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FEATURES

ICAO UPDATE

COVER

Later this year Australia plans to commission a network of ADS-B ground stations, implementing a continent-wide ATC surveillance system for the first time. By the end of 2005, a large percentage of the Australian jet fleet is expected to be fully equipped for the upgraded service (see article, page 5).

Photo of Qantas Airways A330 courtesy of Airbus

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Continent-wide ATC surveillance system soon to become reality in Australia

In recent years Australia has been preparing to implement a network of ADS-B ground stations that will lead to improved air traffic management throughout its continental airspace. By the end of 2005, a large percentage of the Australian jet fleet is expected to be fully equipped for the upgraded service.

GREG DUNSTONE
AIRSERVICES AUSTRALIA

Airservices Australia has been active in the field of automatic dependent surveillance-broadcast (ADS-B) for some years because the technology offers the possibility of continent-wide air traffic control (ATC) surveillance for the first time. That dream is about to become reality this year when Airservices Australia commissions a network of ADS-B ground stations in late 2005.

Bundaberg Operational Trial. In 2002 Airservices Australia installed a single ADS-B ground station at Bundaberg, Queensland, equipped a number of aircraft with ADS-B avionics, and modified Australia's operational air traffic management (ATM) system to process and display ADS-B tracks. The technology used is Mode S extended squitter on 1090 megahertz (MHz), which is recommended by ICAO as the initial worldwide interoperable ADS-B link.

The Australian ATC system and the ATC training simulator were enhanced to support ADS-B and operational procedures were developed to use the technology at active ATC positions. Training of controllers was completed in 2004, and a safety case for operational ATC use of the Bundaberg system was completed and approved.

Initial operations were limited to ATC situational awareness and then to the provision of air traffic information. The Bundaberg area is served by radar above 12,000 feet, and the major focus of ADS-B at this site was to improve lower level surveillance coverage to allow earlier issuance of clearances as aircraft climbed into controlled airspace. Bundaberg proved to be a good site to conduct initial comparative tests since radar and ADS-B were both available at higher flight levels.

Approval to provide five nautical mile (NM) separation services based on ADS-B surveillance data was granted by the Civil Aviation Safety Authority (CASA) of Australia in December 2004.

Many lessons were learned during the deployment and, like all new technologies, some teething problems were experienced. However, the system performance exceeded expectations since detection coverage, position accuracy, velocity vector accuracy and update rate were found to be better than Australia's fast rotation monopulse secondary surveillance radars (MSSRs).

Support for the new technology from airline operators and air traffic controllers has been strong. The industry views ADS-B as a key safety and efficiency initiative, and clearly sees the potential benefits of extensive deployment across the continent. Airlines gave significant support to the operational trial, in part by allowing the installation of additional avionics in their aircraft and by conducting the required pilot training.

Upper Airspace Project (UAP). Encouraged by the results of the Bundaberg operational trial, a plan was formulated to deploy ADS-B across the continent in all areas not covered by radar. Currently, procedural ATC is used to separate aircraft in these areas using voice position reports received on very high frequency (VHF) air-ground frequencies. The objective was to increase safety through provision of automated safety alerts, and to increase operational flexibility and efficiency through use of 5 NM separation standards, primarily to aircraft operating above flight

