orgs = organizations; SMS = safety management system; U.K. = United Kingdom

Notes: A strategic planning exercise of the U.K. CAA SMS was to visualize a citizen–air traveler at the center of risk factors, then prioritize relevant risk mitigations.

Source: U.K. Civil Aviation Authority

Figure 2

The current SSP contains regulations specifying the SMS requirements for the companies operating under Federal Aviation Regulations Part 121, *Air Carrier Certification;* for the FAA Air Traffic Organization; and refers to the SMS rulemaking under way for aircraft design and manufacturing organizations and airports. Voluntary adoption of SMS by other industry sectors is expected. "That's the area that we're not fully compliant with [ICAO standards]," Younossi said. A related FAA strategic initiative calls for riskbased decision making "to ensure that we are moving to a safety management construct," he said.

Ground-Level SMS

By harnessing efficiencies gained in SMS data automation and merging cross-functionality trends into a centralized safety database, airline safety departments can better analyze what is

happening over time and strategically target their mitigations, said Christopher SanGiovanni, director ground safety, JetBlue Airways.

"[We've] moved to a single data stream and a common causal taxonomy over the last several years," he said. "[The SMS determines how we're] currently turning data into information by using automated outputs on what we call *live dashboards*, and ... we are already seeing benefits of targeted mitigation."

Consolidating safety data streams quickly led to the discovery of different risk "languages" being spoken by different departments. "We could not trend causation, for example, across an internal evaluation ... because we were using different languages to categorize our findings and even different methodologies. ... So we therefore developed the JetBlue safety event taxonomy. Simply put, it's a language to identify causal factors that span organizational findings [and based on the industry-standard human factors analysis and classification system (HFACS)]. [It's] systemic in nature as well as [applicable to] individual errors and failures."

With the HFACS framework of causal factors, the SMS can compare one accident with another or even compare events that seem impossibly dissimilar, such as comparing cases of pilots entering the wrong information into the flight management system and ramp personnel incorrectly loading cargo.

"With HFACS, these two events can be compared not only by the psychological origins of the unsafe act, but also by the latent conditions within the organization that allowed these acts to happen. ... Common trends within an organization can be identified," he said. JetBlue has optimized use of descriptors within the framework, creating a still finer classification called *nano* codes.

"With hundreds of nano codes now identified ... we are able to trend across the different safety and quality programs in a very JetBlue-specific way," SanGiovanni said. "This analysis and categorization feeds our SMS management structure. Systemic risk that develops a notable trend is identified through investigation, evaluations [or] even our [voluntary] safety-concern reporting.

"Then it enters the system from the bottom and flows up the SMS structure until the risk is accepted or mitigated at an acceptable level at the specific level of the organization with authority to do so. ... The automated data dashboards allow for constant live, up-to-date key performance indicators and trend monitoring — facilitating senior leadership engagement and addressing their thirst for data [and enabling them to drill down with a few mouse clicks into associated precondition nano codes]. ... This automation of the data is our foundation for future advanced analysis, such as data modeling, [and] ultimately forecasting, predictive software and text mining. ... The targeted mitigations and the data visualization are already allowing us to see how effective the mitigation is over time. Targeted mitigation is our underlying philosophy [because] we have limited resources; we cannot tackle head-on every issue that data identify. [We] must be selective and productive with our mitigation and use a risk-based approach."

Notes

1. TSB. "Erroneous Air Data Indications, Sunwing Airlines Inc., Boeing 737-8Q8, C-FTAH, Toronto–Lester B. Pearson International Airport, Toronto, Ontario [Canada], 13 March 2011." Aviation Investigation Report Number A11O0031. The report said that discrepancies between the Sunwing SMS manual and company practices at the time of the event included a hazard analysis procedure not practiced, an investigation procedure that did not detail how to conduct investigations, and lack of training on safety-event follow-up responsibilities of safety coordinators. Transport Canada subsequently accepted the airline's corrective action plan, TSB said.

2. ICAO. Annex 19, Safety Management. First Edition, Nov. 14, 2013. Annex 19 is supported by Doc 9859, Safety Management Manual, Third Edition, May 3, 2013.

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Brexit: the options open to the UK government and the impact on the aviation safety framework

by Chris Smith, Holman Fenwick Willan LLP

Following the Brexit referendum, it remains unclear how the UK will negotiate its access to the EU single market in aviation. The way in which the existing aviation safety framework will be affected is also uncertain, since EU aviation safety regulations, such as Regulation (EC) No 216/2008 (which established the European Aviation Safety Agency (EASA)), will no longer be automatically directly applicable and therefore any regulations not implemented domestically will no longer have force in the UK.

The current government has made clear that they are not looking for a deal based on existing precedent; instead, they are looking for a bespoke agreement. This appears logical given that all of the existing arrangements that have been negotiated will, at least in part, be unsatisfactory to either airlines or the electorate. Despite a political inclination to negotiate a bespoke agreement, it is nevertheless worthwhile examining what current arrangements exist (outside of EU membership) as, undoubtedly, the UK's access to the EU market will sit somewhere on this spectrum.

