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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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Front Cover Picture: Investing in Next Generation Technology at CTC Aviation.
Credit: CTC Aviation and SIM Industries.

focus ON COMMERCIAL AVIATION SAFETY

Is Change Good for You?

by Dai Whittingham, Chief Executive UKFSC

Some years ago, I was surprised to find myself feeling incredibly tired following one of my monthly simulator sessions (yes, we had to do one per month…). The session had only been an hour from start to finish and had comprised a normal start-up and departure, an electronic warfare exercise that involved intercepting jamming targets, followed by a normal recovery via an instrument approach.

All manual flying on instruments, but it was bread and butter, routine stuff. So why was I so tired? I had asked myself the same question while sat with the obligatory coffee afterwards, and eventually it dawned on me: I had been working very much harder than normal. And the reason was simple – nothing had gone wrong! I had not been presented with a single system failure or fault from start to finish. But this was the simulator, where I always ended up on one engine, or on fire, or with no electrics or hydraulics, or with a complex scenario that eventually prompted an ejection decision and so I had spent the previous hour frantically scanning the cockpit trying to spot what I had obviously missed and with my mind working overtime on possible 'hidden' problems.

"And what has this got to do with us?" I hear you ask. Well, there have been a number of recent incidents where crews have shut down an engine when they didn't really need to, with one captain observing that his experience in the simulator had been that engine faults inevitably led to a shut down, hence he was pre-disposed to that as a course of action. I was always taught that, unless the QRH directed otherwise, you only shut an engine down as the last resort; if possible, leave it at flight idle until you are certain you won't need it again (ie you are on the ground).

In the last few months, a 757 crew was faced with an engine stuck at 1.5 EPR; there was no concrete advice in the QRH although time was available for discussion. They opted to secure the engine at 8000ft in the descent and subsequently made a safe landing. But what would they have done if the good engine had failed on them? Would a cold start on an uncontrollable engine have worked? And how would you fly the approach on one engine with a fixed EPR? (Now that would be an interesting simulator exercise…) Again, the simulator experience would have guided this crew into the scenario that engine problem = shut down.

The same issue of simulator content becomes stark when we look at the Go Around. Of all the GAs that are flown, not many occur when you are minus an engine and at Decision Altitude, but that is what you routinely practice in the simulator. In the air, you are much more likely to have a GA initiated by ATC when you are still approaching the descent point, or at altitudes well above DA because you recognise that you are unstable, or closer to the ground for the same reason. And then you have a light aircraft with lots of excess power and we wonder why FDM shows level busts, speed and pitch events.

As another example of where simulator training may have influenced the outcome in the wrong direction (NB: this is my personal assessment), there is an incident currently under investigation in which a crew opted to RTO because the configuration warning horn had sounded. There was some minor damage to the aircraft, though it stopped within the available runway distance. The configuration warning system had operated as expected and the crew will have responded accordingly – indeed, the warning is used as a trigger for an RTO by many simulator instructors. So on this occasion, the crew responded per their training. What is the problem with that?

The problem is that this incident occurred during a touch and go. I accept that it is not a normal manoeuvre, but it is often a part of initial base training or conversion to a new type; moreover, pilots are unlikely to be exposed to touch and go without an instructor in the other seat. My own view is that rejecting a touch and go is unwise simply because you will have no idea what performance figures you are dealing with or how much energy you will have to dissipate in stopping - you will certainly not be able to calculate a V1 with any reasonable accuracy. You might think you will be able to stop, but you can't be certain. In effect, you are in much the same situation as having landed long and hot, and your chances of a runway excursion (the No 1 cause of hull losses) are raised very significantly.

My argument for ignoring the warning here is that the probability of the configuration warning sounding during a touch and go is very high – you can expect flaps and trim to be in the wrong place when you push up the power, so brief it accordingly. I would still want to take a quick look to see that the flap selector is in the right detent and that speedbrake/spoilers are stowed, but everything else can wait until you are airborne.

I think it fair to say that the simulator regime – which has developed over many years - is producing some expectation bias when it comes to the GA and engine faults. Reliability has improved to the point where it is the 'high technical merit' faults that more likely to be encountered, so should we be practicing for them? At the least, there are questions to be answered about what we use the simulators to train for. Feel free to disagree with me; I will be happy to publish your letters because I think it is a debate worth having.

Manual Flying Skills

by Capt Chris Brady, easyJet

My predecessor wrote in the last edition of FOCUS asking if technology had improved flight safety. I think most of us would agree that the many technological advances over the years have improved flight safety; the accident statistics certainly bear this out. However, the downside is that there is a perception that an increased use of, or reliance upon, automation may have led to an erosion in manual flying skills. This is a contentious statement and extremely difficult to prove, especially in view of the fact that all commercial pilots must have met, and most will have exceeded, the minimum standard necessary to operate an aircraft within the last year and failure rates have not increased. But it is a common perception and many pilots, particularly the older ones who have been used to lower levels of automation in previous types, believe this to be true.

Many airlines have an automation policy which requires pilots to "make use of the highest level of automation appropriate to the phase of flight and the airspace in which the flight is being conducted." The reason behind this is to give the task of controlling the aircraft to the automatics at busy times to free up capacity in the pilots to allow them to concentrate on managing the rest of the flight duties. These can include monitoring the flightpath, reading and responding to flight mode annunciations and checklists, briefing, descent planning, radio calls, weather avoidance, non-normal handling, paperwork etc. Nobody would deny that this is a sensible policy. However, for many airlines and pilots, the times when manual flight is permitted hinges upon their interpretation of the word "appropriate". Unfortunately, due to our differing levels of experience and perception of risk, what seems appropriate to one pilot might not be appropriate for another; so operators may wish to review their automation policy to ensure that all factors are taken into consideration in its guidance for when manual flight is appropriate.

Unfortunately, there are times when pilots don't have a choice but to fly manually and these may include high-workload situations such as responses to TCAS, GPWS or windshear events; autopilot, hydraulics, probe or IRS malfunctions; circling approaches, strong crosswinds, any landing in which autoland is not available and every take-off. When you add in the "startle factor" associated with some of these situations it is not surprising that sometimes performance is below the minimum standard and tragically, in some cases, this can be a contributory factor for an accident.

So what can be done and by whom?

Operators: Should consider reviewing their automation policy to ensure it recognises the need to maintain proficiency in manual flight. Ideally it should balance the requirement to use the highest level of automation appropriate to the conditions with a statement not only permitting manual flight but encouraging it.

Crew: Should take the opportunity where appropriate to maintain their proficiency in manual flight within the guidelines of their company policies.

Regulators: Should allow airlines the flexibility to use precious simulator time in the best way to manage the risks that they have, rather than keeping a rigid focus on the same predictable engine-out exercises every six months. The UK CAA now permits programs such as Alternative Training Qualification Programme (ATQP) which allows this. Other regulators should consider following UK CAA's lead and those airlines which have not adopted ATQP might wish to review it.

Manufacturers: Should continue to develop their technology to make it easier and safer to use by the flightcrew. Manufacturers are already working on some good initiatives such as TCAP which softens altitude captures to reduce the number of nuisance RAs, AP/FD TCAS Mode which enables the autopilot to fly the TCAS RA manoeuvre thereby reducing the number of inappropriate responses to an RA.

Airports and Regulatory Authorities: Should be encouraged to provide an RNAV approach for every runway not served by an ILS and arguably for ILS runways for when the ILS is out of service. With such technology widely available it is difficult to build a case for the continued acceptance of non-precision and particularly circling approaches.

You will notice that some of these suggestions are pushing towards more manual flight (automation policy, crew recency and use of simulator time) and some towards less manual flight (AP/FD TCAS Mode and RNAV approaches), we are back to the phrase "where appropriate" again!

Here at the UKFSC we will lobby the authorities for a faster introduction of RNAV approaches and any other technological advances that will assist the crews. It is up to all of us to go back and review our company procedures and, for the crew amongst us, ensure that we continue to maintain our manual flying skills.

New Flight Crew Reminder Function

by Brad Cornell, Associate Technical Fellow, Flight Deck Product Development and Gordon Sandell, Associate Technical Fellow, Avionics and Air Traffic Management

Boeing has developed a comprehensive monitoring and alerting system to reduce flight crew workload by allowing flight crews to set up automated reminders to alert them when specific events are achieved or actions are required. The alerting system is available on the 777 and 787.

In addition to operating airplane systems, flight crews must perform many specific tasks during a flight, such as fuel checks and crew changes. Historically, flight crews have used a variety of different techniques to help them remember to perform tasks not monitored by the airplane.

