focus

ON COMMERCIAL AVIATION SAFETY WINTER 2006

ISSUE 65

THE OFFICIAL PUBLICATION OF THE
UNITED KINGDOM FLIGHT SAFETY COMMITTEE

ISSN 1355-1523

The Official Publication of
THE UNITED KINGDOM FLIGHT SAFETY COMMITTEE

focus

ISSN: 1355-1523 **WINTER 2006** **ON COMMERCIAL AVIATION SAFETY**

__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.

Editorial Office:
Ed Paintin
The Graham Suite
Fairoaks Airport, Chobham, Woking,
Surrey. GU24 8HX
Tel: 01276-855193 Fax: 01276-855195
e-mail: admin@ukfsc.co.uk
Web Site: www.ukfsc.co.uk
Office Hours: 0900 - 1630 Monday - Friday

Advertisement Sales Office:
UKFSC
The Graham Suite,
Fairoaks Airport, Chobham, Woking,
Surrey GU24 8HX
Tel: 01276-855193 Fax: 01276-855195
email: admin@ukfsc.co.uk
Web Site: www.ukfsc.co.uk
Office Hours: 0900 - 1630 Monday - Friday

Printed by:
Woking Print & Publicity Ltd
The Print Works, St. Johns Lye, St. Johns,
Woking, Surrey GU21 1RS
Tel: 01483-884884 Fax: 01483-884880
ISDN: 01483-598501
e-mail: sales@wokingprint.com
Web: www.wokingprint.com

contents

Front Cover Picture: Dornier 328 "Space Jet"

Human Factors

Over the last few years, Human Factors (HF) has been a major topic of conversation in the aviation industry. One could almost say that a new industry has developed in support of the subject.

The main question is: Has this emphasis on HF had any effect on improving aviation safety?

Human error is a complex interaction between a number of different factors and citing human factors as a cause of an incident or accident does not shed any light on the real cause of the event. It certainly does not help anyone to learn from an event or stop the same event from re-occurring.

The development of a "just culture" in companies has led to an increase in the number of safety reports generated by aircrew, cabin staff and engineers. Often the increase in the number of reports is attributed to increased reporting levels and not to an increase in the number of unsafe events. Is this correct or is the number of unsafe events increasing? Do we accept this increase in reporting rate to avoid taking any positive action?

One of the major causes of incidents and accidents is failure to follow procedures, both at the organisational level and the personal level. This may be due to an unintended action (error) or an intended action (non-conformance). The errors may be attributable to human factors and these will always occur as people do make errors. On the other hand non-conformance or rule breaking can not be allowed to continue without intervention.

There are a number of reasons why people break the rules and some of these are: to make the job easier, to save time, real or perceived pressures to cut corners, poor understanding of the safety risk, complacency and ineffective disciplinary consequences.

It is true that some non-conformances do occur in exceptional circumstances, like during an emergency. Here the individual may attempt to solve a problem when the rules or procedure are felt not to be applicable. The individual uses his existing knowledge to solve the problem and in so doing violates the rules. Generally if all goes well there is no come back but when it all goes wrong ……..!

Two of the three largest flight safety areas of concern are level busts and runway incursions. Failure to follow procedures is the main cause of these types of events. They do not occur during a period of exceptional circumstance but during routine operation, so why then do they happen? Do crews who do this eventually become complacent? If so, how should this complacency be corrected?

In some organisations following a non-conformance, individuals are sent for additional training to reinforce positively the need to follow procedures. Some individuals see this positively as beneficial. Others see it as a punishment for having made a mistake. Do those who see retraining as a positive, work in an organisation with a "just culture", whilst those who see it as a punishment do not? Has the subject of a "just culture" been taken too far in some organisations, where individuals are absolved of their accountability for non-conformance?

Flight Safety does require an open and just reporting culture in order that we are able to monitor safety trends. It also requires positive management and supervisory attitudes to ensure that personnel are correctly supported. But most of all it requires well trained crew that are accountable for their actions and who will accept that re-training is part of the job. Their licence is issued to them on the understanding that they obey the rules and follow laid down procedures. Why else would it be called a licence.

UK FLIGHT SAFETY COMMITTEE OBJECTIVES

- To pursue the highest standards of aviation safety.
- To constitute a body of experienced aviation flight safety personnel available for consultation.
- To facilitate the free exchange of aviation safety data.
- To maintain an appropriate liaison with other bodies concerned with aviation safety.
- To provide assistance to operators establishing and maintaining a flight safety organisation.

Is This The Way To Behave?

by Ian Crowe, Willis Ltd

My aircraft engineering apprenticeship back in the 60's was 4 years long and carried out in-house. We were recruited, selected, given some basic tools, a rusty piece of metal and told to file!

It was not until much later that I realized this had very little to do with aircraft engineering but everything to do with discipline. Your handy work may not have been terrific, but your attitude was being watched and assessed by experienced instructors who could spot a 'good one' - so they told me later. Misconduct, not your inability to file a straight edge was unacceptable, which could result in you finding yourself looking for the nearest exit.

We knew how to behave and had a lot of fun in the process.

I took some of these life lessons with me. Later as an instructor in the company of other like-minded individuals, we demanded a great deal from our students. Not only did they have to pass the 'skills test' but they also had to meet or exceed our expectations and occasional misgivings.

We did not question the initial selection process with comments like, how did he or she get through? Often because we were involved in the selection process ourselves, so we were hardly likely to be that critical.

This melting pot of enthusiasm, expertise and experience produced good results, as we could filter out the 'bad ones' and encourage the 'good ones'. This may not have been terribly PC but it worked, no really, it did.

We were able to advise the operators at the sharp end should a student's performance show signs of deterioration, but more significantly on many occasions we would have a quiet chat with the student to prevent any reoccurrence.

In other words there was a common thread running through the organisation with the ultimate goal of providing a safe environment for our passengers and people.

This year the topic of our Annual Safety Seminar held at the beginning of October was Training. We were very fortunate in having 7 excellent speakers covering all aspects of our business. I would like to take this opportunity to thank them for their kind support. However, the thread running through this year's presentations were not entirely based on safety, but outsourcing.

We outsource because the cost to provide a dedicated training facility is so great, the investment so long term, and with the continual drive for profitability outsourcing often seems to be the answer.

I should say at this stage that I'm not speaking about specialist training provided by say a manufacturer, but the initial ab-initio apprentice type training.

It is unlikely that a third party training organisation will be as rigorous to question, back course or fail lots of people, etc. After all, and this may sound a little harsh, their income and reputation is based on throughput.

Outsourcing has financial considerations; however, there are further consequences, which should be considered. You will appreciate that we cannot outsource our responsibilities.

Standing behind inspections, audits and other activities can provide management with a warm feeling and an opportunity to say we have been following the policies and procedure. But this approach may not stand up to detailed investigation.

Over the next 20 years the number of aircraft and passengers carried are expected to double. We will need people properly trained to continue to improve our current safety standards.

Should the pressure to respond to financial targets through outsourcing continue to rule the safety of our business?

I believe it comes down to this. Is it a case of 'can we' versus 'should we'? In this seemingly ill disciplined and PC world we can do what we like. We can continue to outsource, but should we?

Is this the way we want to behave?

Global Solutions for FOD Prevention

by Flt. Lt. John Franklin

On 25 July 2000, an Air France Concorde crashed just minutes after take off from Paris Charles de Gaulle Airport killing all 109 people on board and 4 people on the ground. Two years later the accident report confirmed that FOD (Foreign Object Debris) in the form of a 40cm piece of metal had caused the tragedy. It's hard to believe that something so simple could cause such a disaster, yet it is estimated that FOD on airport runways causes about US$4bn damage to aircraft every year.

Figure 1. Concorde Accident – 25 July 2000.

FOD Prevention is a key component of aircraft safety and in the complex environment of civilian aviation it requires the support and participation of not just airlines and airports but also the many airport tenants who all have their own part to play in the fight against FOD.

Whatever part of the industry you are involved in, a company FOD Prevention Plan could save not only lives but also a significant amount of money. The benefits of understanding FOD and tackling it at source are huge. By way of example, in the late 1990s United Airlines perceived that FOD was costing them dearly and instigated a pan-company FOD Reporting system that identified that the cost of FOD was historically in the region of US$25 Million every year. They then embarked on a journey that saw them work closely with airports to reduce FOD that lead to a reduction in cost to US$8 Million by 2005. To any airline a cost saving of the order of Millions is certainly significant and the knock on effect is an improvement in safety that can only benefit passengers and the industry as a whole.

The endeavours of United Airlines proves what can be done by a focussed FOD Programme, but where do you start? Well, a key source of advice and information on FOD is an organisation called National Aerospace FOD Prevention Inc (NAFPI). NAFPI is a non-profit making, non-partisan association of people and organisations from many different areas of the aerospace industry (including military, commercial airlines and airports, manufacturing and support industries). Collectively, NAFPI recognises the negative impact FOD has on both aviation safety and fiscal responsibility. The organisation is committed to a common goal to educate, create awareness and promote FOD Prevention best practice in all aspects of aerospace operations and manufacture.

NAFPI was formed in 1985 by a few committed people who realised the problems FOD presented. They had the vision to understand what could be achieved by organising people from various industries and disciplines within aerospace in order to combat FOD and provide resources to help this effort. Despite being a USA based organisation, the MoD's Defence Aviation Safety Centre who are also an active participant in the UKFSC, has provided one of the 10 board members of NAFPI since the late 1990s.

Figure 2. NAFPI Chairman – Richard Bell of Northrop Grumman

The chairman of NAFPI is currently taken from Northrop Grumman and the other organisations supplying board members are Boeing, Lockheed Martin, United Space Alliance, USAF, US Defense Contract Monitoring Agency (DCMA), United Airlines, Atlanta Hartsfield-Jackson International Airport and BAE Systems. All board members are volunteered by their companies to give a small amount of their time to assist in the running of the organisation. Moreover, over 1000 individuals are registered as members of NAFPI.