European Common Aviation Area (ECAA) – the UK could sign up to the ECAA Agreement, a multilateral agreement between the EU Commission and non-EU member states including Norway, Iceland and 8 Balkan states (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the former Yugoslav Republic of Macedonia, Romania, Serbia and Montenegro and the UN Mission in Kosovo). All parties to the ECAA Agreement would have to approve the amendment required for the UK to become a party, which would be conditional upon (a) an acceptance and implementation of all of the European Community's aviation law (Community acquis); and (b) a framework of close economic cooperation, such as an Association Agreement with the EU. An Association Agreement for access to the single market is likely to require the UK to observe the 4 Treaty Freedoms, including the political hot-potato that is freedom of movement. However, the benefits would include mutual recognition of AOCs and Certificates of Airworthiness and airlines continuing to operate within the EASA framework.

Bilateral agreement between the UK and the EU – this mechanism has been used by Switzerland and forms part of the package of seven bilateral agreements Switzerland has negotiated with the EU. As a consequence, Switzerland has had to adopt a significant amount of EU aviation legislation, which was annexed to the bilateral agreement and is bound to the fundamental principles of the EU's single market, including freedom of goods, services, capital and labour. That said, it is not correct to assume that all bilateral agreements will be contingent upon observing the 4 Treaty Freedoms. Both the US and Canada have successfully negotiated bilaterals without being subject to the Treaty Freedoms. Whilst this mechanism provides a better bargaining position in respect of the adoption of legislation, again the potential requirement to accept freedom of movement may upset Brexit supporters. The inter-dependence with other trade agreements is also likely to mean that the clarity businesses so desperately need is unlikely to be forthcoming anytime soon.

Bilateral agreements on a state-by-state basis – such agreement would circumvent the need to observe the Treaty Freedoms. However, the impact on day-to-day operations may be significant. Whilst the UK already had a sophisticated safety framework prior to EASA, in order to legislate on aviation safety, the powers of the CAA would have to be repatriated and revived. It will then be up to the UK government to decide whether it should simply adopt the Community acquis in its entirety and legislate it into domestic law or whether it wishes to take a different approach. Sitting outside the EASA framework also has wide-reaching implications for airlines, manufacturers and MROs alike. The lack of reciprocal recognition of AoCs and CoAs may also prove problematic for airlines wishing to freely move aircraft around the EU.

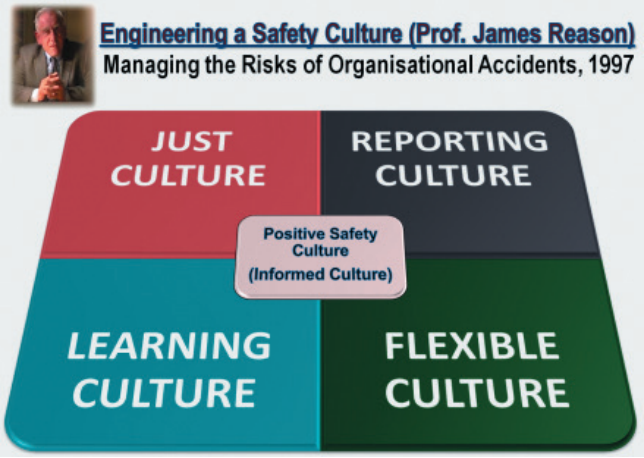
As advised above, this Brexit government is not looking to past precedents as a basis upon which to negotiate access to the EU single aviation market. The success of any future deal with the EU will undoubtedly be contingent on the government being aware of the potential issues for industry. This will involve each individual stakeholder undertaking a comprehensive risk assessment to ascertain those issues that will make or break their business. Only when the 'line in the sand' is known and conveyed by industry, can the government effectively enter the negotiating arena.

RISK CULTURE: The missing link in Safety Culture debate?

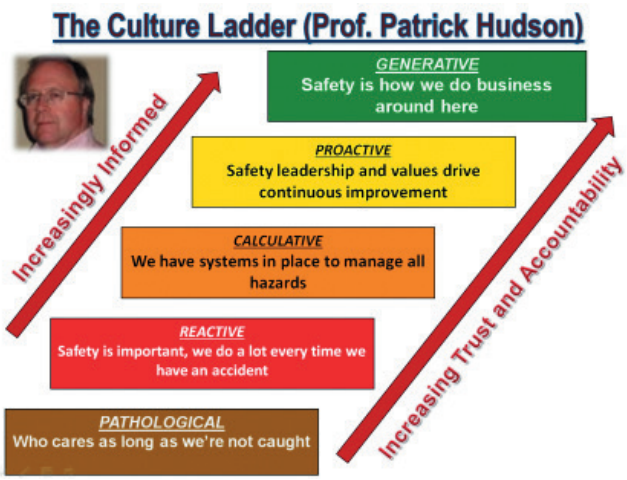
by Cenqiz Turkoglu, Cranfield Safety and Accident Investigation Centre