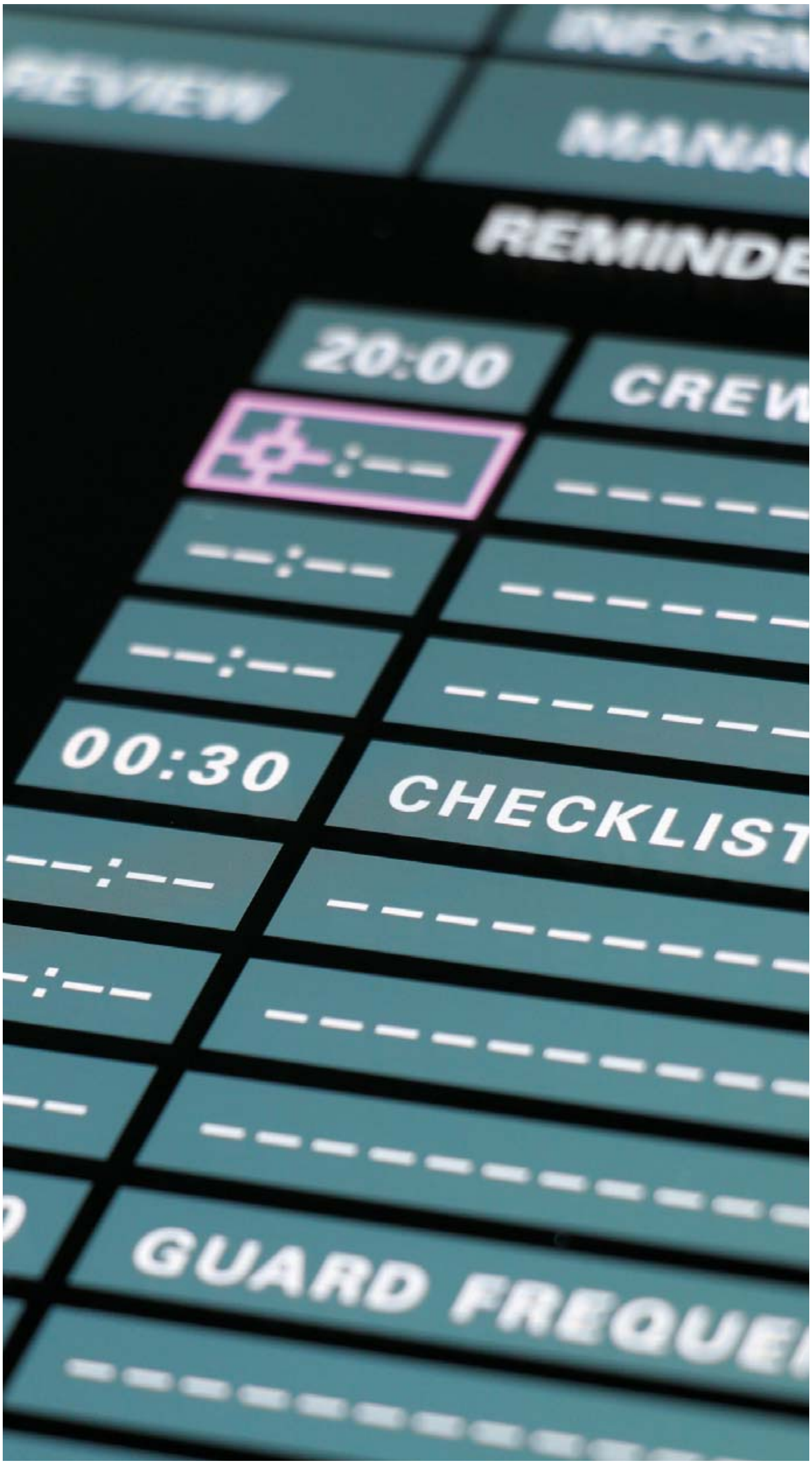
Boeing has developed a new function that allows flight crews to easily set up automated reminders to alert them when specific events occur or when actions need to be taken. Available on the 777 and 787, the function enables operators to use the baseline communication system's airline modifiable information (COMM AMI) to activate the reminders. Alternatively, operators can incorporate the reminder page portion of the baseline AMI into their operator-specific COMM AMI using the ground-based software tool (GBST).

This article explains how the crew reminder function can be used and how flight crews can set up reminders.

The benefit of standardized crew reminders

There are several levels of flight crew workload when operating a commercial jet transport airplane, including planning the flight, setting the airplane systems, departing the airport, and operating the airplane systems to maintain the desired flight path.

In addition to operating systems on the airplane, there are many flight crew tasks associated with managing the flight.



A new function lets 777 and 787 flight crews create automated reminders to alert them when specific actions need to be taken.

Flight crews have developed several different techniques to help remind them to perform various tasks associated with managing the flight that are not monitored by the airplane. These techniques range from inserting waypoints into the flight management system's route to writing notes on paper and putting the paper in the forward field of view. Examples of these tasks include fuel checks, crew changes, or starting the auxiliary power unit before descending to an airport that has an unserviceable ground cart.

Boeing has continuously made a concerted effort to simplify system designs while incorporating comprehensive monitoring and alerting systems. These systems help reduce flight crew workload associated with operating the various systems on the airplane. Having already reduced workload in operating the systems, Boeing now focused on reducing crew workload to manage the flight, and came up with the crew reminder function.

Reducing crew workload through automated reminders

The crew reminder function provides an easy way for crews to set up automated reminders that alert them when specific events are achieved or specific actions need to be taken (see fig. 1). The flight crew reminder function can be implemented in the 777 and 787 COMM system.

Typically, operators develop their own COMM menus and displays compatible with their automation systems and procedures using a GBST. Once the operator-specific pages are finalized, an AMI file is created specifically for the COMM function. The 777 and 787 also come with a baseline COMM AMI, and operators can incorporate any of the functions included in the baseline AMI into their unique COMM AMI without additional cost or effort other than what is required to copy the reminder function from the baseline AMI. The reminder function can also be added to an existing operator's fleet by incorporating the reminder portion of the Boeing baseline AMI into the operator's current COMM AMI and reloading the revised COMM AMI file on the airplane.

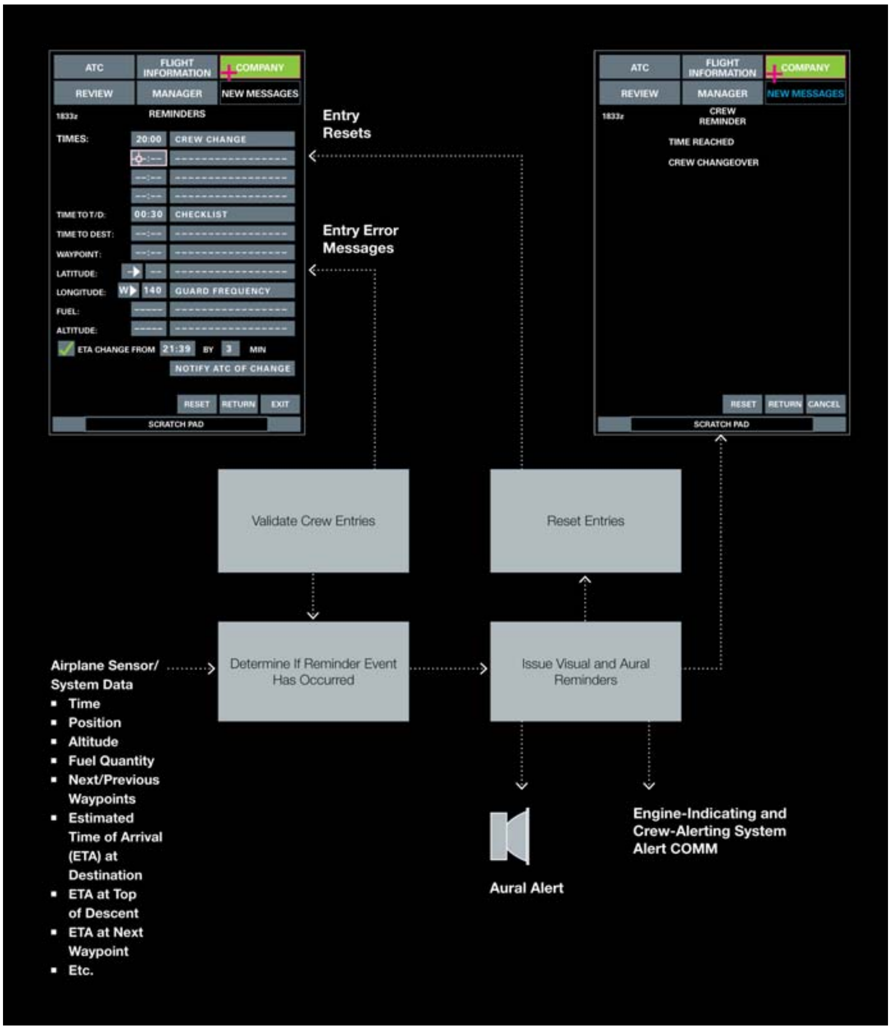


Figure 1: Flight crew reminder function
The crew reminder function provides an easy way for flight crews to set up a variety of automated reminders that alert them with visual and aural reminders when specific events are achieved or specific actions need to be taken.