Figure 3. NAFPI 2nd International FOD Prevention Conference

Since its inception, NAFPI has hosted 27 FOD Prevention Conferences in the USA and in recent years has expanded into a global organisation, hosting its First International FOD Conference in London in 2003 and its Second International Conference in Blackpool in May 2005. The latter, which was co-hosted by BAE Systems, saw over 150 delegates from countries across Europe, Asia and the Americas share ideas and improve their understanding of how to prevent FOD. They were also afforded the opportunity to witness best practice at first hand during a benchmarking tour of the BAE

Figure 4. Benchmarking Tour of BAE Systems Typhoon Manufacturing Facility

Systems Typhoon Manufacturing facility and the Warton airfield.

The 3rd NAFPI International Conference will be held on 1-2 May 2007 at the Hilton Hotel, Blackpool. The event will feature two days of facilitated panel discussions, keynote presentations and exhibits to enable delegates to share proven methods and best practices of preventing FOD throughout the aviation/aerospace industry. If you are serious about Flight Safety and recognize the need to prevent FOD and its impact in the aerospace industry then the Conference is an ideal opportunity to kick start a FOD Prevention Programme.

Since becoming involved in NAFPI, here at the MoD we have learnt a great deal about how to improve the way we tackle FOD Prevention. FOD has now been fully integrated into our Aviation Safety Activity and over recent years our pro-active approach has saved many millions of pounds and potentially the lives of our precious crews and military passengers. A significant amount of information that has enabled this success came from our participation with NAFPI and its Conferences. We never rest on our laurels and return each year to re-assess our efforts against others in the industry, for us the FOD Prevention journey never ends, but what about you?

Will you read this article and then just go about your day as if nothing has happened, or will you strive to get more involved in FOD prevention and perhaps without ever knowing it, save somebody's life one day? Ultimately the choice is yours. If you choose to help reduce FOD, through the endeavours of NAFPI there is the collective knowledge of over 1000 aerospace specialists to call on. Finally, if you are involved in FOD Prevention, or have staff who are, the NAFPI International FOD Conference will not just be an excuse for a few beers in the delights of sunny Blackpool, the information you will get will be worth its weight in FOD.

National Aerospace FOD Prevention Inc and BAe Systems Present

THE 3RD INTERNATIONAL FOD PREVENTION CONFERENCE

FOD PREVETION CULTURE - AN ESSENTIAL COMPONENT OF AVIATION SAFETY

www.nafpi.com

1-2 May 2007 at the Hilton Hotel, Blackpool, UK

Conference Description:

The 3rd International FOD Prevention conference objective is to make the wider aerospace industry aware of the need to prevent foreign object debris/ damage from our aircraft, airports, runways, manufacturing facilities, flight lines and all aspects of aerospace operations. The conference provides an effective forum for the exchange of ideas, solutions, expertise.

Who should Attend:

Anyone who has an interest in flight safety. This conference attracts major industry representatives from: Airlines, Airports, Cargo Haulers, Aircraft Manufacturing & Repair, Military, Space, Support Industries, and many others from Aviation organizations.

Who should Exhibit:

Anyone who's products or services increase flight safety & FOD prevention. Examples: borescopes, cameras, lights, tools, tool kits/ tool control, FOD detection systems, aircraft protective devices, personal protective equipment, wildlife control, runway sweepers, vacuums, etc... Companies also exhibit to showcase their FOD prevention programs, products and services.

Conference Program:

NAFPI and this year's co-host invite everyone to come to Blackpool and take part in the 3rd International Aerospace FOD Prevention Conference to see the latest FOD prevention techniques, equipment, and technological advancements used in the industry to prevent FOD, promote awareness, and combat a common enemy. Experience two days of facilitated panel discussions, keynote presentations and exhibits. Share proven methods and best practices of preventing FOD throughout the aviation/aerospace industry. FOD can come in many different forms, and produce disastrous effects if not identified and corrected.

Registration Fee = $350.00 per person   Exhibit Registration Fee = $750.00 (Per Booth)   **Rates increase after 1 Apr 2007**

European contact: Steve Frost +44 (1772) 854108 FAX +44 (1772) 855230, E-mail: steve.frost@baesystems.com

USA contact: Richard Bell +1 (310) 331-6536 FAX (310) 332-1436 E-mail: rb.bell@ngc.com

Hotel Reservations

It is your responsibility to make your own hotel reservations. Please quote NAFPI FOD Prevention Conference for special rate

Hilton Hotel
North Promenade, Blackpool,
Lancashire FY1 2JQ
Tel : 01253 623434
Fax : 01253 294371

Room Cost - £80.00 per night

BAE SYSTEMS

Disagreements About Deicing, Post-deicing Inspection Contribute to Serious Incident

Citing inadequate procedures for contracting airport ground services, the Italian Air Safety Board said that the flight crew of a Fokker 70 did not recognize that the wings were cold-soaked, suspect formation of clear ice or inspect the upper-wing surface before takeoff.

FSF Editorial Staff

Ingestion of clear ice - which had not been removed from upper-wing surfaces during deicing by an airline contractor - led to failure of the right engine and high fan vibration in the left engine during takeoff of a Fokker F-28 Mk 70 (Fokker 70), prompting the flight crew to conduct an emergency landing at the departure airport.

No injuries or fatalities occurred to the four crew members or 30 passengers during the serious incident involving KLM Cityhopper Flight 1636 at Caselle Airport, Turin, Italy, on Feb, 16 2002, at 0650 local time said the final report of the Agenzia Nazionale per la Sicurezza del Volo (Italian Air Safety Board, ANSV). Aircraft damage comprised pits/scratches on fuselage skin, windows and the right wing; bent leading-edge tips on five fan blades in the left engine; and damage to the right engine, including fractured fan blades, damaged leading-edge tips of fan blades, a cracked accessory gearbox, a cracked hydraulic-pump housing and various detached/ loosened components of the engine, cowling and cowling doors.

The aircraft, typically used to conduct several scheduled flights per day between Turin and Amsterdam, Netherlands, had been parked for about 9.5 hours after its last flight of the day preceding the incident flight. The quantity of fuel remaining from the previous day was adequate for flight to Amsterdam and the aircraft was not refueled in Turin.

"Based upon the amount of fuel in the wing tanks, en route temperatures during flight, the weather conditions upon arrival at Turin and during the night, the captain's observations during the preflight inspection the following day, the Rolls-Royce technical report, and the description of the pieces of ice collected from the runway, it is concluded that a thick layer of (clear) ice formed on both wings of the aircraft while it was on the ground in Turin." the report said.

During preflight inspection with a flashlight in darkness and rain, the captain from ground level saw ridges of ice under the leading edges of the wings, slushy water and ice in small areas on top of the wing, and slush on the trailing edge of the left wing.

"During the preflight inspection, the captain decided that the aircraft needed to be deiced," the report said. "He did not specifically ask [Societa Azionaria Gestione Aeroporto di Torino (SAGAT) Handling] for an anti-ice treatment, as he did not consider that icing conditions existed at that time. No fan-ice check was performed."

The deicing truck operator completed spraying the aircraft with 413 liters (109 gallons) of Kilfrost ABC 3, Type 11, 50-percent deicing fluid by 0610. The fluid temperature was 65 degrees Celsius (C. 149 degrees Fahrenheit [F], and the report said that investigators could not determine whether the fluid-temperature combination was appropriate for cold-soaked wings in the overnight light rain, snow, wind and air temperatures from 2 degrees to 0 degrees C. (36 degrees to 32 degrees F).

"According to the deicing [-truck] operator, he deiced the upper side of the wings as normally required, and on request of the captain he deiced the underside of the wings and the horizontal stabilizer." the report said. "The captain did not specify any specific type or mixture of deicing fluid to be used. The deicing truck operator stated that he requested the pilot 'to control the result' of the deicing, to which, he also stated, the pilot answered. 'OK good'... On the basis of his recent deicing experience, the captain decided that he should go outside the aircraft to check the wings. It was not normal procedure for … crew to perform a post-deicing inspection when an inspecting company[1] is mentioned in company publications…... He did a visual check of the undersurface of both wings and noticed that the ridges of ice beneath the wings had now disappeared. He did not touch either of the wings."

Among several pieces of engine debris from the incident aircraft, pieces of clear ice were found on the right side of the runway centerline at the location of the aircraft rotation.

"The pieces of ice were described as appearing like glass, clear and compact and of different areas but with similar thickness of about 1.0 centimeter [0.4 inch]," the report said. "The largest pieces found were approximately 10 centimeters [four inches) by 10 centimeters, of irregular shape and also 1.0 centimeter thick."

During the three months preceding the month of the incident, the airline's flight crews had applied the procedure for "economical tanking" (i.e. fueling at Amsterdam without refueling at Turin for the return night) for 16 day-return flights and for 66 night-stop flights. This procedure was used for the incident flight.

The report cited the following procedure from the aircraft operations manual. "When the [outside air temperature] during ground stop at the next station is expected to be 10 degrees C or less, no economical tanking should be performed."

Clear ice below a snow/slush layer is difficult to detect, and the undetected ice layer may separate from the wing during the takeoff roll or rotation, possibly causing substantial loss of lift and/or severe engine damage. Although the pilot-in-command has the final responsibility for ensuring removal of frost/ice/snow/slush from wing leading edges and upper surfaces before takeoff, how this was to be accomplished became a focus of the investigation, the report said.

"At stations where no ground engineer [maintenance technician] is available, the deicing/anti-icing handling agent is responsible for the correct and complete deicing/anti-icing treatment of the aircraft." the report said. "At stations where a ground engineer is available, the ground engineer is responsible for the release of the aircraft free of frost, ice, snow or slush. [The ground engineer] is also responsible for the correct and complete deicing /anti-icing treatment of the aircraft.

"After completion of the deicing treatment, the aircraft should be thoroughly checked. These checks should be carried out by the deicing/anti-icing handling agent. In some cases, the presence of (clear) ice on the upper-wing surface can only be determined by touch. To release the aircraft for the flight, the ground engineer or captain has to be assured that this check has been properly carried out."

According to the airline's regional operations manual, SAGAT Handling would conduct deicing/anti-icing operations and Alitalia would conduct post-deicing inspections, the report said.

"[The airline's aircraft operations manual] said, 'As the Fokker 70 wing is critical for ice buildup, a tactile check is required in certain circumstances,'" the report said "'These checks may be performed by the flight crew but normally are performed by a licensed ground engineer, not necessarily Fokker 70/100-licensed ... The tactile check must be done by touching the indicated area by bare (or surgical-glove-protected) fingers to check for ice/frost/snow/slush contamination. For this check, a platform with a minimum height of 1.0 meter [3.3 feet) is needed to reach the area.'"