The Background & Introduction

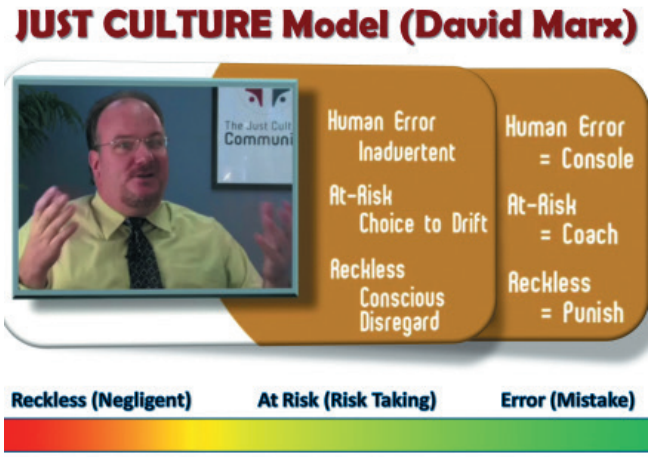
The ICAO Safety Management Manual (Doc 9859) and many other guidance materials published by the regulatory authorities around the world refer to models and frameworks such as '4 Components of Safety Culture' (Prof. Reason), 'Culture Ladder' (Prof. Hudson) and 'Just Culture' model (Dave Marx). As a result, the stakeholders in aviation have so far considered only these perspectives in terms of measuring, assessing and developing their safety culture.



While these models are valid – and when effectively applied – they can have significant impact on organisations' safety performance, it can be argued that they seem to be very much focused on collection of past event data, which is inevitably backward looking and they do not specifically aim to explore how risk is perceived and managed at different levels in organisations.



For example, what/how risk decisions are made by front line operators and if senior management is presented with the same risks accepted by front line staff, would they take the same/similar decisions? In other words, have different groups in different levels in organisations more risk averse or more risk taking attitude than each other? If so, what does it mean from a safety perspective as well as for the overall business? It can be argued that these kinds of questions are not addressed by the existing safety culture frameworks.



'Risk Culture' – on the other hand – has been studied and recognised as an important part of organisational culture, in other risk oriented industries such as financial institutions as well as some safety critical industries. Additionally the role of 'risk culture' in overall risk management process is recognised within the ISO 31000:2009 'Risk Management – Principles & Guidelines', which is not a certification standard but used as a guideline by many organisations. The main idea of this study derives from the 'Risk Culture' guidance material produced by the Institute of Risk Management (IRM, a UK based non-profit organisation), in order to support the implementation of ISO 31000:2009. The term 'Risk Culture' is not well known or regularly discussed by airline and/or MRO industry safety practitioners, but it has the potential for integration within the existing 'Safety Culture' models currently applied in the commercial air transport industry. Investigating how risk is perceived and managed across the organisations (in different disciplines/departments i.e. flight operations, engineering etc.) and understanding some of the common themes on what/how risk decisions are made, can help to develop a 'Risk Culture' assessment tool.

The concept of 'Risk Culture'

The idea of introducing 'Risk Culture' as a new component of 'Safety Culture' may potentially have a number of benefits. The question of 'how much risk is excessive' will always be subjective just like the non-existing line between 'risk taking and reckless behaviour' (Dave Marx Just Culture model). Nevertheless if the front line operators are taking risks based on their perception and certain circumstances, and these are not acceptable to the line or senior managers, then there will be opportunity to address underlying causal factors (systemic issues) and/or giving clear messages about the unacceptable risky behaviours. Furthermore in some countries or organisations, the degree of 'can-do attitude' can be a driving force for excessive risk taking because people genuinely care about their employer and they believe that they are saving the day (i.e. releasing or accepting an aircraft with a 'not clear cut' defect in order to avoid huge cost driven by a technical delay.)

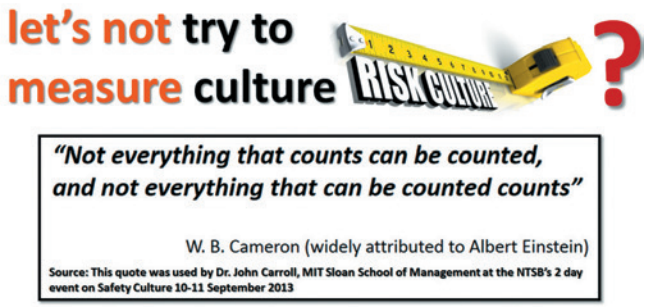
Clarification of 'Acceptable' & 'Unacceptable' risks (however subjective and difficult it may be) can enable proactive application of 'Just Culture' policy in an organisation. Because collecting data on 'accepted vs rejected risks' may give managers the opportunity to identify any potential 'excessive risk taking' by front line operators so that risks unacceptable to the management can be clarified/addressed and such behaviours can be hopefully avoided before an actual incident occurs. Otherwise, those who accept some level of risk in their operational environment may not realise that their actions are not acceptable to the management and they continue 'getting away with it' until it ends up with a bad outcome and then this will likely lead to a disciplinary action. Subsequently the management who may eventually take disciplinary action also has to take the difficult decisions whether to try to justify the decision taken by communicating with the whole workforces or let the rumours go around in the organisation (i.e. whether the disciplinary action was justified or not) The adverse impact of 'taking disciplinary action' on particularly reporting culture (mature reporting i.e. reporting of own mistakes) is most probably inevitable in many organisations. The concept of 'Risk Culture' may proactively identify such issues and address them by organisational development and learning.