The reminder function allows the flight crew to select from a list of predefined conditions and enter text specific to the reminder, such as "Crew Change" (see fig. 2). When the condition is met, the COMM function posts a message and the flight crew is alerted by a COMM message on the engine-indicating and crew-alerting system and with an aural alert identical to an incoming company uplinked message. The reminder can then be accessed on the COMM display just like any other uplinked company message.

For operators of 777 and 787 airplanes wanting to obtain this feature, Boeing will provide a set of software components with instructions that can be added to an operator's AMI source data and recompiled on the GBST to create a loadable database.

Figure 2: Entering and reviewing reminders
The reminder function allows the flight crew to select from a list of predefined conditions and enter text specific to the reminder (left). When the condition is met, the COMM function sends a message to itself and the flight crew is alerted by a COMM message on the engine-indicating and crew-alerting system and with an aural alert.

Reminders for a variety of events

After reviewing the parameters that were available to the COMM function and consulting with operators and Boeing test pilots, a list of reminders was developed for nine specific events:

- Reaching a specific time (multiple reminders can be set).
- Reaching a specific time-to-go to top-of-descent.
- Reaching a specific time-to-go to the destination.
- Passing a specific waypoint in the flight plan.
- Crossing a specific latitude.
- Crossing a specific longitude.
- Reaching a specific fuel state.
- Reaching a specific altitude.
- The estimated time of arrival (ETA) at the next waypoint changing by a threshold value entered by the crew.

An airline can customize this list by deleting reminders that it finds are not useful in its operations or by adding its own reminders.

Using crew reminders on the flight deck

There are a number of ways in which this function can be used on the flight deck. For example, air traffic control (ATC) may send a clearance (e.g., AT 2130z CLIMB TO AND MAINTAIN FL390) that needs to have action taken on it sometime in the future. The times can range from a few minutes to a few hours. Following receipt of such a conditional clearance, the crew can easily set a reminder time or position to comply with the clearance using the crew reminder function.

Routine uses include:

- Adding equal time point reminders between extended-diversion-time-operation airports, such as between Hilo and Los Angeles on Pacific crossings.
- Adding a point-of-no-return reminder as a time or position.
- Adding a fuel state reminder that can supplement the flight management computer “MIN FUEL” calculation.
- Setting a position for change of radio guard (such as 140 degrees west or 20 degrees north on Pacific crossings).
- Setting a time to call the resting crew on supplemented crew operations.
- Notifying ATC when ETA at waypoint changes.
- Setting a reminder to log on to ATC (at a time or location) for a datalink.
- Setting a reminder for when to request an oceanic clearance (for North Atlantic operations).

Summary

Boeing has developed a new function that enables 777 and 787 flight crews to create automated reminders to alert them when specific events are achieved or when actions need to be taken.

Reprinted from AERO Magazine courtesy of The Boeing Company.

Anti-Collision Warning Beacons - A view from the ground

by CAA Ground Handling Operations Safety Team (GHOST)

You're on final approach into a Category B airfield in IMC after an uneventful eight hour flight. You have control of the aircraft, whilst your vastly experienced and capable First Officer handles the radio communications and monitors the approach. The winds are light. The cloud base is slightly lower than first advertised but the approach is nothing but routine, up until now. You request *"Gear Down"* followed by the *"Landing Checklist"*, almost immediately after which you are alerted to both an unexpected audible and visual warning. The Master Caution flashes red. It does exactly what it is supposed to do - draw your attention to something that requires immediate action, to prevent further possible consequence…

Now consider that scenario in a different but familiar environment.

You're in the final phase of dispatch after an uneventful turnaround of this narrow body twin-jet. As the designated Team Leader, you are joined by a vastly experienced and capable team you know well. Whilst the number of hold bags for the outbound flight was more than expected for this time of the year, it's been a well co-ordinated and routine turnaround, up until now. As you are conducting your final pre-departure under-wing duty, you are alerted to an unexpected visual warning. The anti-collision warning beacon flashes red. It does exactly what it is supposed to do - draw your attention to something that requires immediate action, to prevent further possible consequence…

In both scenarios, personnel have been trained to understand what these warnings mean and what to do.

Have you ever switched on your anti-collision warning beacons but have not been ready to initiate the pushback? Have you ever thought about how your Ground Crew will, or are supposed to react? What are you trying to tell them? Are you expecting them to stop what they are doing and move away from the aircraft because something that may harm them is about to happen, or are you just expecting them to hurry up, so that you can meet your scheduled departure time?

The Ground Handling community frequently experiences occasions when Flight Crew switch on the beacons whilst the aircraft is still in the hands of the turnaround team, even when lower cargo hold doors are still open, loading equipment is still in place or sometimes when there is no pushback vehicle at the front of the aircraft.

The industry standard for ground operations can be found in the IATA Airport Handling Manual 630 (4.3.10): ***"On departing aircraft, as soon as the anti collision beacons are on, personnel must remain clear of propellers, engines inlets and exhausts. Personnel, unless required to perform a specific function must immediately vacate the area. There should be a clearly defined procedure detailling how personnel involved in the departure process are to remain clear of the aircraft when the anti-collision beacons are on".***

Ground personnel are also warned in the IATA Ground Operations Manual (4.11.13): ***"Anti-collision lights that are switched on are a visual indication to ground staff of imminent engine start-up or aircraft movement".*** This consistent and simple message is replicated in many organisations' policy/procedure manuals and related training courses.

Switching on the beacons, without prior communication, could encourage short cuts or even apply pressure to the point where a specific safety related task is not completed at all, in order to expedite your departure. This action contributes to the erosion of a well established industry safe working practice and has the potential to endanger your flight, as there are a number of related consequences to consider:

Pre-departure safety checks

Anti-collision warning beacons are often switched on whilst a member of the dispatch team is conducting a pre-departure safety walkround. Due to the continued challenge of unreported aircraft damage, the Ground Handling Agent is tasked with checking for significant damage which may have occurred during the mid or latter stages of the departure. It must be remembered that the Flight Deck and/ or Ground Engineer walkrounds might be completed up to one hour before departure. That leaves a lot of time for aircraft/ ground support equipment interaction and the potential for damage to occur.

Historically, this check was purely a 'holds & hatches' check but due to the aforementioned reasons, it has developed into a far more thorough exercise. It will typically require the person responsible to walk around the silhouette of the aircraft, checking door areas, leading/ trailing edges, engines, the undercarriage and of course for any FOD that may be in the vicinity of the pushback zone. The Agents are not qualified engineers but have been trained to be able to identify damage, or even question anything that doesn't look right. Over the last few years, the following examples will show just how important this often, last line of defence, is:

- The headset operative noted damage to the fan blades and cowling of number 2 engine. It was duly inspected and confirmed as being a bird strike. The aircraft was grounded. He was later advised that the engine would not have survived the stresses of take-off thrust.

- Damage was noticed to the inner wing (port side). The flight deck was informed and the aircraft was subsequently offloaded and taken offline for maintenance.

- XXX noticed that engine number 2 was leaking with what he thought was fuel. Subsequent ground runs revealed that it was leaking oil and there would have to be an aircraft change.

- A hatch was identified as not properly secured and required engineering assistance to rectify the fault. This would certainly have affected cabin pressurisation during Flight.

- XXX noticed a piece of FOD was embedded in the tyre. The engineers were informed and checked the tyre, which had to be replaced before departure.

- A leak from the nose leg strut was brought to the Captains attention. It transpired that the strut had failed and had actually collapsed.

In order to reiterate the importance of identifying similarly hazardous situations to those listed above, the majority of Ground Handling Agents have established schemes to officially recognise individuals who have done so. Whilst it could be argued that they are *"just doing their job"*, it serves a greater purpose of encouraging an open reporting culture.

In light of the above, would you want to distract your Agent whilst they are in the process of this check? There is a good chance that this person will be your headset person, so how will they react if halfway around this check, the beacons are switched on… Are you changing their focus during a safety critical duty?

Ground Crews can also assist with this situation - As visibility of all ground activities from the Flight Deck is extremely limited, they should inform Flight Crews that they will be *'offline'* whilst they conduct this safety check.

Communication is even more important if ground to aircraft systems are not available and hand signals are used. If the person responsible for oversight of the engine start/ pushback also conducts the safety walkround, it is recommended that another member of the Ground Handling team remains in visual contact with the Flight Crew, in order to maintain continued communications and prevent any frustrations that may lead to the inappropriate use of the beacons. On completion of the safety walkround, the person responsible should clearly indicate to the Flight Crew that this duty has been completed.

Loading Error

Loading Errors, specifically those that involved unsecured loads, continues to top the charts for ground handling related Mandatory Occurrence Reports (MOR) received by the UK Civil Aviation Authority. Does the pressure applied by the premature switching on of the beacons, influence the way that the dispatch/ loading personnel behave? It is very possible that the last of the cargo loading system floor locks, the bulk load restraint nets and/ or the final supervisory check of either, may not be completed prior to pushback for the same reasons stated previously.