In contrast with the airline's written procedures for flight crews (in English), the SAGAT Handling written procedures for deicing truck operators (in Italian) said that airline ground personnel, the aircraft captain or an authorized post-deicing inspection company was responsible for the final check that ice/frost/snow/slush contamination had been removed and for releasing the aircraft for departure.

"The ground-handling contract between SAGAT Handling and [KLM Cityhopper], with regard to the deicing/anti-icing procedures did not conform to the standard IATA [International Air Transport Association] handling-agreement specifications." the report said.

During the investigation, the airline and the two companies listed in airline manuals provided the following contradictory information, the report said:

- "KLM Cityhopper stated that there was a verbal agreement with Alitalia regarding the post-deicing inspection. KLM Cityhopper claimed [that] the agreement was that SAGAT Handling would inform Alitalia when deicing would take place and that Alitalia would send a ground engineer to inspect the aircraft after deicing was completed;
- "SAGAT Handling stated that there were neither verbal nor written instructions from KLM Cityhopper about this agreement; [and,]
- "[The Alitalia representative said that] Alitalia was not the handling company performing inspection after [deicing]/ anti-icing and that there wasn't any related contract with KLM Cityhopper, neither at the time of the audit (January 2001) [at Turin for a group of European airlines][2]: nor at the time of the serious incident (February 2002) in 2001 and 2002. Alitalia personnel ... in Turin did not have any certification on the Fokker 70: [and] Alitalia personnel were not trained to perform deicing inspection on the Fokker 70."

Communication about rectifying the deicing-audit findings occurred during 2001 between the KLM Cityhopper and SAGAT Handling. Nevertheless, Alitalia was listed as the inspecting company in airline manuals when the incident occurred.

Analysis of organizational contributing factors indicated that the aircraft captain and the deicing-truck operator had different expectations.

"According to the deicing operator, his request to 'control the result' directed to the captain, would have in essence related to the post-deicing inspection" the report said. "The reply from the captain — 'OK good' — may have been interpreted as confirmation of this. The captain, on the other hand, could not recall any ... conversation with the operator other than the request to spray the underside of the wings and the tail. The fact that the captain could not recall any part of this conversation with the deicing [-truck] operator could indicate that the captain did not comprehend the meaning of the request to 'control the result.' There is no certainty about the actual or intended meaning of the conversation between the captain and the deicing operator: however, it can be concluded that there was a misunderstanding between them regarding the final inspection of the aircraft.

"The captain stated that, according to the regional operations manual, Alitalia ground staff would perform the post-deicing inspection. The captain, however, did not call for any Alitalia operator before deicing nor did he request any verbal or written report from Alitalia ground staff after the treatment confirming the airworthiness of the aircraft. There were no procedures or instructions from the [airline] company to this effect and as such, the captain could have assumed that Alitalia would have been summoned by SAGAT [Handling]."

To deice an aircraft, however, the deicing-truck operator needs to be aware that clear ice is present and to use the required type and concentration of deicing fluid, fluid temperature and spraying technique which includes varying cross-sectional area of spray and distance of the nozzle from the surface of the wing, the report said.

Analysis of organizational contributing factors within the airline showed that inappropriate division of responsibility for managing the deicing of all aircraft ineffective quality assurance and inadequate communication of deicing concerns to the accountable manager (i.e. the airline representative designated for the organizational structure required by Joint Aviation Requirements-Operations [JAR-OPS 1]were involved.

In spite of the... JAR-OPS 1 requirements, the responsibilities as described in the KLM Cityhopper basic operations manual prior to the serious incident showed that deicing-operation responsibilities were shared between the manager [of] ground operations [and] the manager [of] flight operations " the report said.

The airline's quality-assurance manager had alerted the manager of ground operations and the manager of flight operations about previous fluid-type discrepancies and the discrepancy about Alitalia performing post-deicing inspections at Turin and he received a reply that these would be corrected.

"Although the quality-assurance manager noticed several times that [his alerts] did not have the [result] he expected, he took no further action, as he anticipated that the next audit would be sufficient to correct the situation." the report said. "The accountable manager on the other hand, was aware of deicing problems but [said] that these were so vast in number that it was difficult to decide which one had more importance."

Among the report's findings relevant to contracting for deicing and conducting post-deicing inspections were the following:

- The [airline] operating company's instructions, procedures and equipment were insufficient for ensuring the discovery and removal of clear ice:
- According to company deicing [tables] and holdover tables, a minimum of' Type 11 75-percent fluid was required to be sprayed as a second-step anti-icing treatment for the conditions of rain on cold-soaked wings:
- The deicing operation carried out before the flight did not remove the (clear) ice from the upper surface of the wings:
- There was misunderstanding between the captain and the deicing operator regarding the final inspection of the aircraft:
- There was no (1.0-meter-high) platform readily available at Turin and there were no surgical gloves available either at the handling agent or [aboard] the aircraft:
- The (clear) ice on the upper surface of the wings was not discovered after the deicing treatment was performed:
- Information concerning recognition, detection and removal of clear ice in the company ... publications was considered insufficient and confusing for ensuring the discovery and removal of clear ice:
- KLM Cityhopper did not have a contract for an inspecting company in Turin:
- [The] quality system regarding the deicing process was ineffective. The feedback system did not ensure that necessary corrective actions were both identified and carried out in a timely manner: [and,]
- The crew was not aware that there was no deicing/anti-icing inspecting company available in Turin for KLM Cityhopper:

The following recommendations about contracting for deicing and conducting post-deicing inspections were directed to the airline:

- "Clearly define postholder [3] responsibilities with respect to icing operations and assign an order of priority to these responsibilities:
- "Review and modify all ground-handling contracts to conform to industry-recognized agreement specifications:
- Review the company's instructions, procedures, training and information reported in the relevant publications (basic operations manual, regional operations manual [and] aircraft operations manual) related to detection and removal of clear ice: [and,]

- Specify and inform all crew of their responsibilities regarding the execution of the duties that are performed by ground-handling companies:

General recommendations included the following:

- "European [aviation authorities and] international aviation authorities [should] establish international safety standards and procedures for ground-handling companies: [and],
- [Ground-] handling companies [in Italy should] publish the operating [deicing]/anti-icing manual (normally published in Italian) also in English:

[This article, except where specifically noted, is based on the Italian Agenzia Nationale per la Sicurezza del Volo Final Report no. I/2/04, Serious Incident Occurred to Fokker 70. Registration Marks PH-KZH,, Torino Caselle Airport. 16th of February 2002. The 144-page report contains photographs, charts, tables and diagrams.'

Notes

[1]. The report said, "Although the …… aircraft was one-stop deiced/ anti-iced with Type II/50-percent fluid, it was not the intention of the captain to anti-ice the aircraft. For the purposes of this report therefore, the deicing/anti-icing of the aircraft will only be referred to as deicing."

[2]. In 1998. the Deicing/Anti-icing Quality Control Pool (DAQCP) was formed; by early 2004, the pool had 37 European airline members. On Jan. 22, 2001, KLM Cityhopper 'on behalf of DAQCP ... conducted a deicing audit on SAGAT [Handling] and Alitalia service for maintenance in Turin the report said.

[3]. To comply with the organizational requirements of European Joint Aviation Requirements Operations 1, nominated postholders are functional positions held by individuals - such as "manager flight operations (postholder)' - who report to the accountable manager within an airline (the title assigned to the corresponding individual within the airline may vary).

Reprinted with acknowledgement to Flight Safety Foundation *Airport Operations* Vol.31 No.1 by FSF Editorial Staff

Towards Safer Checklists

Jo Davies - FORCE, Cranfield, UK

How many times could an accident or incident have been avoided by improving the design of Abnormal and Emergency Checklists also known as Quick Reference Handbooks (QRH)? How many Pilots have had problems finding the right checklist? How many times has smoke on the flight deck created serious difficulties in reading the checklist?

A recent study carried out by FORCE (Flight Operation Research Centre of Excellence), Cranfield University, UK (Wood 2004) highlighted the fact that 1% of the time an Emergency and Abnormal Checklist is used on a civil flight deck a problem with the checklist is encountered. The study analysed the Mandatory Occurrence Reports (MOR) held by the CAA using the criteria of "Emergency Checklists incorrectly used or omitted". It was noted that almost 30% of reports were concerned with a lack of suitable procedure for the situation experienced while 26% reflected an incorrect procedure and 26% ambiguous procedures. Of the remainder approximately 13% of reports were assigned to Company Procedures and only 5% were attributed to crewmembers failing to follow established procedures or drills.

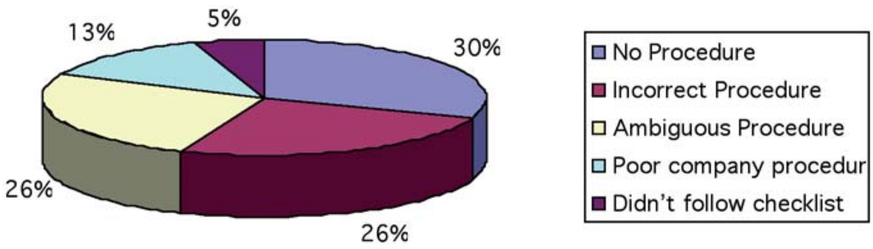
Problems encountered with checklists include:

- Selecting the wrong checklist
- Completing the wrong checklist
- Difficulty in understanding a checklist
- Difficulty in following a checklist
- Getting lost in a checklist
- Failing to complete a step after an interruption

Operators are often unwilling to make changes to Manufacturer's checklists due to legal implications associated with deviating away from accepted Manufacturer's procedures. Therefore the situation can and does exist whereby the airlines are using checklists that are inconsistent with their operating procedures.

As a result of the FORCE study, a Checklist Amendment Working group was set up at the Civil Aviation Authority Safety Regulation Group (CAA SRG) HQ at Gatwick. It comprised a multi-disciplinary group of Flight Inspectors, Test Pilots and Human Factors Specialists from CAA and FORCE.