The discussion on Measuring vs Assessing/Evaluating Safety and or Risk Culture

There are a number of safety culture measurement/assessment tools such as 'Aviation Safety Culture Inquiry Tool' (developed by NLR) and 'Safety Culture Indicator Scale Measurement System' (developed by Terry L. von Thaden & Alyssa M. Gibbons @ University of Illinois at Urbana – Champaign) These tools aim to collect quantitative data from the respondents by asking them likert-type questions i.e. how strongly they agree or disagree on certain statements related to key dimensions of Safety Culture. The use of such tools can certainly be valuable and it can enable the management of an organisation to conduct such surveys to identify areas for improvement, take necessary action and then conduct the survey again to verify if the actions taken were effective. This approach aligns with Deming's PDCA (Plan, Do, Check, Act) cycle, which ultimately aims 'Continuous Improvement'. However the concept of measuring culture can also be controversial.

There are many attempts to define the term 'Culture' as well as 'Safety Culture'. However it is inevitable that these definitions vary and can be subject to debates. In one of his speeches, charismatic ex-leader of Southwest Airlines, Herb Kelleher, described the term culture as 'DEFINITIONALLY ILLUSIVE'. Also the well-known social scientist Geert Hofstede, who has been researching culture for decades, defines it as 'UNWRITTEN RULES OF THE SOCIAL GAME".

So it can be argued that measuring culture may not be realistic and perhaps the term assessment or evaluation of the culture with a more qualitative approach can be equally powerful compared to quantitative approaches previously mentioned. Because whether

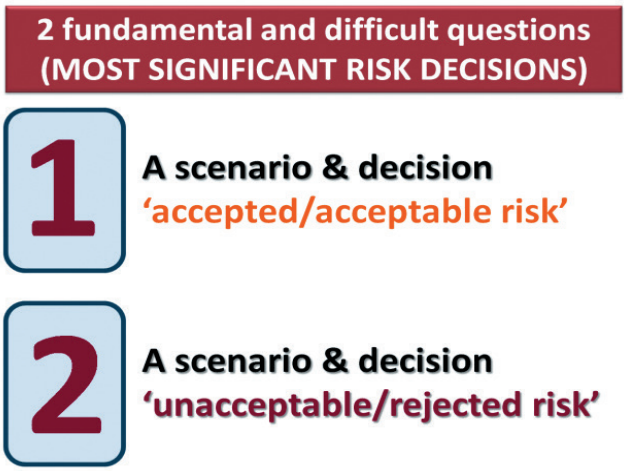


measuring (quantitatively) or assessing/evaluating (qualitatively) approach is used, the ultimate aim is to identify areas for improvement for the management to take action. Today's modern management techniques very much focus on 'performance monitoring' including the use of 'key performance indicators' (KPIs), but there are also sceptics about their use. It is worth remembering that Deming, who transformed the Japanese automotive industry after the WWII by introducing the 'Statistical Process Control' (SPC), also argued against the notion 'if you can't measure it, you can't manage it'. In his book, '7 Deadly Diseases of Management', he described one of the fundamental costly myths as the **"Management by use only of visible figures, with little or no consideration of figures that are unknown or unknowable."** Perhaps it can be argued that KPI's related to safety culture can be included in this category.

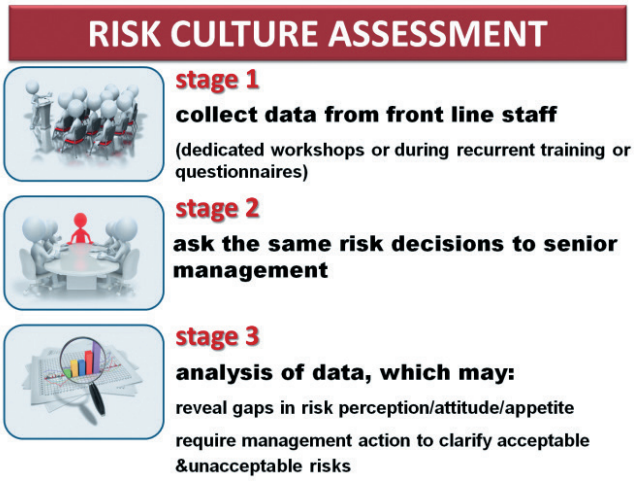
Assessment of 'Risk Culture' in Organisations: A Simple Qualitative Approach

A scientific approach to measure 'Risk Culture' in organisations can be developed by the introduction of a scale system but perhaps a simpler and equally powerful approach to assess the 'Risk Culture' can also be achieved by using a '3 step approach' and asking qualitative questions to enable respondents to share their experiences on the 'MOST SIGNIFICANT RISK DECISIONS' they made.

There is no doubt that there are certainly some challenges and limitations of such an approach and how much it can achieve. To start with, asking the respondents about the risk decisions they made can be a barrier for how much they are willing to share; therefore the use of different methods for data collection (through workshops, training sessions or questionnaires) should be considered.