Aircraft Checklists

One UK operator, after experiencing an increase in related reported incidents, conducted an in-depth investigation into some of the causal factors and found that the pre-start checklists contributed to the problem. As the manufacturer's checklist places *"beacon"* directly after *"ATC clearance"*, pilots were getting ahead of the game by completing the pre-start checklist as soon as they were ready to go, as they needed to get in the queue for ATC start clearance.

Therefore, 'ATC clearance' was the trigger for the beacons, whether or not ground crews were actually ready. As a preventative measure, the operator split it into *'before'* and *'at'* Start Clearance and added a requirement to obtain ground clearance before switching the beacons on. The ground clearance is now the trigger for the beacons:

BEFORE START CLEARANCE

Applicable to: ALL

SEATS, SEAT BELTS, HARNESSES, RUDDER PEDALS, ARMRESTS ....ADJUST
MCDU ....IN TAKEOFF CONFIGURATION
EXT PWR ....CHECK OFF
BEFORE START CHECKLIST down to the line ....COMPLETE

AT START CLEARANCE

Applicable to: ALL

PUSHBACK/START UP CLEARANCE ....OBTAIN
Obtain ATC pushback/startup clearance.
Obtain ground crew clearance.

BEACON ....ON
SIGNS ....SET

Personnel Safety

Many Ground Handling organisations are experiencing concerning incidents of ground personnel not staying clear of aircraft whilst engines are running and/ or beacons are switched on, despite it being one of the first rules covered in training for personnel working in the ramp environment - so why does it happen? Personnel are also trained to leave the under-wing area of the aircraft when the beacons have been switched on - so why don't they?

Clearly there are a number of reasons for these behaviours, one of which could be the inappropriate use of the beacons. The practice of using the beacons as 'attention getters' could be devaluing their purpose to the point where, in the eyes of the Ground Handler, they just become another flashing light rather than an indication of potential danger. Safe systems of work can easily become eroded if custom and practice tolerates contradictory behaviour.

If the aircraft is parked on a stand that has roadway behind it, all passing traffic should stop when the beacons are switched on. If it becomes common practice for the beacons to go on and yet the pushback doesn't start for a prolonged period of time, people may start to ignore them and continue to drive vehicles behind the aircraft. This behavioural drift has the potential to result in a very serious incident.

Other Causal Factors

Another reason as to why behavioural drift is apparent may be due to the actions of other influential personnel that regularly work in and around the aircraft. For example, a Ground Engineer's confident manner can sometimes deviate into a disregard for procedure. On occasion, the post arrival walkround of the aircraft (predominantly long-haul) has been seen to be initiated before the aircraft has even parked. In the past, this practice has unfortunately led to serious injury.

It is also understood that some airlines' procedures require Ground Engineers to establish contact with the Flight Deck on arrival, to be able to communicate any potential brake serviceability issues. This procedure has been adopted for operational purposes, must be recognised as such and should not be open to any interpretation by other operational personnel.

Whilst the anti-collision beacons are almost always associated with the moments before pushback, they also have another purpose - they also warn of other possible risks to those in the vicinity of the aircraft. For example, an engine ground run, a slat and/ or flap extension or even a regeneration test of a repaired hydraulic system, etc. Whilst any Ground Engineers in attendance would no doubt do their utmost to warn those in the immediate vicinity, the beacons will also warn those who may not have received any initial cautionary brief.

If the anti-collision warning beacons are to be tested as part of a routine daily engineering type inspection, for the reasons stated above, it is recommended that the Ground Handling Agent is made aware.

Summary

Please reflect for a moment on how your attention focus changes when the Master Caution Warning light illuminates in the flight deck and give a thought to how someone on the outside of your aircraft will have their attention focus changed by the "Master Caution Warning Light" they recognise - the Anti Collision Warning Beacons.

Hopefully this article will provoke a few thoughts, provide a few explanatory considerations and most importantly remind all that safety is the number one priority. Therefore, in the interest of best practice, GHOST and the UKFSC recommend that stakeholders consider the following actions:

- **Aircraft Operators**
  - Through training and monitoring, ensure that flight crews do not use these beacons as a 'ready message' to ground personnel whilst they are conducting final pre-departure preparations
  - Encourage, or even introduce procedures that require Flight Crews to establish communication with the Ground Crews, before switching on the beacons
  - Conduct a review of the pre-start checklist, to see if the aforementioned issue exists, with a view to revision
  - Engage with Engineering organisations and/ or departments to reiterate related procedures/ behaviours
- **Ground Handling Agents**
  - Through training and monitoring, ensure that ground crews stay/ walk away from aircraft that have engines running and/ or anti-collision beacons illuminated
  - Inform the Flight Deck that you intend to conduct the pre-departure safety walk-round
  - Use enhanced communications for this procedure if hand signals are to be used
  - Report any related incidents of inappropriate beacon use

For any related comments, feedback or information please contact GHOST@caa.co.uk

Navtech Charts and ADQ2-IR

by Jonathan Kirk, Quality Auditor, Navtech, Inc.
July 2013

Introduction

Operators falling under EASA OPS clauses CAT.GEN.MPA.180 (a) (12), CAT.OP.MPA.135 (a)(4) and, 175 (b)(5) and CAT. IDE.A.355, which require operators to carry on each flight *current and suitable aeronautical charts for the route of the proposed flight and all routes along which it is reasonable to expect the flight may be diverted and use electronic navigation data products that support a navigation application meeting standards of integrity,* will normally purchase navigation products from a commercial provider such as Navtech. These products are used in all phases of airline operations such as ground manoeuvring, take-off, enroute, arrival and taxing onto gate at the destination aerodrome, and as such form part of the safety barrier in the reduction of the identified Significant 7 Areas of Risk. Following analysis of global fatal accidents, the UK CAA have identified a 'Significant Seven' areas of safety risks[i], and it can be argued that Navtech Charts could provide a safety barrier in the majority of these identified areas of risk.

Significant 7 Areas of Risk	Chart type
1. Loss of control	Portrayal of engine failure procedures and de/anti-ice procedures and pads. Accurate portrayal of missed approach procedures.
2. Runway excursions	Accurate aerodrome and ground manoeuvring charts.
3. Controlled flight into terrain	Accurate portrayal of terrain or MSA on IACs. MORA figures on enroute charts.
4. Runway incursion	Accurate aerodrome and ground manoeuvring charts.
5. Airborne conflict	Correct RTF frequencies and procedures required by national ATC. MEA figures on enroute charts.
6. Ground handling	Accurate aerodrome and ground manoeuvring charts.
7. Fire	Correct RTF frequencies and procedures required by national ATC and accurate aerodrome and ground manoeuvring charts.

Errors in a manual production system

The goal of every operation or production system is to generate a useful product. The product may be a service, information, or physical object. Each production cycle begins with inputs that are transformed into a more desired stated or into a product. In each process, excessive variations and errors can cause nonconformities, with three undesirable consequences:

1. Scrapped or wasted resource
2. Degraded process throughput
3. Abrogation of specification by undetected nonconformities which reduce the value of the product to the customer; and, for the aviation industry, a reduction or elimination of a safety barrier.

This article focuses on Navtech Charts production process, but as will be highlighted, the full ramifications of ADQ2-IR will be felt throughout most production streams for most products in the Navtech flight operations solutions.

Traditional method of chart production

The traditional method of chart production may be considered a manual method, even though the use of CAD (Computer Aided Drawing) has moved production from the days of wax and film cutting to that of today where each provider has to master aspects of design, compilation, data processing, data assembly, graphic presentation, reproduction; and, all with an eye on the commercial costs involved.

Consider that a rough 'back of the envelope' calculation points to 300 separate pieces of data on an average chart and major aerodromes like Amsterdam (70 charts), Heathrow (70 charts) and Paris de Gaulle (100 charts). Also consider that each chart, apart from the chart type template, is completely unique; there is only one ILS 06 for the EHAM chart, Brookmans Park (BPK) 7F chart, or Dieppe (DPE) 5E STAR chart. In practice, each chart which is created is drawn from scratch from the appropriate chart type template, and even though data such as a TWR frequency may appear on the all the charts, it is, in fact individually entered onto each and every appropriate chart and not 'copied and pasted' from charts of the same series. Adding more complexity, Navtech has no control on the volume of AIP data being changed by States at every AIRAC cycle.

A single entry, manual production stream, despite all the 'checks and balances' in place, cannot achieve a Data Assurance Level of more than 1x10-3, this means that statistically there will be errors on charts. What happens if that error is a TDZE, THR coordinate, or a transposed character so instead of FL 130 it reads FL 310? Whilst there a few accidents which cite aeronautical data as a contributing factor, e.g. Cali accident Flight 965, Dec 95 and Linate Airport, Oct 2001, it is rare that erroneous data is the sole contributing factor.