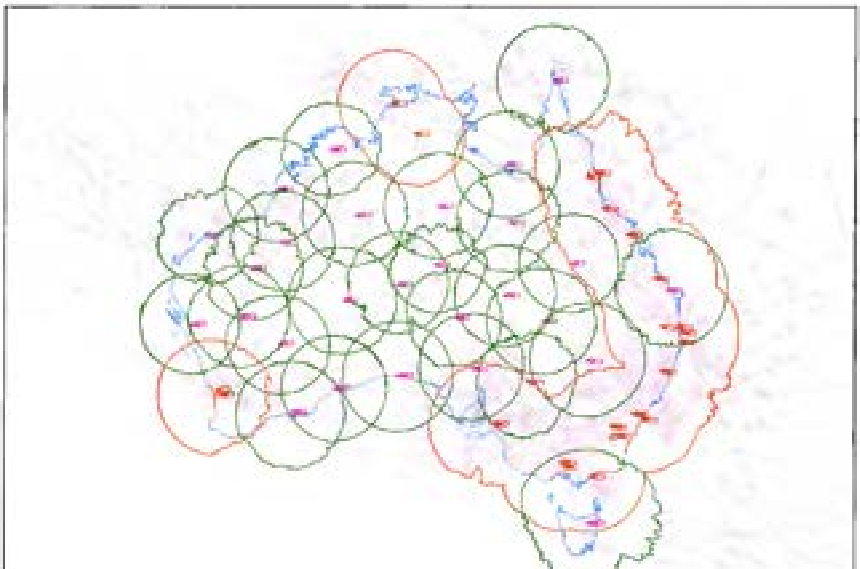
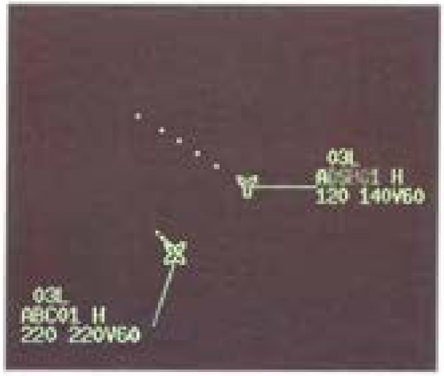


Figure 1. The Upper Airspace Project implemented by Australia combines radar (orange) and ADS-B (green) coverage to provide ATC surveillance across the continent.

level (FL) 300. The initiative, approved in 2003, is known as the ADS-B Upper Airspace Project (UAP). A diagram of the planned resulting radar and ADS-B coverage is shown in *Figure 1*.

The UAP does not require mandatory equipage by airlines but rather the delivery of benefits to those that choose to do



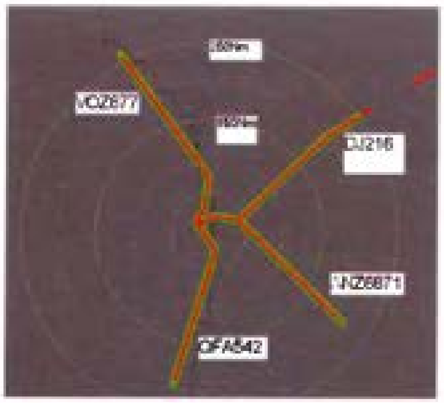


Figure 2 (above). Different ADS-B track symbols are used to convey the level of accuracy and reliability of data. Figure 3 (top right) compares red ADS-B tracks and green radar tracks for four flights. In Figure 4 (right) the ADS-B antenna can be seen mounted on one side of the Brisbane Airport radar tower.

so. Airlines that do equip will be afforded operational priority, and capable aircraft will not be required to provide voice position reports. Pilots of such aircraft can also expect to receive their preferred flight level requests more often.

Most importantly, ADS-B equipped aircraft will be provided with an additional safety net because of the ability to detect mismatches between controller expectation and reality. Both route conformance monitoring and cleared level adherence monitoring will be provided using ADS-B reports received every second. Today, in procedural airspace, reliance is placed on voice reports and, for some aircraft with FANS-1/A equipment, on ADS contract (ADS-C). Automated surveillance and detection using ADS-B will remove the reliance on voice reports and is expected to add significantly to en-route safety.

It is necessary that controllers be able to operate in a mixed equipage environment. While ADS-B separation will be applied in cases where both aircraft are equipped for this service, procedural ATC will be used otherwise. This is achievable in Australian airspace because of the capabilities of the Australian advanced air traffic system (TAAATS). Based on the Eurocat-X ATC system, TAAATS displays different position symbols for flight plan tracks, radar tracks, ADS-C and unique ADS-B position symbols. The display is based on a priority system: if the aircraft is detected by radar, the radar symbol is always displayed; where there is no radar detection, ADS-B symbols may be shown. Finally, when no surveillance data are available, a flight plan track is shown. If a radar track is also detected by ADS-B, a special indicator is depicted in the label.

In fact, two possible ADS-B symbols will be displayed under the UAP. These are illustrated in *Figure 2*. A Class 1 ADS-B symbol will be displayed when the data are received through ADS-B ground stations with a position accuracy and integrity adequate for the provision of a 5 NM separation standard. The track symbol shown at the left in Figure 2 is an example of a Class 1 track; this is the existing ADS-B track symbol being used in the Bundaberg ADS-B trial in Eastern Queensland.