Also the subjectivity of risk creates a challenge amongst the front line operators as well as between the management and the front line operators. Nevertheless identifying differences in 'risk appetite' should initiate healthy discussions in the organisation and this proactive approach may ultimately result in beneficial outcomes such as addressing the causal factors encouraging risk taking through organisational learning and development.



Industry-wide '1st Risk Culture Survey'

After conducting two workshops during the internal safety events of two different operators (one in the Far East and the other in the EU), at the beginning of April, I launched the 1st industry-wide 'Risk Culture Survey' questionnaire to collect data from pilots, engineers and their managers. The questionnaire is mainly about two fundamental questions. 'Accepted/Acceptable Risks' and 'Rejected/Unacceptable

Risks' and the factors encouraging professionals to take risks but also expects the respondents to share their experiences and observations about mitigation strategies. So far I received just under 150 responses. Although the response rate has been disappointing and perhaps the results may be statistically insignificant, I am delighted to see some very interesting and enlightening responses from pragmatic point of view. The questionnaire can be completed anonymously but one of the ways I tried to increase the number of respondents was to offer the opportunity to enter a bursary draw to attend a professional course at Cranfield University if the respondent is willing to provide an email address. This will also give me the opportunity to be able to collect data from the same population every year as I aim to conduct a longitudinal study, which hopefully will enable us to identify some trends or emerging issues in the industry. More information about the concept of 'Risk Culture: the missing link in Safety Culture?' and the link to access the questionnaire can be found @ www.riskculture.org.

Regarding the analysis of the data collected so far, the details will be presented in a separate report soon but a quick review of the responses to one of the questions clearly indicates that the 'brutal competition' (as described by one of the industry executives) and some of the external pressures such as consumer protection legislation continually put pressure on front line operators. The good news is that despite the respondents indicate their opinion strongly about the commercial pressure they constantly feel during daily operation, their responses to 'accepted risks' did not include many examples of 'excessive risk taking'. But equally the responses to 'rejected risks' also confirm that the expectations to accept considerable risks do exist in order to keep the flying schedule.

Why and how should you participate?

How risks can be mitigated and how commercial pressure can be managed is ultimately the key to maintain the remarkable safety performance the industry has achieved today. So my ultimate pitch to all professionals at the coalface and also the safety practitioners is three fold:

- If you are involved in making operational or strategic organisational risk decisions, YOUR EXPERIENCE MATTERS! PLEASE SHARE IT FOR OTHERS TO LEARN FROM YOUR EXPERIENCE AND RISK MITIGATION STRATEGIES!
- Please promote the study and the questionnaire (www.riskculture.org) so that we can collect more data in coming years. The real-life examples of 'Accepted & Rejected Risks' will verify the key challenges but also may enable us to identify emerging issues and threats, which may not be reported through existing channels.
- If you wish to conduct a collaborative study, not only to collect data from the front line operators but also ask the same risk decisions to different levels in the management in your organisation, please do not hesitate to contact me. The differences in 'RISK APPETITE' in an organisation may enable to address some fundamental systemic issues, which may be the causal or contributory factor to a potential accident.

180° turns on runway

by Stéphane Brizay Flight Operations Engineer and Xavier Jolivet Director Flight Safety Enhancement

Performing a 180° turn or U-turn on a runway may seem an ordinary maneuver compared to other phases of the flight. However, operational experience over the past 10 years shows that unintentionally leaving the runway while completing a U-turn can happen, even to experienced pilots, in any conditions, even on dry runway, on any aircraft type including the A320 family aircraft. A specific technique exists for such U-turns to avoid runway excursions.

U-turns on runway: a significant contributor to runway excursions

Who would naturally think about U-turns on runways when referring to aviation accidents? Although not intuitive, this relationship does exist. Indeed, operational experience shows that a number of runway excursions resulted from a failure to manage such a maneuver correctly. In less than 10 years, more than 20 runway excursions with some incidents leading to an ICAO Annex 13 investigation have been reported to Airbus.

Beyond the potential for significant aircraft damage or time for inspection and repairs, the consequences of such events translate mainly into operational disturbance. They lead to flight cancellation, the need to offload and defuel the aircraft when it has to be returned to the pavement, not to mention the impact on airport operations with the potential closure of the runway and its associated safety implications. The airline involved is often put in an embarrassing position from a brand point of view due to the speed of modern visual communications.

The number of recent events may be growing due to a reporting bias, but the issue has now drawn attention from a safety vantage point.

Thanks to the reported events, Airbus was able to analyze and understand the conditions of occurrence.

Lessons from in-service events

Some possible preconceived ideas are dismissed by facts especially concerning the runway contamination, the pilot's experience or the type of aircraft. Let's review the 21 events reported to Airbus over the past 10 years in figures:

Aircraft type Runway state	A320 family	A330 family	A300/A310 family	A350	Total
Contaminated	5	4	0	1	10
Dry	2	6	0	0	8
No information	0	1	2	0	3
Total	7	11	2	1	21

Beyond these two dimensions, a thorough analysis of the events shows that the runway surface quality is also an important parameter. Indeed, a degraded or damaged runway surface may have as much influence on the performance of a U-turn as a contaminated runway.