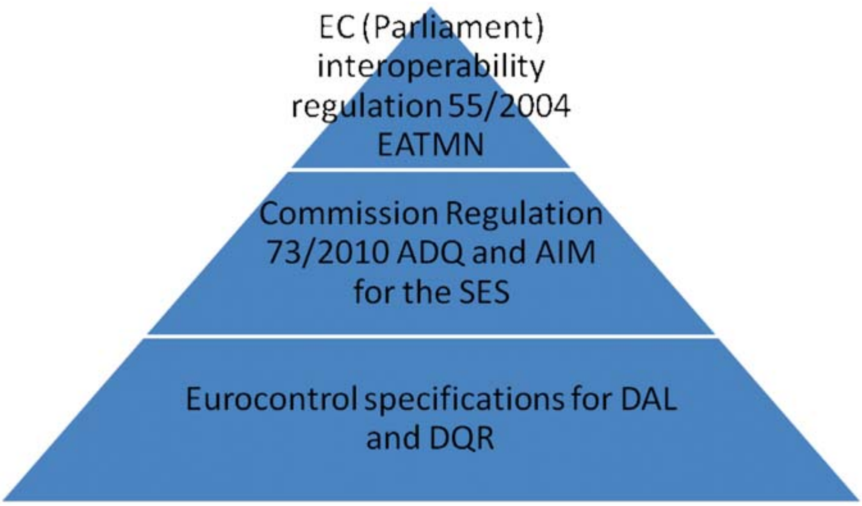


Fig 1 Regulation and document heirarchy for ADQ implementation

Mitigating the Significant 7 Areas of Risk

Mitigation is not just a Navtech challenge, but a challenge throughout this sector of the aviation industry and affects all commercial providers of aeronautical data, and one which is being addressed by European Parliament under the banner heading of SES and SESAR, as shown Above:

The purpose of the ADQ mandate[ii]

A brief synopsis of the ADQ mandate is to improve and assure, through the provision of evidence, that aeronautical data / information provided by States and manipulated through the production process gives the required degree of assurance and that the data will not be adversely compromised or degraded during processing. There are two parts: (EU) 73/2010 which is applicable to States or the 'upstream' activities until publication of the AIP and ADQ2 IR which is applicable to the 'downstream' activities, where Navtech operates. The final details and timescales of ADQ2-IR are still under discussion by the interested relevant European parties, but a transition period of between July 2014 and June 2017 for full compliance has been suggested.

The start of AD2-IR is at the end point of (EU) 73/2010, which will have the desired effect of a seamless join between the two regulations and the AIS / AIM data originators and the commercial providers such as Navtech. The electronic distribution method of the data from the data originator may be either by 'pull' which is where the intended user accesses and extracts aeronautical data by visiting the originators website and downloading, or by 'push' which is when aeronautical data is delivered into the intended users system.

The 'upstream' activities derive from ICAO Annex 15, ISO and AIXM and the 'downstream' activities from ED-76 which has not been revised since 1998, and describes Data Assurance Level (DAL) by means of 10x-x, which is difficult to prove that is has been achieved. Under ADQ, the DAL is described by means of Critical, Essential and Routine, with each paragraph and sub-paragraph of an AIP being assigned an appropriate DAL. Achieving the associated DAL is by assured data entry such as blind double entry or single entry systems. Compliance to the update EUROCAE ED-76 (RTCA DO200A equivalent) ensures that the method of entry and transmission of data maintains the appropriate DAL.

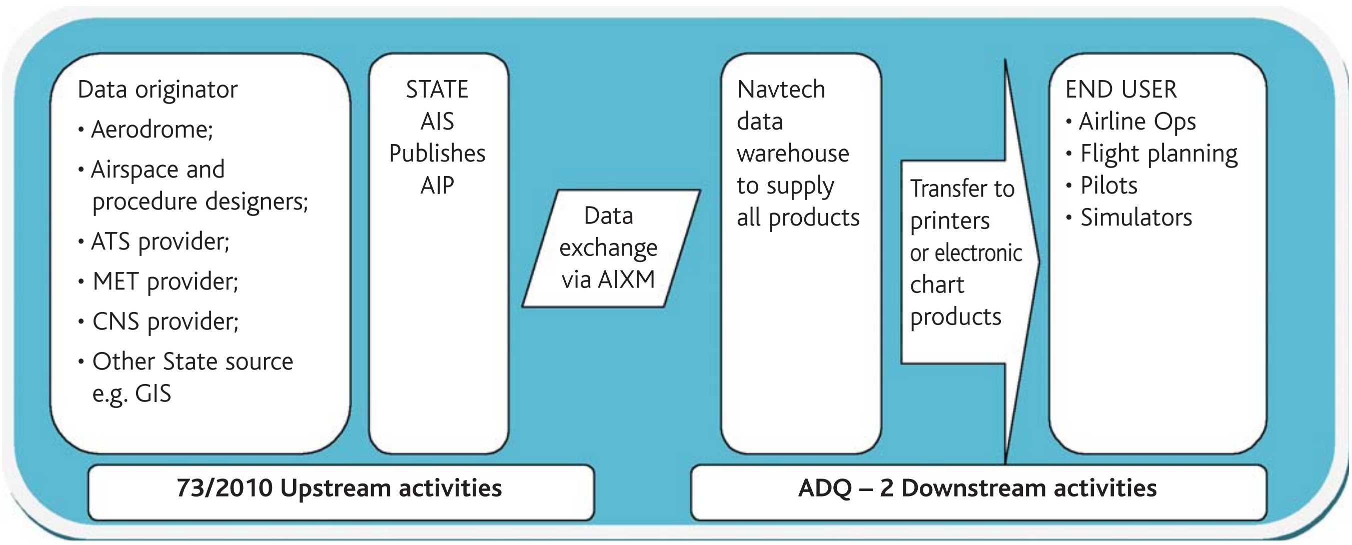


Fig 2 Diagram describing Upstream and Downstream activities for Navtech Charts

Data Integrity Level	Data Assurance Level	ED-76 (and equivalent DO-200A)	Example
Critical	DAL 1	1x10-8	TORA/TODA/ASDA/LDA
Essential	DAL 2	1x10-5	Twy width
Routine	DAL 3	1x10-3	ARP

The term Integrity is used within ADQ to mean the integrity of data. It relates to a measure that a data item retains its originally assigned value and that it has not been lost, altered or corrupted unintentionally. So if it was incorrect initially, it will remain incorrect throughout the processing. It does not have any bearing on how wrong the aeronautical data and information may be if integrity is lost.

Table 1 Showing Data Assurance Levels

Of course, States which transmit data in AIXM are considered to have achieved the appropriate DAL, and as long as data is handled as per ED-76, then no further steps are required, and the data can be placed on Navtech Charts or in other Navtech products.

The aeronautical data and information process chain extends from the original data sources e.g. surveyors, through AIS / AIM and publication to the end user of the aeronautical data. This chain includes providers of navigation products, flight planning, and terrain and obstacle databases. ADQ 2-IR maintains the integrity of the data chain from State providers to the end user, be it a pilot or ATS. In effect, the AIS / AIM side of the aviation industry is moving from product-centric operations to data-centric operations.

To ensure compliance to ADQ2-IR, Navtech has adopted Eurocontrol's Harmonised List and the UK's CAA DAL and turned them into spreadsheet or data inventory which, when compared to the requirements of Navtech's Production (Flight Planning, Navigation Data, Charts and Aircraft Performance) will give a Master list. A MMEL, if you will. This exercise has thrown up some interesting discussion topics, including those such as customer data on tailored products and Type 2 charts. The customer is responsible for the supply, update and correctness of data, but Navtech is responsible for the accurate portrayal of supplied data on its products. So, is this data handled in the same way as State supplied data? Will Type 2 charts be published digitally or still as a graphic and will this be transmitted via AIXM or still as a pictorial chart?

Navtech Charts' compliance to ADQ2-IR comes from Aerocharter, which is a purpose designed and built automated charts software tool which incorporates an AIXM feed capability and has the blind double entry system which allows for data entry from non-AIXM States. However, the processes and procedures of the manual entry system have to be redesigned to ensure that the DAL required is reached and maintained. Additionally, although a regime of blind double entry will slow production at the front end of production, it is offset by the automatic feed of AIXM data from States, the reduction of wasted resource due rework caused by data errors on charts. It will ensure that the assigned DAL will not be degraded during process throughput, and more importantly a safety barrier will be maintained.

Information is accurate upon submission.