The second track symbol will also be used any time data is received only from an ADS-B ground station, but in this case the data may have a theoretically lower reliability, for example, an ADS-B position report without the necessary integrity and accuracy to support the provision of the 5 NM separation standard. Such a report could result from an examination of the ADS-B downlinked integrity data or could apply to particular ground stations that were not designed to the same reliability standard. However, the positional data could be suitable for the application of another standard, provision of traffic information, situational awareness and automated safety alerting functions.

Policies, standards and procedures for the use of ADS-B surveillance using these track symbols in Australian airspace are currently under development. In the meantime, all contracts necessary for the purchase and deployment of the nation-wide programme have been placed, including one with Thales ATM of France, for 28 duplicated ADS-B ground stations.

Contracts have been awarded for further enhancements to the ATC system, such as the ability to support 1,000 ADS-B reports per second, and graphical ATC displays of global positioning system (GPS) receiver autonomous integrity monitoring (RAIM) capability.

A separate back-up system has also been developed to deliver ADS-B tracks to controllers' displays in the event that the central TAAATS processing nodes fail, similar to a radar direct access or bypass channel. The processing is simple and uses the downlinked flight identity that is included in ADS-B messages. The bypass system has been built "in house" by a separate software team than that involved with the contractor's system, and has been subjected to the same system engineering and testing processes as the primary ATC system.

An ADS-B ground station software test bed has been established and will be used to manage the software configuration and testing of future software upgrades.

Factory testing of the ground stations has commenced and prototype stations established at Melbourne and Bundaberg. One such ground station was temporarily installed on the Brisbane Terminal area radar tower to provide a direct comparison of ADS-B and radar performance at a single location. This experiment showed that ADS-B detection capability and accuracy are equal to or better than radar. It has also demonstrated that ADS-B can coexist with existing primary and secondary surveillance radars.

Figure 3 illustrates MSSR tracks in green and ADS-B tracks in red. As shown in *Figure 4*, the ADS-B antenna mounted on the Brisbane radar tower is situated below the SSR antenna, accounting for the slightly lower range in most cases. Still, in some cases high integrity ADS-B messages from commercial in-service airliners were received from distances of more than 340 NM from the sensor.

These trials and initial deployments also showed a remarkably high "take-up rate" of the technology in commercial airliners. A significant percentage of Airbus A320 and A330s operating in Australia are equipped as well as numerous Boeing B737-800 and long-haul B777 aircraft. New aircraft from Boeing and Airbus typically include ADS-B capabilities. It is expected that by the end of 2005 a large percentage of high flying jets based in Australia will be fully equipped.

Many international aircraft have already been observed transmitting Mode S ADS-B messages in accordance with ICAO Annex 10* including Singapore Airlines, British Airways, Vietnam Airlines, Asiana, EVA Air, Cargolux and others (*Figure 5*). This is occurring largely because of the synergy created by the European requirements for elementary and enhanced surveillance and the fact that Boeing and Airbus have made this capability available on new aircraft. Typically, the major avionics manufacturers have included ADS-B functionality in the same transponder software upgrade as the enhanced surveillance upgrade. The same cannot be said for the manufacturers of regional aircraft, which have not yet included ADS-B avionics in new aircraft deliveries, although this is expected to change during the next year or two.

The installation strategy for UAP is to proceed simultaneously with a project to replace all existing VHF radios in Australia. As installation teams visit remote sites to replace old radios with new ones, they will also install the ADS-B receivers and antennas, and will connect these to the digital communications infrastructure. The ADS-B radio is DC-powered and consumes less than 100 watts. Some sites that are very remote and are powered by solar cells communicate with ATC centres via satellite. Remote monitoring and control is critical to successful deployment and considerable focus has been placed on this aspect during specification and testing. It will be possible, for example, to perform remote delivery of software upgrades.

The ease of installation has been demonstrated a number of times as Australia has deployed ground stations. At a recent ICAO ADS-B Task Force meeting in Singapore, three separate ADS-B ground station vendors set up live ADS-B demonstrations within a few hours of their ADS-B ground stations and antennas being released from customs.