The overall goal of the working group was to investigate Manufacturers' and Operators' checklist design and amendment processes and explore the extent to which Human Factors issues were taken account of. It was evident that the existing Guidelines on the Design and Presentation of Emergency and Abnormal Checklists (CAP 676) were not being used. It was also considered that these guidelines required further improvement in order to capture the important design attributes that could increase the operability and utility of the checklist and reduce the number of errors.



The new guidance material focuses both on the design attributes of a checklist and guidance for all stakeholders on processes that reflect best Human Factors practices in the design and amendment of checklists.

The primary goal of CAP 676 is to ensure that Flight Crew, when faced with a system failure or fault condition are able to retrieve the appropriate drill quickly and accurately and carry out all necessary actions to contain and manage the condition into a safe configuration commensurate with best operational practice.

In order to assist the stakeholders in evaluating their checklist against good design principles a Checklist Assessment Tool (CHAT) has been developed. The tool provides usability rationale to support the design attributes that are contained in the CAP and is a stand-alone tool.

CHAT is divided into three main areas:

- Physical Characteristics
- Content
- Layout

Within each section there are a set of Y/N questions and it takes about 45 minutes to complete. When assessing a checklist it will become immediately evident where potential error prone situations may exist.

Physical characteristics cover all aspects, which ensure that the drills appropriate to the fault condition can be retrieved and executed in a timely and error free manner.

- Size is important as it must be easy to stow and its use must not interfere or obscure any of the controls or displays.
- The binding should enable the pages

to be folded back and it must allow pages to be inserted easily whilst ensuring that they are secure enough and that they do not fall out.

- The cover must be distinguishable from other documents on the flight deck to minimise the likelihood of retrieving the wrong document. It should be larger than the other pages to ensure that it is easy to find the front cover in the event that it has been folded back on itself.
- It is also recommended that the checklist be laminated to protect from possible spillages if it is kept within the vicinity of drink cup holders.
- Tabs make it easy to locate the appropriate drill and will display the section number therefore they must be large enough for a thumb to be placed on them. The index and the tabs must be physically aligned and logically linked.
- The drill should be legible at 600mm and the size and type of font will both contribute to legibility.
- Research has shown that it is more difficult to read text in uppercase therefore this should be avoided for large blocks of text.
- It is difficult to be totally prescriptive for size of text as it may be more important to contain a drill to a single page but it is not recommended to use a font size less than 10pt.
- A larger font size is recommended for smoke-related procedures where legibility will be very poor.
- Where emphasis and differentiation is required use of bold type, larger font, underlining or boxing can be applied but should be used sparingly to maximise the effect.
- A contents list must be included at the front of the document in order to navigate to the correct section of the checklist. An index of fault captions will also provide a quick route to the correct drill.

The **content attributes** will generally support the cognitive (orientation and decision) processes. Brevity, accuracy, clarity and consistency are important design drivers.

- The checklist should start with a clear title and ideally a description of the failure condition and drill objective to provide confirmation that the correct drill has been selected.
- Fault legends should be replicated to also support confirmation.
- Memory items are actions that are carried out immediately following the diagnosis of the fault and the Pilots are trained to memorise and action them without reference to the checklist. However under stressful conditions recall can be poor and error-prone, therefore they should be limited to only those actions necessary to stabilise the situation.
- The number of memory actions should be ideally less than six and should not contain any embedded actions with additional decision paths.
- The memory items will always be at the start of the drill and should be discriminated from other action items.
- Cautionary notes will contain system implications and must occur before any action notes and be discriminated from other explanatory notes.
- The action items should take the form of 'do' lists with the action followed by response or status. These can be numbered as an aid to place keeping and discriminating action items.
- Complicated decision paths should be avoided where possible but where they do occur, structured layout of the conditional statements and resultant actions can reduce the likelihood of getting lost, completing the wrong action or not completing the action at all.
- It can be helpful to provide a review of system status in terms of performance limitations and constraints resulting from the completion of the checklist items.
- Items, which are carried out at a later phase of flight, should be grouped together at the end of the checklist.

The **layout design attributes** largely support the execution of the tasks.

- The drill must have a clearly defined start and finish and if they occupy more than one page then they should be separated into logical sections and be supported by a continuation indication.
- Cross-referencing should be minimised where possible, duplicating steps that need to be repeated if necessary. Instructions need to be clear and unambiguous so if cross-referencing is used the bounds of the instruction need to be clearly stated. E.g. carry out steps 3 to 5.
- If figure, tables or graphs are used they should be clearly linked to the drills with which they are associated.
- Tables or graphs reproduced from Aircraft Flight Manuals must be legible and useable.
- Whilst brevity is a design driver and drills should minimise the amount of words required it is necessary to ensure that they remain.

understandable and that time is not wasted trying to read and understand them.

- Where the Checklist refers to particular controls, the entry must be the same as that used to identify it on the aircraft panel.

- Where the checklist is used for different variants the type-specific actions must be clearly labelled.

- Certain critical drills must be immediately accessible and it is suggested that they are located on the back cover. These include emergency evacuation drills and rejected take-off and overrun drills.

An example of a CHAT page is shown below:

It is envisaged that Manufacturers may find it beneficial to follow the design process outlined in CAP 676 Issue 2 and use CHAT to check that the design attributes have been satisfied. In order to ensure that the Checklists are fit for purpose and useable the Operators may assess them against CHAT to identify potential problem areas and request changes from the Manufacturers.

Alternatively they may wish to tailor the drills to their own operating procedures in which case CHAT may be used to check that they conform to good practice. Pilots and trainers may use CHAT when they are concerned about error prone situations to determine whether the checklist itself is deficient in any way. In a similar manner Regulators may use CHAT as part of the acceptance process or during an investigation.

CAP 676 together with the CHAT tool is available on the CAA website www.caa.co.uk/CAP676 and all stakeholders involved in Flight Safety are encouraged to check the QRHs that are in use on their aircraft and move towards safer checklists.

Note:
FORCE (Flight Operations Research Centre of Excellence) at Cranfield University was commissioned by the CAA in 2004 to provide independent research on key flight safety issues in aviation and is jointly funded by the CAA and EPSRC. The area of work on Abnormal and Emergency Checklists was one of a series of safety related topics that FORCE has investigated. Other, current areas include metrics for manual flying skills, automation and training issues. If there are any flight safety concerns that FORCE may be able to assist on - please contact our Director, Captain Simon Wood, on simon.wood@Cranfield.ac.uk.

Ch. 7	Title	Attribute	Y	N	Comment (when N is checked)
Physical Characteristics					
1.1	Document size	Is the size of the document appropriate to the stowage space available?			The checklist must be able to be stowed in an accessible location and easily retrieved in an emergency.
		Can the document be used without interfering with the controls or obscuring the displays?			This check needs to be carried out on the flight deck. The document should be reduced in size if there is any interference or obscuration.
1.2	Binding	Can the document be opened through 360°?			Access to required page(s) needs to be accomplished without requiring the crew to hold the pages open. Thus ideally the checklist will be able to fold back on itself. Recommend change if this cannot be achieved.
		Can amendment pages be easily inserted?			Ring binders are recommended.
		Is binding robust? – can it fall apart?			If the binding is loose, pages could be lost. Recommend change binding.
1.3	Cover	Is the cover robust to protect pages within?			
		Is the colour significantly different to minimise incorrect checklist selection?			The Emergency and Abnormal operation should be easy to distinguish. Recommend change colour of cover.
		Is the cover easily distinguishable from the pages within?			If the checklist is folded back on a particular page when stowed it may not be easy to locate. Recommend change the colour or size.
		Does the title of the checklist and aircraft type appear on the front cover?			In a multi fleet operation this could result in the wrong checklist being used. Recommend change cover.
		Is the checklist stowed in the proximity of drink containers?			Drink stains could render the checklist unusable. Recommend protecting checklist in some manner (e.g. using laminated pages).

Full members

Chairman
Willis Ltd
Ian Crowe

Vice-Chairman
BMED
Robin Berry

Treasurer
Air Contractors
Capt. Anthony Barrett-Jolley

Non Executive Director
RAeS
Peter Richards

Aegean Airlines
Capt. Dimitris Giannoulatos

Aer Arann
Capt. Paddy Callahan

Aer Lingus
Tom Curran

AIG Aviation
Jonathan Woodrow

Airclaims
Paul Clark

Air Contractors
Capt. Anthony Barrett-Jolley

Air Mauritius
Capt. Francois Marion

Air Seychelles
Ben L'Esperance

ALAE
Dave Morrison

Astraeus Ltd
John Denman

BA Connect
Capt. Ed Pooley

BAE SYSTEMS Reg. A/C
Alistair Scott

BALPA
Carolyn Evans

Belfast Intl. Airport
Alan Whiteside

BMED
Robin Berry

bmi regional
Peter Cork

British Airways
Steve Hull

British International
Capt. Terry Green

CAA
Dave Lewis - MRPS
Sarah Doherty - Safety Data Dept.
Ed Bewley - Flight Operations

CargoLux Airlines
Mattias Pak

Cathay Pacific Airways
Rick Howell

CHC Scotia
Mike Whitcombe

CityJet
Capt. Tom Murphy

Cranfield Safety & Accident Investigation Centre
Graham Braithwaite

CTC Service Aviation (LAD)