For further information on this topic, go to:

- AIXM http://www.eurocontrol.int/services/aeronautical-information-exchange-model
- eAIP http://www.eurocontrol.int/articles/electronic-aeronautical-information-publication-phase-2-p-11
- Digital NOTAM http://www.eurocontrol.int/articles/digital-notam-phase-3-p-21
- ADQ http://www.eurocontrol.int/articles/aeronautical-data-and-information-quality-adq-mandate
- For information about Navtech's products visit http://www.navtech.aero

i **Information taken from http://www.caa.co.uk/default.aspx?catid=2445**

ii **Information taken from http://www.eurocontrol.int/articles/aeronautical-data-and-aeronautical-information-quality-adq-2-mandate**

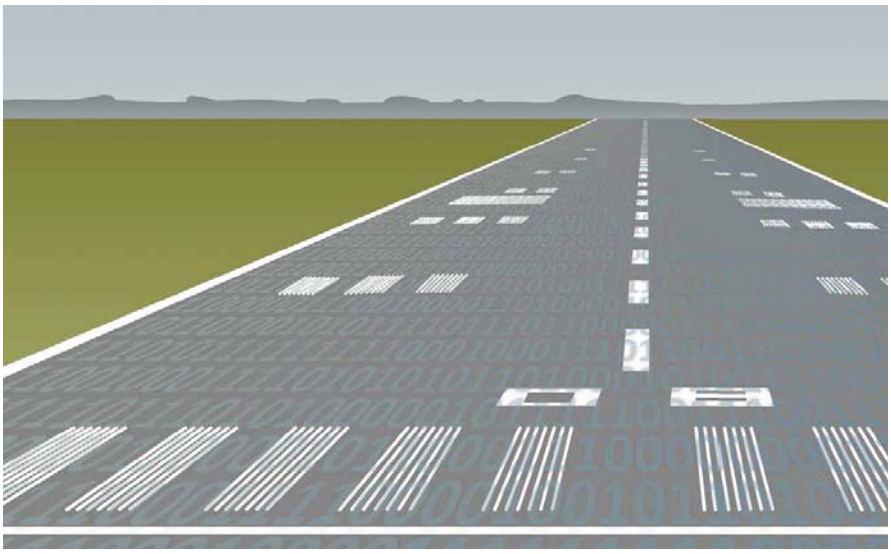
AIP Paragraph	Subject	Eurocontrol HL	CAA	Navtech	Navigation Data-entry	Charts-entry	Charts (Minima) -entry	Aircraft Performance-entry	Flight Planning -entry
2.13	Declared distances			N/A	N/A	N/A	N/A	N/A	N/A
2.13.1	Runway designator	CRITICAL		CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL
2.13.2	TORA	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	N/A	CRITICAL	CRITICAL
2.13.3	TODA	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	N/A	CRITICAL	CRITICAL
2.13.4	ASDA	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	N/A	CRITICAL	CRITICAL
2.13.5	LDA	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	N/A	CRITICAL	CRITICAL
2.13.6	remarks	CRITICAL			CRITICAL	CRITICAL	N/A	CRITICAL	CRITICAL

Table 2 Showing AIP Para 2.13 Declared distances and the DAL applied to Navtech products

Your Slip Is Showing

by Joe Vizzoni

FOQA data can detect airports where runways are likely to be slippery and help pilots compensate.



Pilot statements such as "it was as slippery as grease" and "I thought I wouldn't be able to stop in time" would normally be associated with stopping on winter contaminated runways. These are, rather, pilot responses upon landing in *rain* and on a *wet* runway. They form part of the pilot feedback in a test program related to aircraft braking action.

In fact, the test program revealed that some wet runways have equal or worse braking action than snow- or ice-covered runways.

The Program

The braking action test program came about in 2010 at legacy Continental Airlines, which has been merged with United Airlines, and was based on using the aircraft itself and flight data to better assess braking action. In cooperation with Kongsberg Aeronautical, which possessed an algorithm developed for the purpose that it could easily be adapted and downloaded into the aircraft, the airline's flight operational quality assurance (FOQA) group saw this as an exciting safety project and subsequently initiated the test program. Due to the inherent sensitivity of FOQA data and its use, representatives of pilots as well as operational management were summoned to take part in decisions and approve the framework for the test program.

Sensitive Issues

When it came to sensitivity in the use of flight data, one factor proved essential and favorable. The algorithm and the subsequent program loaded onto the aircraft fleet did not require flight data downloading from the aircraft or any other distribution of flight data. The program was designed to obtain braking action information purely through onboard calculation processes. Only the resulting braking action information was transmitted by a downlink.

The braking action information generated by the system on the aircraft was not influenced by the pilot. The information did not reflect on the skill and airmanship of the pilot.

According to established practices, the FOQA group did not have direct contact or communication with pilots. All crew contact was through the Air Line Pilots Association, International (ALPA) as a gatekeeper.

With a clear understanding of the framework for the test program, the next step was to set up a system to assess, receive and evaluate feedback from pilots.

Management of Test Data and Pilot Feedback

Braking action data were processed, handled and communicated for feedback from pilots Figure 1. The following steps and phases further detail the procedure:

- The FOQA group checked daily incoming data from flights and looked for landings that qualified as being within the determined runway slipperiness threshold.
- Landings found to be within the runway slipperiness threshold were then tested against the weather conditions prevailing at the time of landing. By using METARs (the international standard code format for hourly surface weather observations) for the airport, the FOQA group could easily assess whether the landing information likely represented a slippery runway landing.
- To ensure the anonymity of the crew and avoid potential traceability, only a deidentified METAR eliminating the date was used to match the flight.
- In the next phase, the FOQA group approached the ALPA gatekeeper with the landing details. He contacted the crew to receive their feedback.
- The ALPA gatekeeper relayed the feedback and comments to the FOQA group.

The system comprising detection, verification and the final validation by the pilot worked well, and the pilot statements referred to earlier represent some of the feedback results.

'Friction-Limited' Braking Action

Setup of the on-board algorithm and program is, in broad terms, targeted to detect when aircraft encounter "friction-limited" braking situations. Detecting when an aircraft encounters friction-limited braking is a key constituent in determining maximum braking capability for an aircraft. The test program defined braking action as "dry," "good," "medium" (fair) or "poor" and assigned numerical equivalents of the airplane braking coefficient.

For practical purposes throughout the test program and in pilot contact, the feedback process was focused solely on landing situations in which braking action was classified as being less than "good." This was to avoid adding to pilots' workload for routine landings, when the test was designed to focus on difficult occasions.

A Pilot's Dilemma

Although it is common knowledge that wet runways may be slippery, the issue of slippery runways traditionally has been associated with winter operations and winter contaminants.

However, recently the wet runway issue has received increased attention, and for good reason. Early in this test, program data showed that airports where runways were neither grooved nor crowned for water drainage had increasingly higher risk of being slippery when wet. Various types of deposits on the runways compounded the problem.

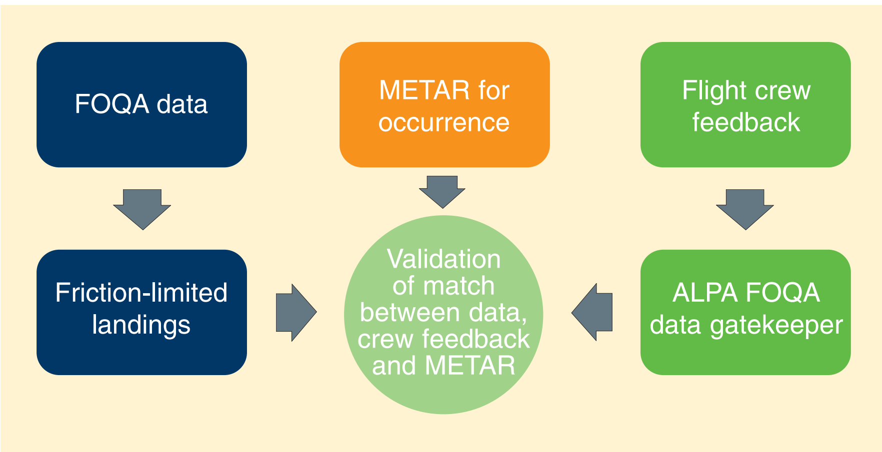
Ideally, airport management should ascertain proper runway design and maintenance programs to ensure proper friction. In reality, this is not always the case, and the test program revealed substantial variations. A pilot's job is to make the right decisions and land the aircraft safely given the prevailing conditions. Therefore knowledge of, and access to, crucial information is of utmost importance for the pilot.

Test Program Findings

One unexpected outcome of the test program was the finding that a few airports recurrently presented slippery conditions. The METAR analysis confirmed conditions to be rain and/or wet runways. Pilot feedback also supported the finding that conditions were slippery. Some of the pilot statements quoted earlier originate from these airports, primarily located in Central America, where the runways are typically neither grooved nor crowned. A history of overrun accidents further added to a perception of these airports being at higher risk.

To conduct further in-depth analysis, the FOQA group plotted, using a global positioning system tool, the number of slippery landings on maps of the runways to enhance situational awareness of the problem. The photograph (p. 14) shows an

FOQA for Wet and Slippery Runways Test Program



ALPA = Air Line Pilots Association, International; FOQA = flight operational quality assurance;
METAR = international standard code format for hourly surface weather observations.
Source: Joe Vizzoni

Satellite photo of Guatemala Airport. Magenta areas indicate positions where the on-board program recurrently indicated friction-limited braking. These positions were defined by the global positioning system, enabling comparison of multiple flights.

example of one of the airports where aircraft encounter friction-limited situations. For practical purposes, the illustration only shows encounters at groundspeeds less than 70 kt. This also is the phase of the stopping run when engine reverse thrust and aerodynamic drag have less impact on the deceleration and leave most of the stopping to the wheel brakes. The photograph shows consistency and further supports the findings.