A separate contract was awarded to the Volpe National Transportation Systems Center, part of the U.S. Department of Transportation, to develop enhancements to Australia's existing GPS RAIM prediction system. As Australia allows non-precision approaches to be flown using GPS receivers, the current system makes and electronically distributes predictions regarding the expected periods when non-precision approaches may not be available using Technical Standard Order (TSO) 129 GPS navigators. This system makes predictions for numerous airports in the region based on the satellite almanac and GPS notices to airmen (NOTAMs) on the assumption that the aircraft is using a TSO 129 navigator. The situation with ADS-B is different, since the predictions are required for geographical areas instead of defined airports with GPS approaches.

The RAIM system enhancements will initially deliver predictions for 1 degree latitude by 1 degree longitude blocks of airspace. The objective is to warn controllers of possible ADS-B outages that may arise from GPS satellite faults, maintenance or geometry. This is achieved by displaying a colour outline overlay on controllers' screens for areas that may be subject to an outage in the next tens of minutes (*Figure 6*).

Figure 5. Screen capture of a situation display featuring B747s operated by British Airways and Singapore Airlines using an ADS-B receiver located at Melbourne Airport.

The UAP project is expected to start coming online in late 2005. Installation, training updates, certification and related activities are scheduled to occur in 2005.

Lower Airspace Project (LAP). The next envisaged step in Australia is to extend ADS-B benefits to those operating below FL300, and to strengthen the benefit package above that level. A project called the ADS-B Lower Airspace Project (LAP) is being developed for consideration by the

Australian aviation industry. LAP is being discussed extensively, and agreement has been reached on the scope of the project, which is now being subjected to a cross-industry business case that includes consideration of the overall costs and benefits to the industry and identifies which industry segments are net winners.

The project development phase has identified a synergistic benefit related to general aviation (GA) aircraft. Specifically, if a GA aircraft is fitted with ADS-B, it is almost essential to also equip that aircraft with a high-quality GPS system; for LAP, this has prompted inclusion of a plan to decommission some navaids as a result of the availability of high-performance GPS receivers installed as part of the ADS-B deployment.

The proposed scope of the LAP includes four elements, as described below.

The first element is the replacement of ageing en-route SSR-only radars in Australia with ADS-B ground stations. Existing terminal area radars will be replaced with new Mode S and short-range primary radars. For this to occur, and for the same level of service to be provided, it will be necessary for all aircraft using the controlled airspace currently served by en-route SSRs to be equipped with 1090 MHz extended squitter ADS-B capable avionics.

Second, there is a need to outfit a large portion of the Australian aircraft fleet with "ADS-B out" avionics. The Australian regulator has published two TSOs (C10005 and C10004) that outline a minimum avionics package for the low-end general aviation fleet. To ensure operators install the upgrade, the Australian industry is considering mandatory ADS-B equipage in certain airspace such as that served by existing en-route radars. A mandate will also significantly improve the benefits of ADS-B to those operating above FL300. Without such a mandate, ADS-B will only be advantageous in cases where two equipped aircraft are being separated, whereas with a mandate imposed equipped aircraft will derive the benefit when in proximity to any other aircraft.

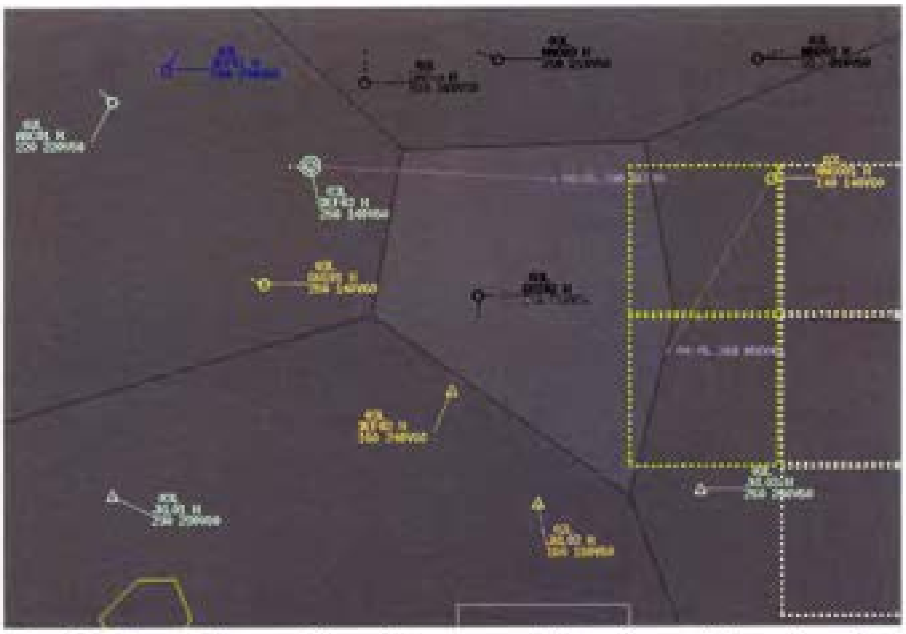


Figure 6. Colour outline overlay is used to warn controllers of areas that may be subject to GPS outage in a matter of minutes.