As for the pilot's background, it turns out that it was extremely variable from one event to the other. In other words, a runway excursion when performing a U-turn on a runway is not the preserve of the least experienced pilots...

Reporting: the most precious input to enhancing safety

In one surprising event, although the crew had experienced a runway excursion, they realigned the aircraft and took off. Damage

on the gear was observed at arrival. Even at low speed, a runway excursion can damage the aircraft in a way that can affect the safety of the following flights. Any runway excursion, as smooth as it may seem, requires the aircraft to be checked prior to the next flight in accordance with the AMM guidelines.

Moreover, to ensure the aircraft integrity for the next flight, to allow safety lessons to be learnt and to be able to take appropriate mitigation measures from analyzing all events of similar nature, all runway excursion events need to be reported.

As of today, the analysis of the events made available to Airbus through reporting allowed us to dismiss possible preconceived ideas, such as: it only occurs to the least experienced pilots or only on contaminated runways or with large aircraft. It also allows us to highlight the key points or parameters that need to be checked before initiating the turn and executing the maneuver, as well as to emphasize the best technique and tips to perform such turns safely.

Eventually, thanks to airlines reporting, the technique available today in the FCOM is going to be revisited and improved as part of the FCTM. Key values relating to the recommended runway width will be kept in the FCOM. These updates will be available by the end of 2016.

Technique and tips to perform a safe u-turn on the runway

The analysis of in-service events allowed the technique for U-turns in the FCOM to be revisited. The philosophy of the new revision will align with the existing content and emphasize the key steps of the technique for performing successful and safe U-turns. The technique was initially developed for U-turns on a runway, where there are standard markings at the borders of the runway.

As far as possible, a U-turn on the runway needs to be prepared before arriving on the runway. The preparation includes a discussion on who will be PF and in which direction should the turn be performed in accordance with the airline policy.

Performing a safe U-turn on a runway is not just a matter of managing the turn itself. It starts before initiating the turn….

Before initiating the turn

Initiating the turn in good conditions relies on a number of complementary aspects beyond the ones mentioned before.

Suitability of runway width with the conditions of the day

Performing a safe U-turn on a runway requires anticipating the space required for the safe completion of the maneuver. The minimum runway width for a given aircraft type is provided in the FCOM. However, it is important to keep in mind that this value is based on the following assumptions: the runway is dry, the runway surface quality is good and the technique recommended by Airbus is used. Therefore, it may be necessary to add some margins if these conditions are not met (e.g. contaminated runway).

In summary, before considering a U-turn on a runway, check that the runway width is sufficient with respect to the minimum published in the FCOM possibly adjusted to the anticipated conditions of the day.

Consider the actual runway surface quality

As previously mentioned, the state of the runway may require the margins provided by the FCOM to be adapted. The maneuver is to be performed with the maximum available steering of the nose wheels and in such a configuration, a poor surface may make the wheels slip and increase the turn radius.

It is important to keep in mind that painted areas such as runway threshold markings can be significantly more slippery than the rest of the runway. Indeed, some investigations highlighted that the repainting of the white strips tended to fill the runway's textured surface. In other instances, pieces of multiple layers of painted surface became detached over time, thus generating depressions likely to retain rain water even though the remainder of the runway had already dried up.

A330-300	Divergence angle	Measure of necessary width Nose Wheel Steering Angle (NWSA) 95% (m)	Difference compared with FCOM recommended value of 20° (m)	Measure of necessary width NWSA 80% (m)	Difference between 80 and 95% NWSA (m)
	10°	56.2	-0.17	65.6	9.4
	Recommended 20°	56.4	0	65.7	9.3
	40°	58.1	1.7	67.4	9.3

As a consequence, special care must be taken when the trajectory requires taxiing the aircraft over a painted surface. A good friction coefficient experienced while still on the unpainted area is not necessarily representative of the one when on the painted marks. The crew must be ready to reassess the situation if any unexpected skidding during the turn is experienced.

Control the ground speed and adapt it to the conditions of the day

Remaining on the runway while performing a U-turn requires control of the trajectory at all times. This involves before initiating the turn:

Stabilizing the trajectory

Stabilizing the initial trajectory before the turn is key in many respects. It allows for:

- optimization of the point of initiation of the turn
- compliancy with the assumptions used to determine the minimum runway width required, i.e. the maneuver is properly performed (initial recommended divergence angle)
- reduction of the number of parameters to be managed during the turn itself.

In order to optimize the turn initiation point and the distance required to complete the turn, it is recommended to adopt a divergence angle from the runway axis. The advisable divergence angle varies depending on the aircraft type but it typically ranges between 15° and 25°.

As illustrated in **Figure 1**, increasing the divergence angle leads to an increase in the turn radius. For example, adopting a divergence angle of 40° instead of the recommended 20° for an A330-300 leads to an increase of about 2 meters. Decreasing the divergence angle by too large an amount would result in the main landing gear possibly exiting the runway at initiation of the turn.

Stabilizing the ground speed

The recommended ground speed for the 180° maneuver should be between 5 and 10 kt on most aircraft. If the speed is not stabilized before the turn, larger thrust adjustments may be needed during the turn. However, these adjustments can lead to an increase beyond the recommended speed, and may be a contributor to a runway excursion.