FOQA Alert

In response to a slippery landing that needed pilot feedback, the ALPA gatekeeper asked the crew for recommendations in addition to their feedback.

A frequent issue was the emphasis on idle reversers. Although never compromising safety, the company recommended, to an extent, idle reverser usage for fuel savings years ago when fuel prices were on the rise. It seemed that too many pilots relied on brakes when reverser usage was more appropriate, especially at the beginning of the landing roll.[1] What surfaced with this test program was potential increased risk with such a policy at certain airports when conditions involved rain and/or wet runways.

Finding that a significant number of pilots addressed the problem and approached it from virtually the same viewpoint, it became apparent that issue had to be pursued. In one of the company's monthly safety meetings, it was decided to bring up the issue. The safety meeting normally involves participants from ALPA, fleet managers, the safety group, etc. At the meeting, the ALPA gatekeeper presented the case supported by the pilot recommendations, the data and in-depth analysis from the FOQA group. This became then an action item.

In considering the action item, the options were to issue a pilot bulletin or insert a 10-7/ FOQA alert — a notification that describes a problem and recommends a response — into the pilots' approach plate for an airport. Due to the seriousness of the issue, the pilot bulletin was considered less appropriate because it would likely be forgotten within six months. The 10-7, on the other hand, represented information in a more permanent form and was used for some of the airports revealed to be at higher risk in the test program.

The 10-7/FOQA Alert Era

The braking action test program continues at an increasing scale and according to its original intent. A little more than two years after the 10-7 implementation, there has been a substantial reduction in pilot statements such as "slipperier than grease" for those airports that were subject to the 10-7.

To further look into the impact of the 10-7 and use of idle reversers, the FOQA group has run an analysis. Where METAR data indicated rain and/or wet runway conditions in landings, their reverser usage was analyzed before and after the 10-7 implementation and showed significant changes. Thrust reverser usage has been more selective. Deployment of reversers upon landing is normal procedure, but in line with policy, the use of reverse thrust by increasing the engine revolution speed has varied. Prior to the 10-7 era, it was normal to see engine speed about 40 percent, which is virtually "idle," even when conditions were rainy or wet. After introduction of the 10-7, the standard engine speed used in rainy or wet conditions was about 80 percent, which is maximum use of reverser thrust.

This action item demonstrates encouraging results. First, it serves as a useful tool for pilots operating in airports that are less than ideal in design and maintenance. Second, in a cost-conscious environment, it also shows that rather than issuing generalized notifications and procedures, proper use of technology and cooperation by pilots can enable a clinical approach and more detailed procedures, better balancing safety with economic considerations.

Selections From a 10-7 Issued for a Runway

- *The runway is not grooved and standing water is likely to be present when raining.*
- *Braking action is likely to be fair–poor when the runway is wet.*
- *Select and use the maximum autobrake setting.*
- *Make every attempt to touch down at the 1,000-ft point.*
- *Use maximum reverse thrust.*

– JV

Safety Culture and Environment

Continental Airlines had a long history of using flight/FOQA data to proactively enhance safety and efficiency, which has continued after the merger with United. Although the braking action test program and the initial 10-7 FOQA alert may seem ordinary, the process epitomized what is needed to build a platform of understanding, trust and cooperation to create the right culture and environment for working with sensitive information such as FOQA data.

For all parties in this test project, the focus has always been on safety. Nevertheless, it has been important to safeguard the corporate safety culture and environment by having proper systems, routines and procedures. When this test program surfaced, the operational management took a keen interest, provided the "green light," and then supported the test program. This was important and provided the proper framework for the project's more active participants.

ALPA and the FOQA groups have had a long relationship and developed good rapport through many years of cooperation. The intriguing part was to have a third party working within the traditional format of the FOQA group and ALPA. It has been a success.

The Future

Although there has been an increasing focus on rain and wet runways, the braking action test program was not specifically set up to find runways prone to higher risk in rain. It was part of a general move to better and more accurately assess the braking capability of aircraft, in particular during challenging winter conditions.

The on-board system developed is now downloaded onto all United's Boeing 737NGs, representing a significant network. Today, this aircraft network furnishes braking action information daily, albeit not yet for operational purposes but only for FOQA group analysis.

United's pilots will continue to serve a pivotal role in the system verification by providing valuable feedback. A print function has been programmed on the flight deck and activated for response, thereby simplifying participation by pilots. The test program will continue to be focused on runway conditions where braking action is assessed to be less than good by the numerical scale of airplane braking coefficient.

In terms of the future viability of the system, the algorithm and program have proved stable and reliable. Currently the system is undergoing a validation in cooperation with the U.S. Federal Aviation Administration. Access to and availability of FOQA data provide new opportunities to improve safety and efficiency of airline operations. By the same token, it is important that the necessary framework be in place to pursue desired results, such as those that have been evident in this project.

Joe Vizzoni has been a part of this test program and all the processes described from its start. He is a first officer with United Airlines on the Boeing 757 and 767 and also has experience as an aerospace engineer, of which nine of 14 years were with Boeing.

Note

1. Thrust reversers are most efficient at higher speed, so to reduce the kinetic energy of a landing aircraft, it is best to apply them at once, thus carrying forward less energy toward the end of the runway.

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Maker's Way

Engine maker training programs for AMTs continue to evolve in light of the development of new technologically advanced and fuel-efficient powerplants. Robert W. Moorman explores the changes in AMT training.

At present, Rolls-Royce has training sites in Indianapolis, Alesund, Norway; Singapore; Bristol and Derby, UK. Image credit: Rolls-Royce.

The ongoing development of engine manufacturers' training programs for Aircraft Maintenance Technicians (AMTs) is somewhat like a two-part series. In book one, readers learn how engine suppliers have spent millions of dollars developing AMT training centers for their customers. In book two, we learn how these centers have expanded their training programs to regions more accessible to their customers. The evolution of AMT training continues.

Part of the service package an airline gets when purchasing a new engine is a guaranteed number of training days for AMTs. GE, CFM International, Rolls-Royce and Pratt & Whitney all provide these AMT training services. Manufacturers typically offer total care packages with the sale of new engines, which includes training programs that could help to reduce warranty costs for the OEM.

Typically, the training is tailor-made, based upon the type of operation customers have. GE Aviation's Customer Technical Education Center (CTEC) in Cincinnati provides standard AMT training for the GEnx, GE90, CF6, CFM, CF34 and CT7. Basic borescope inspection and line maintenance training also are taught on these engines, and digital training solutions are provided.

CTEC will soon expand the scope of its customer training programs to include Customer Operations Leadership Training (COLT), which teaches the operational aspects of engine maintenance. Specific details of the actual training scenario have yet to be released. But AMTs, who eventually want to become managers, should be on the lookout for further details from GE, said CTEC Manager Tim Meyers. In Cincinnati, GE trains around 5,000 customer students per year and provides about 15,000 days of training.

GE also has an AMT training facility in Doha, Qatar, which is part of the GE Advanced Technology & Research Center (GE ARTC). The 144,237-square-foot facility, which opened in 2010, includes six digital classrooms, as well as 14 engine/tool bays for hands-on training.

CFM International, the joint venture between GE Aviation and Snecma, a unit of the Safran Group, has training centers in Paris, Guonghan City, China and Hyderabad, India. More than 10,000 AMTs have been trained at the Aero Engine Maintenance Training Center (AEMTC) in China since it opened in 1996.

Eighty-percent of CTEC's mission involves a five-day familiarization course. Two days involve classroom training, in which students are shown 3D models that can be taken apart virtually. Students see the computer generated components and learn the processes behind those items. For the three remaining days, students receive training in the engine shop. Students are taught to remove an engine from a pylon, components removal and engine inspection as it correlates with the engine manual. All training is engine specific, said

Meyers. GE launched Repair By Piece Part Replacement Training over a year ago to instruct students how to break down an engine module into pieces.

For basic engine maintenance training for newer powerplants, CTEC incorporates Information Technology (IT) such as 3D models and interactive exercises using iPads to dissect the engine. Meyers said training methodologies have evolved over the years to appeal to younger technology-savvy students. Keeping training methodologies current is one of the reasons GE launched CTEC University. The online school allows students to call up 3D and/or audio enhanced training modules at any time. GE provides advanced AMT or Level 4 heavy maintenance training. The students are taught to remove and repair various modules of the engine, such as the fan section, the Low Pressure Turbine (LPT), the High Pressure Turbine (HPT) and compressor, the first component in the engine core.