DARA
Richard Allen

DHL Air
Peter Naz

Eastern Airways UK Ltd
Capt. Jacqueline Mills

easyJet
Capt. Lance Jordan

European Air Transport NV/SA
Vincent Lambotte

European Aviation Air Charter
Ron Hendrick

EVA Airways

Excel Airways
Graeme Stagg

First Choice Airways
Patrick Cafferky

FlightLine
Darryl Haynes

Flyglobespan
Capt. Steve Brown

Flyjet Ltd
Jonathan Dalgliesh

GAPAN
Capt. Alex Fisher

GATCO
Richard Dawson

GB Airways
Capt. Rob Alabaster

Goodrich Actuation Systems Ltd
Gary Clinton

Gulf Air Co
Capt. Manin Al Said

Heathrow Airport Ltd
Tim Hardy

Hong Kong Dragon Airlines Ltd
Kwok Chan

Independent Pilots Association
Peter Jackson

Irish Aviation Authority
Harry McCrink

Jet2.com
Rob Trayhurn

Libyan Airways
Engr. Tarek Derbassi

Loganair
Capt. Stephen Gates

London City Airport
Gary Hodgetts

Lufthansa Consulting GmbH
Capt. Simon Searle

Malaysia Airlines
Capt. Ahmed Zuraidi

Manchester Airport plc
Simon Butterworth

Monarch Airlines
Capt. Tony Wride

MyTravel
Chris King

NATS
Richard Schofield

Penauille Servisair
Mike Cooper

NetJets
Capt. Catherine Thompson

PrivatAir
Jan Peeters

Qatar Airways
Norman Tregaskis

Rolls-Royce Plc
Phillip O'Dell

Ryanair
Capt. George Davis

SBAC
Martyn Graham - Secretariat
Vic Lockwood - FR Aviation

ScotAirways
Julian Harrison

Shell Aircraft
Grant Campbell

Singapore Airlines
Capt. Patrick Lee

Smiths Aerospace
Nigel Moody

SR Technics Ireland Ltd
Frank Buggie

Superstructure Group
Eddie Rogan

TAG Aviation (UK) Ltd
Tony Bisson

TAM Brazilian Airlines
Capt. Marco Castro

Thomas Cook Airlines
Capt. Roger Chandler

Thomsonfly Ltd
Jez Last

Virgin Atlantic Airways
Gavin Staines

Willis Ltd
Ian Crowe

Group members

bmi
David Barry

bmi Eng.
Willam Taylor

bmi baby
Jeremy Purry

Bond Offshore Helicopters
Tony Duff

Bond Offshore Helicopters (Maint)
John Crowther

Bristow Helicopters
Capt. Derek Whatling

Bristow Helicopters Eng.
Andy Evans

Eurocypria
Capt. Constantinos Pitsillides

Cyprus Airways
Andreas Mateou

flybe.
Neil Woollacott

flybe. Aviation Services
Chris Clark

MOD
DASC Capt. Michael Evans
DASC Eng. Wg Cdr Ian Woodhouse

QinetiQ
Flt. Lt. Jackie Doncaster

QinetiQ Eng.
Maj. Mark Chivers

RAeS
Peter Richards

RAeS Eng.
Jim Rainbow

Co-opted Advisers

AAIB
Capt. Margaret Dean

CHIRP
Peter Tait

GASCo
John Thorpe

Legal Advisor
Edward Spencer
Barlow Lyde & Gilbert

Royal Met. Society
Dr John Stewart

Getting the Message

by David Harvey LTCC

Introduction

"Communication usually fails, except by accident"[1]. At first glance this would appear to be merely a humorously pessimistic observation of the way in which humans tend to interact. Look a little closer, however, and you begin to realise how vulnerable we are to misunderstanding, ambiguity and confusion in the course of everyday conversation. Such peculiarities of communication can cause daily problems in casual conversation, and the outcomes are variously amusing, embarrassing or sometimes costly.

Applying these inherent difficulties to radio communication in an aviation context only aggravates and reinforces the problem. The use of RTF eliminates the visual cues and body language nuances that accompany face to face communication. Without these elements, the recipient loses up to 50% of the overall message that is being conveyed and is therefore prone to error.

The likelihood of successful communication is dependent on several factors, such as the clarity of the transmitted message, the level of attention of the recipient, the level of comprehension of the recipient, the level of acceptance of the message, and the effectiveness of the feedback from the recipient to the originator. Established protocols and standard phraseology are designed to protect against communication errors, allowing the four step process of transmit, receive, read-back and receive to take place in a robust manner. Nevertheless, it is clear that Communication Error continues to represent a major causal, aggravating or situational factor in many incidents.

A Citiation 550 misheard a descent clearance to 6000ft and read back 3000ft. This incorrect read back was not detected by ATC. The Citation then descended into conflict with a departing 737. The subsequent loss of separation was resolved by TCAS.

[1] Osmo A. Wiio, 1978

Defining the Problem

On 11th November 1996, the world's worst mid-air collision occurred some 80km southwest of New Delhi, India, resulting in 349 deaths. One of the key causal factors that contributed to this accident was the misinterpretation of a traffic advisory as a clearance to descend. This is perhaps one of the most costly examples of "Communication Error" in the exchange of information between pilots and controllers, a safety critical transaction that is dependent on standardisation and best practice from all parties.

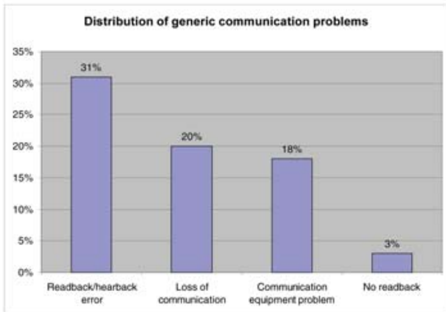
So what exactly do we mean by Communication Error in the ATC environment? Put simply, it is a generic term that encompasses a number of different issues, including callsign confusion, read-back errors, hear-back errors and RTF standards. Communication provides the context in which aviation professionals' work and good RTF discipline plays a significant role in minimising the risk of errors.

RTF sampling invariably reveals mistakes either in phraseology or understanding on the part of controller or pilot. Such errors can result in level busts, runway incursions and a significant increase in overall system risk. There are a number of possible scenarios:

- Pilot reads back wrongly and the controller does not recognise and correct the error.
- Pilot reads back correctly, however this is followed by an incorrect action on the flight deck.
- Pilot reads back correctly, however the controller records the information incorrectly resulting in a subsequent error.

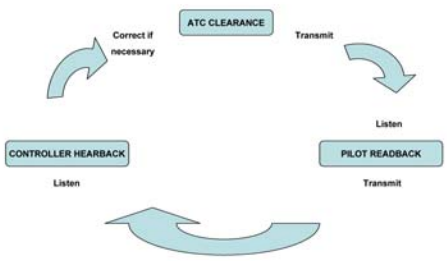
A recent Eurocontrol study shows us that the most frequent communication problems are:

Many of these problems can most easily be mitigated by maintaining rigorous RTF standards and maximising the benefits of the readback / hearback loop that governs the way in which pilots and controllers communicate. The diagram below



Callsign 141 and Callsign 672 were in close proximity routeing to the same airport. Callsign 141 checked in on frequency, ATC mistakenly instructed the pilot to "maintain FL340", which was read back. Callsign 672 then checked in at FL340 and was also told to "maintain".
Callsign 141 then proceeded to descend to FL340, where it came into conflict with Callsign 672.

illustrates how this exchange of information takes place. The ATC clearance is transmitted by the controller; the pilot listens and then transmits the read-back to the controller. The controller then listens to or "hears-back" the transmission and makes any corrections if necessary.

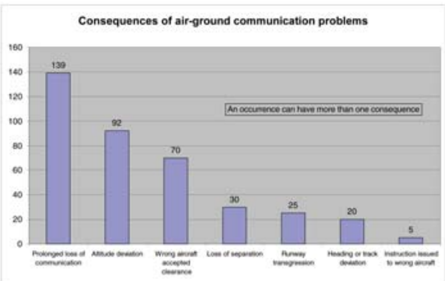


The Scale of the Problem

NATS have reported nearly 700 events in 2005 that involved communication errors:

- 105 of these events resulted in a level bust
- 40 of these events resulted in a runway incursion
- 73 involved a loss of separation (i.e. 10%)

Furthermore, communication error was found to be the key causal factor in 25% of level busts, whilst 40% of all runway incursions were similarly attributed. Interestingly, Eurocontrol data tends to support these findings:



Recent data from NATS has indicated that the most frequently occurring causal factors of communication error are:

- Pilot readback by incorrect aircraft
- Similar confusable callsigns
- Pilot failed to or slow to respond to RTF
- Ambiguous (interpretable) transmission
- Incorrect pilot readback by correct aircraft
- Mis-hear (controller)

Moreover, this data shows us that readback errors account for approximately 20% of all communication error events.

Tackling the Problem

Good RTF discipline is a significant factor in minimising errors in communication. We need to ensure that an industry-wide campaign is initiated to raise standards, increase awareness and address known problem areas. In the air and on the ground, all RTF users must display a determination to use standard phraseology and take extra care with intonation and message content. The following table provides a few hints and tips that, if were all to follow, would go along way towards improving the current situation.

Top Communication tips for Controllers

Delivery

- If it gets busy do not speed up delivery (it does not help)
- Keep it standard
- If it's urgent - make it sound urgent (intonation)

Content

- Avoid multiple instructions; ideally don't include more than 2 instructions per transmission
- Avoid giving headings and levels in the same transmission - if possible
- Keep frequency changes separate from other instructions
- If you issue a heading ending in '0' add the word degrees (Except SRAs)

Caution

- Listen carefully to readbacks
- Use the full callsign for Commercial Air Transport
- Callsign confusion - someone else might take the call

If in doubt, check!

Top Communication tips for Pilots

Standard Calls

- On departure pass - callsign, SID, passing level and first step altitude or SID altitude if no step exists
- On frequency change pass callsign & cleared level
- Keep it standard and listen out

Discipline

- Use callsign and listen carefully for your callsign
- If in doubt ask
- If you don't hear anything for two or three minutes - check in there may be a problem
- Read back ATC instructions in full

Non Standard Calls

- Avoid unnecessary calls such as requests for high speed or direct routeings

If in doubt, check!

Conclusion

As our skies become ever more congested, a high standard of clear and unambiguous RTF is vital.

Communication error can play a significant role in many different types of incident, including runway incursions and level busts. We have to work together as a community to eradicate these errors and engage in a process of continual improvement in order to mitigate the effects of those that occur in future.

Hydroplaning (Aquaplaning)

By Cpt George Fourfis - Sources FAA, Mc Donnell Douglas, NASA

Landing on a wet or icy runway, from the pilot's point of view, represents an operationally challenging situation. When there is considerable water or ice on the runway, an increase in landing distances of 40 to 100 percent can be experienced for similar conditions of gross weight, density altitude, wind, etc. There are many complex factors involved when landing on a wet runway that could affect the pilot's ability to properly control and bring the airplane to a stop. The pilot should understand the following:

1. Aerodynamic, propulsive, inertial, and external forces acting on the aircraft
2. Coefficient of friction and friction forces
3. Reverse thrust effects
4. Hydroplaning phenomena
5. Anti-skid system operation

In this article, we will only deal with item number four: hydroplaning phenomena. As a review, during normal landings we (1) retard the throttles to idle, (2) deploy the speed brakes, (3) apply reverse thrust, and (4) apply wheel brakes as we slow the aircraft to exit the runway. On wet runways, we want to get on the brakes as soon as possible so the anti-skid system can function and provide maximum braking.