Industry is also considering how mandatory equipage can best be funded, particularly for GA operators. Since airspace users effectively fund the deployment of navaids and radars in Australia, the financial advantage of not replacing these facilities can offset the cost of general aviation equipage allowing a transition to an ADS-B environment.

CASA, the Australian regulator, has published a discussion paper which considers these issues in general. These documents are available on the CASA website (http://rrp.casa.gov.au/dp/dp0410as.pdf).

A third element is the possible deployment of additional ADS-B ground stations to provide increased surveillance in regional Australia and at flight levels not served by the UAP. At this stage, a further 16 ADS-B ground stations could be included in the initial phase.

Finally, the project plans to decommission and not replace a significant number of VHF omnidirectional radio range (VOR) stations and non-directional beacons (NDBs) while maintaining a back-up network of navaids. In their place, TSO 145/6 GPS navigators would be approved for "only means" navigation. This is included in LAP because navigator avionics and ADS-B avionics share common elements and hence could be purchased and installed in the same subsidized avionics package.

To support LAP, Airservices Australia is working with GA avionics manufacturers to develop low-cost avionics. It is envisaged that an "ADS-B out" avionics unit will necessarily output a current aircraft position that visual flight rules (VFR) pilots will be able to view on simple cockpit displays such as a pocket PC or personal digital assistant (PDA). Such displays may include terrain maps. Airservices Australia has also purchased a 1090 extended squitter low-cost receiver allowing general aviation to display proximate traffic on multi-function or PDA displays. This unit is expected to be demonstrated in an aircraft in the first quarter of 2005.

The future. Once the fleet is transmitting ADS-B information, Australia expects to derive further downstream benefits in

continued on page 28

* Annex 10 to the *Convention on International Civil Aviation*, also known as the Chicago Convention, contains standards and recommended practices for aeronautical telecommunications. In all, 18 annexes to the Chicago Convention contain provisions for the safe, orderly and efficient development of international civil aviation.

Greg Dunstone is Manager of the ADS-B Programme at Airservices Australia. Based in Canberra, he also chairs the ICAO ADS-B Task Force established by the regional group responsible for air navigation planning and implementation in Asia/Pacific. Further details about the Australian programme are available at Airservices Australia's website (www.airservicesaustralia.com).

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AIRSERVICES AUSTRALIA

Training establishments are increasingly adopting advanced air traffic control simulators

Air traffic controller training today is a far cry from those early days when a student's classroom instruction was simply a precursor to an extended apprenticeship within an operational organization.

MANJINDER BAINS
RAYTHEON CANADA LTD.

UNTIL relatively recently, one of aviation's less well-known idiosyncrasies was the significant difference between the methods used to train pilots and those used to train air traffic controllers, even though both must work in close harmony to ensure the safety of every flight. Professional pilot training was generally more advanced than the training of professional air traffic controllers.

As long ago as 1935, the U.S. Army Air Corps ordered the first six Link Trainer flight simulators to teach air mail pilots the elements of instrument flying at night or in bad weather, in order to stem their increasing accident rates. While primitive by today's standards, the Link Trainer was an important development for its time. It was widely adopted by airline and military organizations, and by the early 1950s over 10,000 units had been built and had taught the basics of instrument flight and its related procedures to an estimated 500,000 pilots worldwide.

Until the mid-1980s, the technology used for training air traffic controllers lagged far behind the capabilities of training systems available to pilots. In the earliest days, classroom lessons emphasized learning and remembering procedures from textbooks, and "simulation" was provided by the instructor's sketches on a blackboard. Even today some training establishments still use model aeroplanes moved by students across large tables to simulate traffic. In one variation of this, models are moved along "airways" of wires in the training room.