Meyers explained that "the MRO in many cases is breaking the engine into modules and sending it to one of our service shops. So we teach a module level course for large commercial engines."

GE offers an optional 5-day specialized diagnostic course to show students how to read and interpret engine data. The CTEC line maintenance course includes next generation borescope training in which 3D imaging tools are used to provide a photo or video of the engine's interior.

GE continues to modify the syllabus to include new engines and improvements to existing powerplants. GE accommodates technologies introduced or enhanced in the GEnx family into the curriculum. CTEC does not provide composite repair at any of the maintenance training facilities. "We try and explain the differences of technology on that engine and troubleshoot faults of the engine, versus going into specific repair," Meyers said. If the engine is more complex because of exterior configuration, "we provide methodology on the most productive way of providing maintenance on a complex engine," he explained.

Other Players

Although capable of housing larger engines, the Rolls-Royce Regional Customer Training Center (RCTC) in Indianapolis, Ind. focuses mainly on AMT training for small civil engines, of which the biggest is the BR715, the 23,000-pound thrust capable powerplant for the Boeing 717-200. The BR700 family of engines also powers several business jets, including the Bombardier Global Express, Gulfstream V and Citation X. The BR725, powers the newer Gulfstream G650. RCTC also provides maintenance training on the AE 3007, which powers the Embraer E135 and E145 regional jets.

The facility also provides AMT training on engines for civil and military rotorcraft. RCTC provides AMT training for 1,200 students annually. A three-day engine familiarization course, a skill Level 1 class, is offered. Students learn about engine configuration, key external engine components and internal instruction design, which includes airflows and oil flows through the engine, an important skill when servicing and troubleshooting the engine.

"We try and provide a tiered system" to training, said Stephen C. Ley, Head of Customer & Product Training for North America. "We find that most of the maintenance technicians have a good understanding of engine basics."

Learning or relearning basic AMT skills is beneficial, but for a number of AMTs, the five-day course allows students for the first time to interact directly with the OEM. The idea, said Ley, is to give a student a deeper understanding of "what I'm doing, why I'm doing it and how it fits into the bigger picture."

Training AMTs today is not about the using latest in training devices and techniques, but about gaining overall understanding of the process in classroom and on-floor practical training.

As for technology, RCTC is careful about what devices are used. So-called 3D trainers "have minimal value," said Ley. "Our customers are telling us they prefer more hands-on skills training."

RCTC doesn't teach students how to tear down an engine, with one exception, the M250 turboshaft powerplant. Hands-on sessions are coupled with self-paced, computer-based training. The object is to enable the operator's AMTs to perform line and heavy maintenance, inspection, and troubleshooting and ground checkout on the entire M250 family of engines.

RCTC provides familiarization, line and heavy maintenance training for the RR300 turboshaft engine, the exclusive powerplant for the Robinson R66 helicopter. Robinson mandates that all dealers must take an RR300 engine familiarization course as a requirement to becoming a dealer.

Internet Value

Ley said Rolls-Royce is becoming more involved with e-learning to supplement existing traditional instruction. Company instructors utilize a robust process (MS 7.2) to

Pratt & Whitney's CTC teaches several hundred courses per year to over 4,000 students globally. Image credit: Pratt & Whitney.

design and develop content that is contained within its Rolls-Royce Quality Management System (RRQMS). Quality and content design is reviewed at regular intervals.

This process also includes a critical step that involves capture of customer training requirements and desired business outcomes to ensure that the Return on Investment is maximized, Ley said. Instructors are trained to design learning content using a flexible set of tools and templates found within the online based MS 7.2 Support Center. Content is created using the Adobe e-learning suite, which includes Captivate. A variety of media tools are used from video clips, audio, photographs, animation and 3D visuals. The intent is to create a learning package that is effective, practical and cost effective.

Sometimes students come to RCTC to develop specific skills, not take a full round of courses.

"It doesn't make any sense to sit through a five-day maintenance training class just to learn a few skills," Ley said. "Why not create an online job aid that is based upon a specific need?"

Ley said the goal is to convert some existing instructor-led engine familiarization courses to online courses, which customers can access through Rolls-Royce MyLearning.

Online courses are good for product familiarization or gaining access to job aids that are targeted to specific in-service tasks. Training online provides flexibility, plus online training is selfpaced and offered 24/7. Training can also be deployed using mobile devices. "This is the direction we want to head, so do our customers," Ley said.

There are other reasons why OEMs are relying more on online instruction. Such a service provides value to the customer and reduces risk for Rolls-Royce in executing the engine contract. Online task aids save money for the OEM in no-fault found incidents and for the airline in lost revenue from taking the aircraft out of service unnecessarily.

With its Total Care fly-by-the-hour package, Rolls-Royce is responsible for all engine parts and shop visits. Competitors' fly-by-the-hour packages also provide for parts and upkeep of the engine.

Rolls-Royce Customer & Product Training is also developing what is known in-house as Data Driven Learning Solutions (DDLS), which AMTs can review as an online job or task aid. This process blends Rolls-Royce's knowledge of its products and current in-service issues with its training content design processes to create concise and targeted learning solutions that can be deployed online, in classrooms and elsewhere.

Rolls-Royce says it is seeing "an increase in the number of requested quotes" for off-site AMT training services at or near the customers' base of operations. The trend is being seen in "both corporate and regional aircraft markets and well as those in defense."

At present, Rolls-Royce has training sites in Indianapolis, Alesund, Norway; Singapore; Bristol and Derby, UK. Other sites are under review.

GE Aviation's Customer Technical Education Center. Image credit: GE.

Across the pond, Rolls-Royce's AMT training on large commercial aircraft engines continues to evolve at the company's Derby facilities, where all variants of the Trent engine are made.

AMT training continues on the Trent 900 powerplant for the A380 as well as the Trent 1000, which is offered on the B787. Rolls-Royce now offers engine removal and installation training for the Trent 1000 when the first B787 is delivered. Like other OEM programs, Rolls-Royce training for the Trent 900 and 1000 includes troubleshooting, which helps ensure longer time on-wing, with better on-wing service. Students visit Derby for Rolls-Royce's required eight-day classroom and practical course, which includes software and hardware training aids.

More Responsibility

The biggest change at Pratt & Whitney's Customer Training Center in East Hartford, Conn. is the increasing training of AMTs on powerplants made by International Aero Engines, the joint venture between Pratt & Whitney and several companies. The original collaboration involved Pratt & Whitney, Rolls-Royce, Japanese Aero Engine Corporation, MTU Aero Engines and Fiat Avio. Fiat Avio dropped out early on and Rolls-Royce sold its 32.5% stake in late June 2012.

"We will be able to train to one source at one location," said Andrew Bordick, Manager of Pratt & Whitney's Customer Training Center in East Hartford, Conn.

In keeping with the IAE integration, Pratt & Whitney will grow its other major AMT training center in Beijing. The expansion at the China Customer Training Center (CCTC) will include sending a V2500 engine for training. Further growth at the China center will depend upon sales of the Pratt & Whitney engines in the region.

Bordick said Pratt & Whitney is considering developing additional training facilities in the Middle East and India. The company continues its' "On-Site" training program where instructors train AMTs at or near the customer's headquarters, typically. This training, which applies to commercial and military engines, is expected to grow, Bordick said. An On Site team is currently in Pakistan.

"The intent is to go where the customer demand [for training] is," he said. On Site training does not include traveling with a full size engine as the manufacturer thinks this would be expensive and counterproductive. However, sending an engine to a fixed facility, such as the CCTC for long-term use is worthwhile, Bordick said.

Pratt & Whitney is developing courses for its' highly fuel-efficient geared turbofan engines, such as the PW1000G, which will power the Airbus A320neo. Bordick describes this 3D aided training as a "real step change in what we do for customer training."

CTC offers AMT's an instructor led familiarization course with hands-on training as well as advanced training, plus on-demand courses that focuses specifically on one engine and or its' systems. CTC's troubleshooting course is designed to deliver a variety of faults for multiple aircraft platforms. The PTS simulation software uses multiple monitors to accurately display fault isolation. Troubleshooting exercises use actual electrical, hydraulic and other schematics, which respond as the aircraft would to each troubleshooting procedure. Graphics provide a physical representation of the aircraft or system being examined.

The center also augments certificated courses with systems understanding courses using 3D models that can be highlighted for better understanding. Pratt & Whitney is working to provide students with their own tablet.

Like other engine makers, Pratt & Whitney utilizes e-learning for instruction, but stresses that it is only one segment of a broad-based curriculum. e-learning should be "supplemental", not a primary source of instruction, said Bordick. The company will use e-learning to provide "vignettes" on component instruction.

Pratt & Whitney's CTC teaches several hundred courses per year to over 4,000 students globally.

Some AMTs continue to seek maintenance training from manufacturers' approved independent training houses. But customers will insist that their AMTs receive initial and advanced training directly from the engine manufacturer as part of an engine purchase agreement, which makes sense, considering the manufacturers know more about their engines than anyone.

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