What are the three different types of hydroplaning?

There are three forms of hydroplaning: dynamic, viscous, and rubber reversion.

Dynamic Hydroplaning

Dynamic hydroplaning occurs when standing water on a wet runway is not displaced from under the tires fast enough to allow the tire to make pavement contact over its total footprint area. What happens is that the tire rides on a wedge of water under part of the tire surface. And it can be partial or total hydroplaning, meaning the tire is no longer in contact with the runway surface area. It is possible that as the tire breaks contact with the runway that the center of pressure in the tire footprint area could move forward. At this point, total spin-down could occur and the wheel stops rotating, which results in total loss of braking action. The speed at which this happens is called minimum total hydroplaning speed.

At what speed will your current aircraft main and nose wheels begin hydroplaning?

The formula that is used to compute hydroplaning speed is: Minimum total hydroplaning speed (knots) equals 9 times the square root of tire inflation pressure (psi) or: $V = 9\sqrt{P}$

For a typical transport category jet main wheels, the speed would be: $9\sqrt{144} = 108$ knots

Figure 1 and Figure 2 show partial and total hydroplaning.

Viscous Hydroplaning

Viscous hydroplaning can cause complete loss of braking action at a lower speed if the wet runway is contaminated with a film of oil, dust, grease, rubber or the runway is smooth. The contamination combines with the water and creates a more viscous mixture... more slippery. It should be noted that viscous hydroplaning can occur with a water depth less than dynamic hydroplaning, and skidding can occur at lower speeds, like taxiing to the gate during light rain, applying the brakes and rolling over an oil spill.

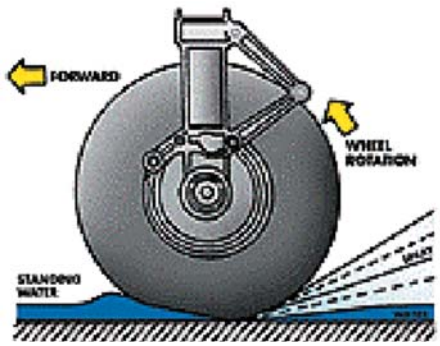


Figure 1: Partial Hydroplaning

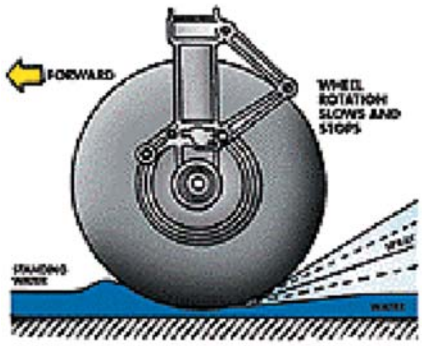


Figure 2: Total Hydroplaning

Rubber Reversion Hydroplaning

Rubber reversion hydroplaning is less known and is caused by the friction-generated heat that produces superheated steam at high pressure in the tire footprint area. The high temperature causes the rubber to revert to its uncured state and form a seal around the tire area that traps the high-pressure steam. It is theorized that this condition would occur on damp runways or when touchdown occurs on an isolated damp spot of a dry runway, which results in no spin-up of the tires and a reverted rubber skid. Now that we have some understanding of hydroplaning, we can summarize some of the piloting techniques that could be employed to minimize the potential of hydroplaning

McDonnell Douglas provided the following information to answer the question:

1. Do not be afraid to delay landing. Under zero wind conditions, most runways have adequate crossfall (rounding of the runway surfaces or crown) to provide drainage under quite high rates of precipitation. It appears that drainage can be seriously affected in crosswinds above 10 knots;

however, a 15- to 20-minute waiting period after a downpour is usually sufficient to drain the water.

- Be knowledgeable of the many variables associated with landing under wet runway conditions:
- Landing weather forecast
- Aircraft weight and approach speed
- Hydroplaning speed
- Conditions of tires — if the tread depth of the tires on an aircraft is greater than the depth of the water on the runway, then hydroplaning will not occur. Knowledge of the general condition of the tires (why we do pre-flights) should be helpful in a qualitative sense when potential hydroplaning conditions are expected.
- Brake characteristics
- Wind effects on the aircraft while landing on a wet runway
- Runway length and slope
- Glide path angle... and finally remember, do not overlook or underestimate the effects of a crosswind because of its low magnitude.

2. Do not exceed 1.3 Vs plus wind additives at the runway threshold.
3. Establish and maintain a stabilized approach.
4. Use maximum flaps to provide minimum approach speeds.
5. Be prepared to go around from the threshold.
6. Do not perform a long flare.
7. Do not allow the aircraft to drift during the flare.
8. Touch down firmly and do not allow the aircraft to bounce.
9. If a crosswind exists, apply lateral wheel control into the wind.
10. Keep the aircraft centerline aligned with the runway centerline.
11. Anti-skid braking should be applied steadily to full pedal deflection when automatic ground spoilers deploy and main wheel spin-up occurs. Do not modulate brake pressure. The anti-skid system will not operate until the main wheels of the aircraft spin... don't lock your brakes before touchdown.
12. Be prepared to deploy ground spoilers manually if automatic deployment does not occur. Spoiler deployment greatly assists wheel spin-up during wet runway operations by materially reducing the wing lift and increasing the weight on the wheels, thus shortening your stopping distance.
13. Apply maximum reverse thrust as soon as possible after main gear touchdown; this is when it is most effective.
14. Get the nose of the aircraft down quickly. Do not attempt to hold the nose off for aerodynamic braking.
15. Apply forward column pressure as soon as the nosewheel is on the runway to increase weight on the nosewheel for improved steering effectiveness. Do not, however, apply excessive forward column pressure because the down elevator will, to some extent, unload the main wheels and decrease braking effectiveness.
16. If the aircraft is in a skid, align the aircraft centerline with the runway centerline if you can. Get off the brakes to maximize cornering capability and bring the aircraft back to runway center. If you are in a crab and cannot align aircraft centerline with runway centerline and attempted cornering is not effective, get out of reverse thrust to eliminate reverse thrust component side forces tending to push the aircraft off the side of the runway.

A good rule of thumb in normal operations is to do most of your reversing above 100 knots and braking below 100 knots.

Data Analysis as a Route to Improved Flight Safety Performance

by John Coppins

Background

Aviation safety professionals have long embraced the principals behind, the Heinrich pyramid. H.W.Heinrich postulated in 1931 that, for every accident, there are 29 incidents and 300 unreported unsafe acts. Whilst the actual figures have never been confirmed (even by Heinrich), the underlying premise has not been challenged as it is, essentially, common sense.

Heinrich's paradigm led to a focus by safety professionals on controlling 'unsafe acts' in a bid to reduce the number of accidents. More recently however, the simplicity of the Heinrich model has been challenged as a definitive aid for reducing accidents in light of research that suggests the pyramid varies dependent upon the nature of the organisation (for example, organisations with a culture of blaming employees for unsafe acts are likely to have less incidents but comparatively more accidents) and that some accidents that cause serious injury *"are unique and singularly occurring events in which a series of breakdowns occur in a cascading effect"* (cf Fred Manuele).

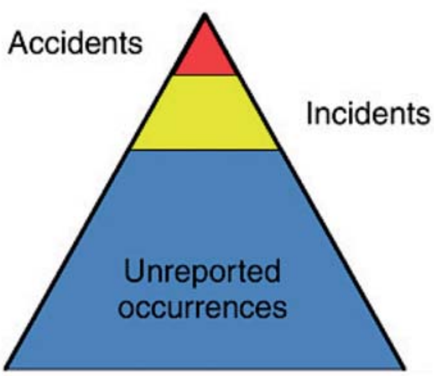


Fig 1 - Heinrich

This new understanding of what contributes to an accident is consistent with Professor James Reason's "Swiss cheese" analogy whereby each slice of the "cheese" represents a defence against an incident or accident. Accidents occur when the holes of the cheese align.

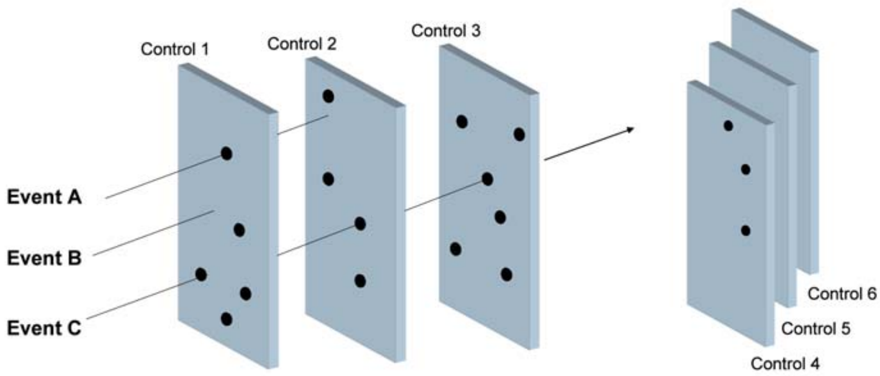


Fig 2 – Professor Reason's "Swiss Cheese" model

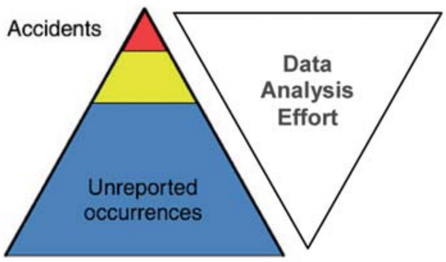
Whilst the two models are not inconsistent, this 'Swiss Cheese' model perhaps provides a better illustration that the key to understanding the root cause of an accident or incident lies in an appreciation of *hundreds* of potential factors – which requires a complete understanding of a range of information from multiple sources.

Information is the Key

There are many factors involved in an incident or accident – some are obvious and direct influences, such as the weather, pilot/crew training and maintenance. Others may be considerably less obvious and indirect, such as human resource information. But whatever the factors and whatever the safety model you subscribe to, information is absolutely key to understanding the nature of the incident, identifying when such incidents may occur again and, perhaps most importantly, moving to a more proactive process for managing the flight safety performance of the operation.