Advances in digital computing and graphic displays in the 1980s provided the major stimulus to controller training, with the result that current air traffic control (ATC) simulators now represent the leading edge of this technology. Airline pilots, who themselves train on very sophisticated flight simulators, are known to be genuinely impressed by the equally advanced training methods now available to their controller colleagues.

Students are shown in an office-sized 225-degree tower simulator designed for small rooms. The simulation in this example features Jakarta International/Soekarno-Hatta Airport.

Simulator training today

Raytheon Canada's FIRST*plus* system typifies the level that ATC training simulation has now reached. Instead of the traditional small classes of students, modern training simulator complexes today — such as that recently installed for the Indonesian Department of Civil Aviation — can accommodate over 60 separate training positions, covering both radar and tower operations, where all students can be involved in a single, large exercise or be divided up into separate groups handling assignments at different skill levels. As well, while some students are involved in group exercises, others — perhaps recent entries — can run independent solo exercises at their own workstations. Separate from the students, other individual workstations can be used for controller certification and recurrent training.

Yet the computer technology which permits the extreme flexibility of the very large, multi-position system is essentially identical to that of the individual desktop simulator used by single ab initio students to gain familiarity with ATC procedures. This is because all recent systems, large or small, are designed around the same standard commercial off-the-shelf personal computers. This approach has several advantages: the choice of widely used PC hardware and network systems brings significant purchase benefits and ease of maintenance, while internationally available commercial components allow system upgrades to readily accommodate newer programme or display capabilities to ensure that a user's system always keeps abreast of the latest technologies. As well, this common core design philosophy means that a smaller training facility can expand its capabilities from a single unit all the way to a major complex by simply adding more individual PCs and accessories in building-block fashion. Put another way, once a basic single system infrastructure is in place, expansion is very straightforward, with no practical upper limit.

Similarly, the colour graphics presentation of the view outside the tower can grow as the training facility's requirements increase. The displayed scene can be expanded from the two-dimensional plan view of the aerodrome and its surface traffic presented by a single user desktop unit to a multi-position installation with a three dimensional, wide-screen view of the airport, extending up to 360 degrees around the tower and supported by a complete repertoire of sound, weather and other effects. While some systems, like the one installed recently in Indonesia, can simultaneously accommodate well over 50 students, in fact there is no limit to the number of training positions.

User-defined training. The simulator system's operating concept is based on it being completely data-driven, which provides users with maximum levels of control over their system and its training scenarios. In other words, the system can be configured by the training establishment's staff to exactly represent their current operational needs. But should these change, reconfiguration of the data is both user-friendly and fast, utilizing modern Windows interfaces. For example, system users can quickly reassign any training position to a different role such as that of controller, controller assistant, instructor or pseudo-pilot. The look and feel of every position is also user-configurable via easy-to-use programme editors. The "any position, any role" concept also significantly increases system operational availability; should one position be offline for repair, the other positions are unaffected, and the role of the offline position can be taken over elsewhere.

One important aspect in student training, and often one of the first areas taught, is in the knowledge of aeronautical language including its unique terminology and phraseology, and the importance of its use in a style that must be brief, yet precise and clear. At the same time, standardized aviation terminology developed by ICAO is even today not yet fully implemented worldwide. While ICAO recently established new provisions for English language proficiency for international aviation operations that should lead to a significant improvement in this situation, for the time being controllers must still be familiar with subtly different phraseologies, accents and special vocabularies. For this reason, the ICAO and U.S. Federal Aviation Administration (FAA) phraseologies provided with systems to help users get started right away can be easily modified, given the simulator's user-definable design, to include unique or specialized local phrases and commands. In the same way, the programme can be adjusted for varying levels of strictness in usage where, like a good school teacher, the computer can make allowances for the learning levels of different student classes. For example, while beginners can be permitted to use terms like "nine" or "twenty four," their use by more advanced students instead of the correct "niner" or "two four" will bring an immediate "say again" voice response from the computer.

Today's simulators are also capable of being quickly switched between operational environments, moving almost seamlessly from tower, ground, terminal and on to the en-route control segment. Consequently, since the programme's database accommodates multiple airports, student training can encompass complete gate-to-gate flight operations, from ground control at one aerodrome, hand-off between all terminal and en-route sectors, to arrivals and ground control at another aerodrome. In addition, of course, the programme includes a variety of non-standard events such as loss of separation or even in-flight emergencies that the instructor can introduce for more experienced students.