As mentioned earlier, any degradation of the runway state either due to runway surface condition or contamination requires additional precautions and margins. In terms of speed, it is safer to target the lower boundary of the recommended speed window, namely 5 kt, to perform a U-turn on a degraded runway.

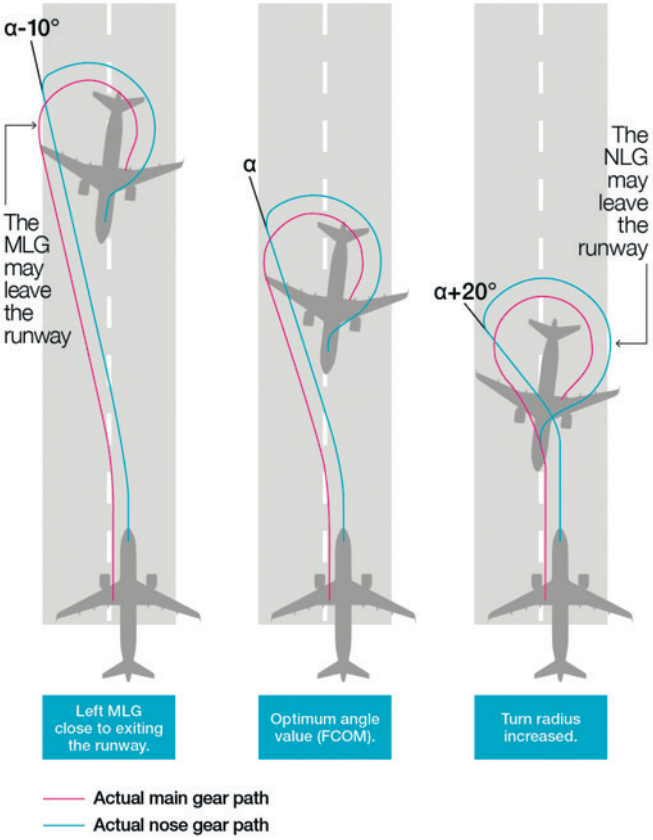
Best Practice

On A300/A310, A330/A340 and A350 families, on dry runways, the use of differential braking to stop one gear (Braked Pivot Turn technique) may induce stress on this gear and could have fatigue effects over time on the gear. Such a technique is therefore not recommended. However, on a wet or contaminated runway, the lower friction coefficient reduces the induced stresses and differential braking, whilst avoiding pivot braking, could help to manage the turn.

This recommendation does not apply to A320 family and A380 aircraft, for which the Braked Pivot Turn technique is usually used without adverse effect on the gears.

Performing the turn

During the maneuver, the ground speed is a key parameter to manage: the objective is to maintain a low (5 to 10 kt) but steady ground speed. If too much speed is lost, turning the aircraft will become more difficult to manage and it may eventually come to a complete stop. To avoid stopping, applying some additional thrust may be necessary. However, gaining too much speed could increase the chances of the



(fig.1) *Turn radius evolution as a function of the divergence angle* **α**

aircraft exiting the runway. Maintaining a continuous speed before and during the turn is therefore of paramount importance.

Initiating the turn

For field of view reasons, the turn is recommended to be performed by the crew member sitting on the seat opposite to the direction of the U-turn. This means that to turn right, the flight crew member on the left hand side of the cockpit is PF; respectively to turn left, the flight crew member on the right hand side is PF.

The visual reference to initiate the turn depends on the aircraft type. On most Airbus aircraft, the turn is to be initiated when the PF assesses that he/she is physically directly over the runway edge. Once the PF reaches the appropriate initiation point, he/she needs to progressively use up to full tiller deflection to turn the aircraft.

During this initial maneuver, due to the aircraft inertia the nose wheels are not fully aligned with the aircraft trajectory. This misalignment reduces the grip of the nose wheels onto the runway and may lead the aircraft to skid if the nose wheels are not turned smoothly and progressively. This is why an aggressive application of full nose wheel steering should not be done.

The speed can be maintained by applying small amounts of asymmetric thrust and keeping idle thrust on the engine on the inside of the turn. As explained before, maintaining a continuous speed is key and after any adjustment to the thrust, the speed must be carefully monitored.

During the turn

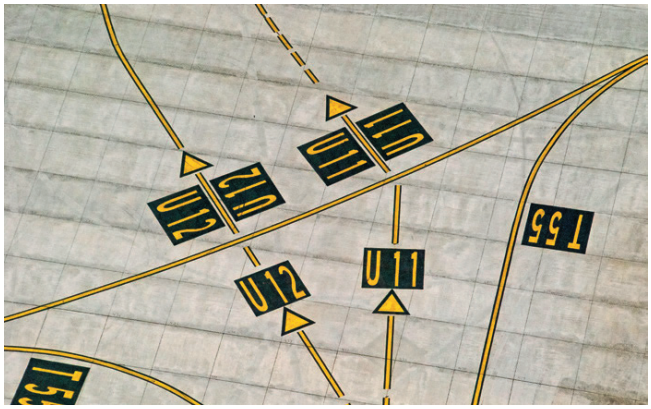
As shown in **Figure 1**, if the divergence angle affects the required turning distance, then the steering value is a parameter even more significant. The minimum distance published in the operation documentation considers a full steering order throughout the whole maneuver.