Information is used today to understand what happened when an accident and, to a lesser extent, a safety incident has occurred. Indeed, in the event of an accident, considerable time, effort and money is spent in trying to identify the root cause. Significantly less time and effort, of course, is applied to the understanding of an incident and the effort invested in analysing the information collected from normal flight operations from a safety context is minimal-certainly less than that for incidents and accidents.

If we revisit the Heinrich model, we can see that the effort involved in analysing the various safety occurrences is actually the inverse of the Heinrich pyramid, with the bulk of the analysis taking place at the time of an accident, some effort when there is a safety incident but relatively little on all those small aspects of operational activity that may or may not ultimately result in a safety concern.



And yet it is surely just as valid to attempt to move to a proactive approach to safety as it is to ensure that lessons are learnt from an incident or accident.

Proactive Safety

Too often companies will collect information on incidents that have occurred, make some form of manual classification as to the nature of the incident and generate a report of the top 10 classifications, generally referring to this process as "analysis". To move towards a proactive approach to safety it is necessary to use **all** the information resources that are available to you, to analyse them effectively and to have available some form of discovery technology to identify potential hazards **before** they become incidents -more on this later.

There are a number of issues to be overcome to enable a proper understanding of safety issues and move towards a proactive safety model:

- Information is in diverse places within the organisation, sometimes difficult to access, and it is often the case that the relevance of the information from a safety point of view is not clearly understood (the "unreported occurrences" in Heinrich's model).
- Most safety "analysis" is carried out on the back of past experience. Whilst experience is essential in understanding safety issues, it nevertheless limits the scope of the analysis and even creates a "bias" within that analysis. To properly analyse safety information requires the ability to find those issues which have not previously been encountered. This, by definition, requires some form of assistance.
- A lot of the information available is in the form of free format text – for example, incident reports have large textual, descriptive elements of the incident. Also engineering comments about component failure and pilot logs are largely textual in nature. Hence, to properly understand potential safety issues it is necessary to be able to analyse textual information.

Information Gathering
The information relevant to providing a safety framework is contained within many different sources, such as incident reporting and maintenance, and, as such, some investment is necessary to pull this information together.

It is now generally accepted within the field of information management that a data warehouse should form the basis of an organisation's information needs, the core principal being one of "one view of the truth" – i.e. one location where the clean, consistent information required to completely satisfy the safety needs is available. The repository for this "one view of the truth" should be view as a strategic asset of an organisation and must be seen as part of an overall information strategy.

Discovery
Traditional analysis of safety information relies on the experience of the analyst and, as such, introduces a bias into the process. In order to counteract this tendency, it is necessary to introduce external assistance in the form of Discovery technology that is specifically geared to finding unknown relationships and trends within corporate information.

Most traditional software tools and techniques tend to present the insights already known or that have already become obvious through graphical display of the information (typically the "big spike" in a bar chart). However, frequently when an issue becomes obvious it may well already be a serious problem. Discovery provides a medium for early warning of **developing** issues hidden within the mass of data.

Free Format Text (Unstructured data)
As a large proportion of the information available to us is in the form of free form text, to ignore it would be to ignore vital insights into potential safety issues. In fact, free format text can actually be a leading indicator of safety issues and, hence, can provide the earliest warning of those issues.

Free format text is, unfortunately, quite difficult to process and gain insight from. In terms of the discovery process, the best technique is to group together similar documents based on the concepts / words they contain and then to use this grouping alongside other (structured) information. In this way, developing trends and anomalies can be identified in exactly the same way as with any other attribute available.

Conclusions

With safety standards already very high, many flight safety issues are already known and, as a result, safety improvement has arguably reached a plateau. To move safety forward there is a need to look for the obscure and unknown issues in order to move performance on to the next level.

By integrating data sources within a data warehouse environment and exposing the information to discovery technology to augment the experience based approach of current data analysis regimes, new and unknown issues and relationships can be uncovered -with the promise of identifying developing issues **before** they become a significant problem.

Whilst the aim in the short term is to identify new issues and adjust or reinforce best practice, in the longer term by exploiting the data resources available to an organisation there will be a real improvement in accident prevention.

By Line

John Coppins has 20 years experience of management information technologies in a variety of industry sectors. He is now a Director of Tenue Ltd., a company specialising in early warning and business intelligence strategies.

Email: j.coppins@tenue.co.uk
Web: www.tenue.co.uk

When is an Operator not an Operator - Corporate Jets, Private or Public Transport?

by Guy Facey – KSB Law LLP

There is currently a European level debate on whether the European authorities are likely to be creating a private category for fractional ownership, similar to FAR Part 91, in the near future. Some commentators have openly suggested that fractional jet ownership company, NetJets, is currently operating on the boundaries of the law, and there are also suggestions that reform would serve to increase NetJets market dominance in Europe, as well as negatively affecting charter operators.

The CAA's view is simple – if a passenger is paying to be carried in the aeroplane then it is public transport. Many variations are possible depending on questions such as; who the owner of the aircraft is, who exactly is being carried and what is being paid for. Many brokers would suggest that there are simple devices which can be used to avoid the effect of the current rules, but many of these are fraught with difficulty. From the aviation lawyer's perspective, reform would be welcome since it would at least provide some clarification. The policy view is that unless the operator operates to public transport standards, the public are not protected.

This may seem like a strange title for an article on corporate jet leasing, but the thorny issue of whether you are a public transport operation often boils down to the question when is an operator not an operator – corporate jets, private or public transport?

Our starting point is a private jet owned by a private company whose founder is a wealthy individual, with an employed pilot. Obviously, you would say, this is not a public transport operation.

All the more obvious, you would say if you know that in the US (where we all assume that corporate jets are more common), privately owned corporate jets are dry leased all the time and their operation is recognised as private under (inter alia) Section 91 of the Federal Aviation Regulations. US lawyers will advise that you can do a dry lease of an aircraft and provided the lessee is the operator, this will not be regarded as public transport. In the UK, our dear old CAA does not regard the situation with anything like the same equanimity. The public policy rule which they are seeking to uphold is that if anybody pays to be carried as a passenger, that is public transport and the operator needs an Air Operator's Certificate (AOC) with all the attendant cost and bureaucracy which that involves. Applying for an AOC probably costs about £20,000 but the key thing is having the organisational structure such as an operations manager, chief pilot and probably an administrative person. Other members of the team will have to be "on the books" although not necessarily employed by the company, for example a line training captain qualified on type who does the initial training and subsequent checks. In addition, the organisation will have to have an operations manual which could take someone six months to write from scratch or one month to copy and adapt if you can find another organisation happy to let you have a copy of their manual. Then (apart from writing the manual) the company will need agreements dealing with maintenance, leasing the aircraft, insurance for public liability, etc. etc. Bear in mind this is regarded as a public transport operation after all ...

The policy view is that unless the operator operates to public transport standards, the public are not protected. In a world where things are reengineered all the time, why not reengineer the rules to make them suitable for corporate jet operators, engineering a solution which imports some of the public transport protections but recognises that the corporate jet owner (or fractional owner) is not the same as the paying passenger on commercial transport? This will, of course, generate debate: some would say the corporate jet owner is worse! He has more money to start a law suit. By the same token, he has the monetary and corporate clout to pay for advisers and to recognise that perhaps his company is the operator of the aircraft and has to pay for the infrastructure to act like the operator – but not with all the weight of regulation which an AOC holder currently has. But at least let's have the debate.

Getting back to our corporate jet example, and whether there is any payment under the law as it stands, it gets worse. "Paid" is widely defined under our Air Navigation Order (ANO) like this: under Article 130, if "valuable consideration is given or promised for the carriage of passengers" then you are into public transport. (Picture the scene – millionaire's wife and estate suing after the accident for lack of AOC etc… You can hear the prosecution barrister now… "your honour, Article 130 does not say that the payment had to be made by [millionaire passenger], but by anybody, and moreover even if [unlucky defendant operator] has not actually received any money, it appears that certain promises were made which amount to valuable consideration…"!) Dangerous stuff.

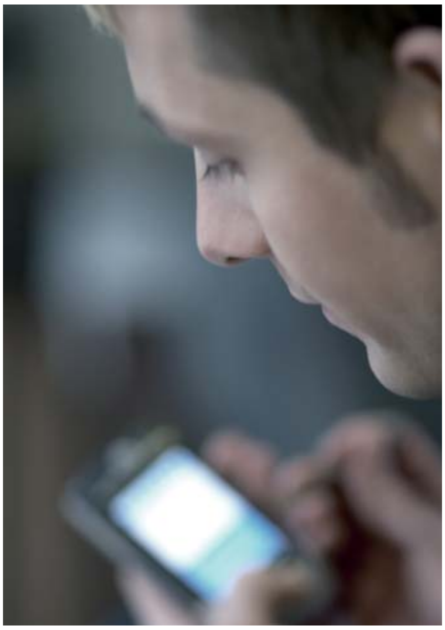
Aviation lawyers in the UK, who advise on corporate jets, have the unenviable task of quizzing their clients about exactly which company is operating the aircraft, which company is leasing it, which company is employing the pilot and so on. Did the lessee under the dry lease operate the aircraft or was it somehow the offshore company which is the registered owner of the aircraft? Who hired the pilot? Who paid what and what was it for exactly? Even if there wasn't a payment was something else promised in return for being carried on the plane? What you want to avoid is the unfortunate case where the hapless pilot is regarded as the operator carrying passengers and he should have had (but didn't) an Air Operator's Certificate with everything that entails. There was a case many years ago where a pilot was prosecuted for exactly this. The facts of that case do not really help us with the modern corporate jet problem because it was the case of a club pilot accepting payment for flying a couple in a club aircraft, a much more blatant breach of the ANO.

We know that EASA is looking at this area. In the author's humble opinion the growth in the corporate jet market means that the regulators ought to look at the rules, not only through the spectacles of the protector of the innocent public but also with a view to promoting aviation (remembering that, from an English perspective, under the first Section of the Civil Aviation Act 1982 one of the functions of the Secretary of State has been to encourage both measures for the development of civil aviation and the promotion of safety, and the CAA is supposed to implement those functions) (Ha! I hear the GA community say…). Apparently some regulators think that the only fractional ownership you can have is for a group of pilots. If the only way of allowing private owners of corporate jets to have access to this market is an AOC, this will force them into the hands of NetJets. This will only reinforce NetJets's market dominance. It is true that the air charter operators say that there is no need for such a reform, along the lines of FAR Sec 91, because this will just make things even easier for the likes of Net Jets. The truth is however that the market is already going in the direction of corporate jets. Why not make lower the barriers for entry for competitors to NetJets? This might actually promote civil aviation and GA, a sector which needs some assistance.