Throughout the turn, the PF is focused on the dynamics of the maneuver. He/she is looking outside in the direction of the expected aircraft trajectory, and adjusting the aircraft speed accordingly.

The role of the PM is at all times to monitor not only the aircraft trajectory but also the aircraft ground speed and to call out any deviation. The PM can monitor the heading, the ground speed indication as well as the ETACS when available. Indeed, by focusing on the outside, the PF cannot closely monitor these parameters and especially the aircraft ground speed to detect any excursion outside the recommended speed range; therefore, the role of the PM is essential.

Finishing the turn

In this phase of the turn, the main challenge is to get the aircraft aligned on the centre of the runway without jeopardizing the remaining runway length or the planned take-off distance available.



When the aircraft is aligned with the runway, the tiller is to be released smoothly before stopping the aircraft to make sure that the nose wheel is aligned with the aircraft and therefore ready to initiate the take-off roll in good conditions.

At any stage before or during the maneuver, should any problem arise, stop and call the tower to get support from a tug. Keep in mind that it is most preferable to call a tractor to finish the maneuver, rather than to recover the aircraft with a landing gear off of the runway.

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Performing a U-turn on a runway is not an insignificant maneuver. Safely performing it starts with good preparation and a precise initiation of the turn as well as implementing the technique properly at the right speed. Whether it has to be performed before taking-off or at the end of the flight, some key aspects are to be kept in mind:

- ***Carefully check the minimum distance published in the operational manual versus the available runway width, keeping in mind that the minimum 180° turning distance published values correspond to a dry runway***
- ***Pay attention to the runway condition, both surface quality and contamination, as they may induce skid and may increase the turn width. Add reasonable margins accordingly***
- ***Adapt the speed to the runway condition (within the recommended speed range)***
- ***In case of a problem at any stage of the overall maneuver, stop the aircraft and call for support***
- ***Should the crew become aware that the aircraft has left the runway surface, even slightly, report the occurrence and inspect the aircraft before taking-off***

Some simple advice to avoid big problems!

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Devon Air Ambulance Trading Company
Rob Mackie

DHL Air
Shayne Broad

Dubai Air Wing
Rory Fagan

Eastern Airways UK Ltd
Ian Smith

easyJet
TBA

Edif ERA
David Thombs

Emirates Airlines
Mark Burtonwood

Flight Data Services Ltd
Derek Murphy

flybe.
Capt. Natalie Bush

GAMA Aviation
Tom Saunders

GATCO
Adam Maggs

Gatwick Airport Ltd
Jerry Barkley

Gulf Air Co
Capt. Khalil Radhi

Ideagen Gael Ltd
Steven Cespedes

Independent Pilots Association
Capt. James West

Irish Aviation Authority
Capt. Dermot McCarthy

Jet2.com
Capt. Jacky Mills

L-3 CTC Ltd
Capt. Phillip Woodley

LHR Airports Ltd
Ian Witter

Loganair
Ian Watson

London City Airport
Gary Hodgetts

London's Air Ambulance
Dave Rolfe

Manchester Airport plc
Chris Wild

Marshall Aerospace & Defence Group
Chris Huckstep

McLarens Aviation
John Bayley

Monarch Airlines
David Copse

National Police Air Service (NPAS)
David Taylor

Norwegian Air UK
Martha Romero

Panasonic Avionics
Bob Jeffrey

Pen Avia
Capt. John O'Connell

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Julie Biringer

RTI
Steve Hull

Rolls-Royce Plc
Phillip O'Dell

RVL Group
Jan-Michael Thomas

Ryanair
Jim Lynott

SaxonAir Charter
Richard Preen

Seaflight Aviation Ltd
Dimitris Kolias

Shell Aircraft Intl.
Jacob van Eldik

SMS Aero Ltd
Ian Chapman

Specsavers Aviation
Mary Petley

Stobart Air
Capt. Clive Martin

TAG Aviation (UK) Ltd
Malcolm Rusby

Teledyne Controls
Mark Collishaw

The Honourable Company of Air Pilots
Capt. Alex Fisher

The PPU (Professional Pilots Union)
Andrew Brown

Thomas Cook Airlines UK Ltd
Terry Spandley

Thomson Airways
Dimuthu Adikari

Titan Airways
Dominic Perrin

UTC Aerospace Systems
Gary Clinton

Virgin Atlantic
Ellie Powell

Vistair
Stuart Mckie-Smith

West Atlantic UK
Alex Wood

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Dale Grassby
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Wg Cdr Phil Spencer - MAA Engineering Oversight & Assurance
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Gp Capt Andy Bastable - RAF

QinetiQ
Flt Lt Tim Burgess

QinetiQ Eng.
Rupert Lusty

RAeS
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RAeS Eng.
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CAA
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Karen Bolton

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UK Airprox Board
Air Cdre. Steve Forward

Thinking about Winter yet?

Dash 7 landing at Sky-Blu blue ice runway, Antarctica. Pete Bucktrout (British Antarctic Survey)