Guy Facey, consultant and head of the corporate department at KSB Law LLP, recognises that it is perhaps timely to draw attention to the requirements for operating under an Air Operator's Certificate rather than privately, and looks at the surrounding arguments of fractional ownership within the aviation industry, the issues of private and public operation and highlights the potential effects of a future reform.

Developments in the Use of mobile Phones on board Aircraft

by Richard Gimblett / Hilary Pullum, Barlow Lyde & Gilbert



The use of mobile telephones on aircraft is currently prohibited. However, new technology has made it possible for these prohibitions to be lifted. This article examines the regulatory challenges posed by the use of mobile telephones on aircraft.

The use of mobile telephones onboard aircraft in flight is currently prohibited by aircraft operators and national civil aviation authorities. These prohibitions are the result of concerns about the risk of interference with aircraft avionic and ground mobile networks.

However, a number of products are now under development which will allow GSM mobile telephones to operate on board aircraft without causing harmful interference either to aircraft systems or (a separate requirement of telecommunications regulators) to terrestrial mobile networks. This technology works by requiring passengers' mobiles to communicate at very low power levels with an onboard base station (signals to and from the ground then being transmitted via a satellite link), while at the same time a network control unit prevents any mobile (whether GSM or otherwise) from being able to detect and communicate with ground networks. One such product, designed for installation on any commercial aircraft, has been developed by OnAir, a joint venture between SITA and Airbus.

In particular, in order to be able to operate, the new systems will not only have to comply with relevant airworthiness certification requirements, but will also require an international legal consensus to be reached on the appropriate licensing regime – an issue which cuts across both telecommunications law and international aviation law. OnAir has been heavily involved in the work of national telecommunications regulators to develop (particularly at a European level) a "horizontal" regulatory approach that would enable such systems to be operated with a minimal administrative burden. This approach requires the system (including use of any necessary spectrum) to be authorised (whether by means of a licence or exemption) by the state of registration of the aircraft. The alternative would be to require authorisation of the system by every state into or over which the aircraft might fly. This would not only be administratively burdensome but, in the event that neighbouring countries were unable to authorise access to consistent spectrum bands, could lead to problems with service continuity or even "blackholes" in coverage.

Quite apart from the practical benefits, introduction of a system of "horizontal" regulation for onboard GSM systems has the advantage that it works with the grain of longstanding international aviation law. The starting point here is the Chicago Convention of 1944 ("Chicago"), which is the basis of international aviation law. Art. 1 of Chicago confirms that every state has sovereignty over the airspace above its territory. That remains the underlying legal principle. However that is subject to all the succeeding provisions of the Convention in which the contracting states have agreed to fetter that absolute sovereignty in the interests of international aviation. Indeed, without such agreements, the civil aviation industry could not exist as it does today. Among such provisions is Article 30 (a) of Chicago, which provides as follows.

"Aircraft Radio Equipment

(a) Aircraft of each contracting State may, in or over the territory of other contracting States, carry radio transmitting apparatus only if a licence to install and operate such apparatus has been issued by the appropriate authorities <u>*of the State in which the aircraft is registered*</u>*. The use of radio transmitting apparatus in the territory of the contracting State whose territory is flown over shall be in accordance with the regulations prescribed by that State…"* [emphasis added]

It is to be noted that Article 30 refers to any radio transmitting apparatus installed on an aircraft and does not differentiate between any different usages to which such radio equipment in question may be put. Thus it applies as much to onboard base stations of the type utilised by mobile telephony onboard service providers as it does to the traditional radio equipment utilised by the flight crew. Thus Article 30 points strongly in the direction of a system of horizontal regulation being applied to the former (just as it already is to the latter). This conclusion is bolstered by the terms of Article 33 of Chicago, which provides that *"licences….issued by the contracting State in which the aircraft is registered shall be recognised as valid by the other contracting States…"*. The effect of this is to bar states overflown from imposing a system of secondary licensing on foreign registered aircraft operating into its territory.

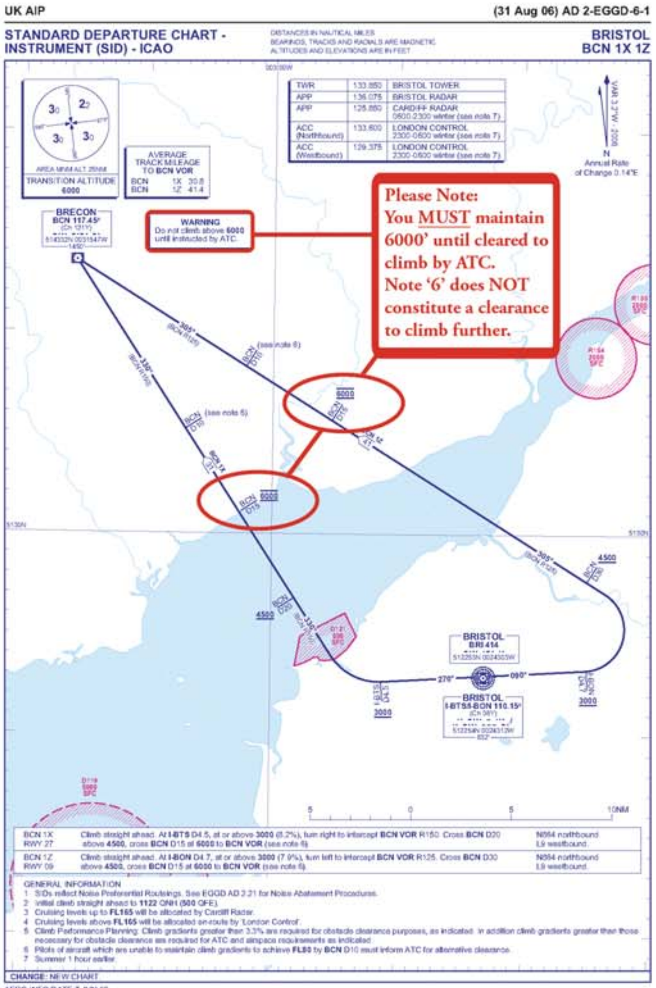
The rights of a country overflown to protect its own territorial networks from interference are preserved by Article 30, which expressly states that the use of radio transmitting apparatus within the territory of that state must be in accordance with any regulations prescribed by that State. This enables States overflown to impose operating or technical regulations designed to ensure that radio apparatus carried by aircraft do not create harmful interference. In the UK we already have such regulation in the form of the Wireless Telegraphy (Visiting Ships and Aircraft) Regulations. It does not however authorise the imposition of any system of secondary licensing or frequency authorisation.

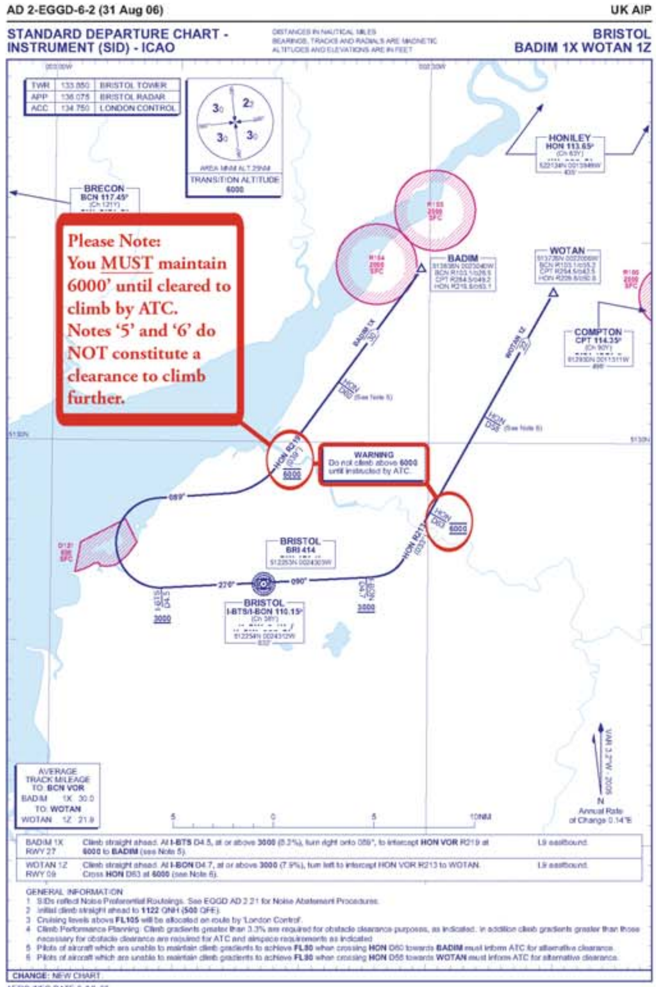
The approach adopted by the Chicago Convention is complemented in the field of international telecommunications law by parallel provisions within Article 18 of the International Telecommunications Union Radio Regulations. Article 18 of the Radio Regulations provides that radio transmitting stations are to be licensed by "*the country to which the station in question is subject*" and makes it clear that, in the case of a radio transmitting station onboard an aircraft, this is the state of registry of the aircraft. International aviation and telecommunications law are therefore wholly consistent with each other in this regard. The "horizontal" regulation framework proposed by OnAir and others for the regulation of onboard GSM systems is therefore one contemplated (and indeed mandated) by the Chicago Convention and ITU Radio Regulations.

Within Europe at least, this argument and approach appears to have gained widespread acceptance. The European Conference of Postal and Telecommunications Administrations (CEPT) has published a draft Decision which would establish such a framework. It is anticipated that within the next few months this Decision will be formally adopted and should then be implemented at a national level across Europe. The day of being able to phone home or office from one's aircraft seat are therefore becoming markedly closer.

Bristol departures via BCN, BADIM and WOTAN

There have been a number of level busts on departure from Bristol since August 31st due to a misinterpretation of some SID charts.





Ensure that you understand the vertical and lateral profile.

Civil Aviation Authority

NATS