Students in Belgium (above) conduct an ATC training exercise using a large screen, advanced 270-degree tower system. Right: A student uses Raytheon's FIRST*plus* simulation programme running on a single PC featuring voice recognition and response for interaction with aircraft.

This end-to-end training is an extremely important aspect in that it provides students with full immersion in a totally simulated ATC operation where they must continually track, coordinate and hand-off flights as well as communicate with pilots and other controllers and facilities throughout the exercise. Before the introduction of advanced air traffic control simulation, students could only experience this level of activity after completing their classroom work and being assigned to an

Modern training simulator complexes, such as that recently installed for the Indonesian Department of Civil Aviation, can accommodate over 60 separate training positions covering both radar and tower operations.

actual ATC facility, where they would spend lengthy periods simply observing the process, followed by their slow integration into the work force.

The instructor's key role. Unquestionably, the instructor is the key player in all simulator exercises, and all systems are designed around this fundamental philosophy. The instructor determines the required training level, assigns students to various roles, sets the exercise parameters and introduces appropriate operational challenges such as traffic conflicts, aircraft problems and even deteriorating weather at destination, requiring traffic diversions. In fact, a wide range of weather conditions can be selected, from Arctic blizzards to desert sandstorms (although few customers would use both in their simulations). Programmes also include full 24-hour operation, from daylight through dusk and into night, and re-emerging into dawn and eventually full daylight. In addition, the programme can be keyed to seasonal changes. And while the seasons and the time of day are not usually relevant to radar training, weather conditions certainly are, and the instructor can, for example, configure the radar displays to show significant thunderstorm activity, thereby requiring the student to assess the merits of re-routing traffic around it.

But whatever the circumstances, the instructor can stop an exercise at any time and, since every step of the exercise is recorded, play it back for review of a specific sequence of events or perhaps to correct an individual student action, with the option of slow, normal or fast replay. During such reviews, the instructor's communication links allow all the students to be addressed, or the instructor can discreetly address one specific student about an individual error. Recorded exercises can also be saved and played back during subsequent classroom sessions.

Pseudo-pilots and voice recognition. To add a further level of realism to training exercises, many simulators use pseudo-pilots who remotely manoeuvre aircraft through the airspace in use. Sometimes these "pilots" are permanently assigned to the task, and sometimes instructors perform this duty. An interesting variation is to assign some students from a class to act as pseudo-pilots, which gives them a valuable understanding of a pilot's perception of the air traffic control system at work. During an exercise, the student controllers have two-way communications links to the pseudo-pilots, who "fly" a number of separate aircraft in accordance with their respective clearances. And occasionally, when directed by the instructor over a private link to the pseudo-pilot, one aircraft will appear to misinterpret its clearance, or perhaps have communications difficulties, thereby keeping the trainees on their toes.

While the pseudo-pilot concept provides excellent augmentation to simulator training, it does have the limitation of sometimes requiring more staff and resources than may be available for a planned large exercise. Consequently, more recent simulators also provide an advanced capability known as voice recognition, where the pseudo-pilots' roles are performed by the ubiquitous PC.

Voice recognition allows controller trainees to speak commands directly to each simulated aircraft via its individual call sign, whereupon the computer recognizes the call sign and the commands and then creates the synthetic voice of the pilot to read back the command and causes the aircraft to follow it. A student who calls, say, Air India 395, will receive a response from only that aircraft. With voice recognition, any number of "virtual" aircraft, each with its own flight plan and individual call sign, can be programmed into the computer, and these aircraft will proceed through the exercise area in accordance with their clearances. Students can transmit amended clearances, altitude changes and a variety of other instructions, all of which will be read back by the specific aircraft addressed, preceded by its call sign, and the student's instructions are then followed precisely. As well, the computer can be programmed to provide a selection of different voices — male or female, high or low pitched — to add more realism to the exercise. Importantly, the instructor can also cause a message to be misinterpreted by a pilot, or missed completely, requiring the student to retransmit.

Flexible applications. Today's advanced air traffic control simulators are not only

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Volunteer-based airport watch augments security effort at major airports

The presence of volunteer observers in the vicinity of airports can help prevent security breaches and even reduce the incidence of crime. In Canada, airport watch programmes using volunteers have been endorsed by police and airport authorities and in some cases have become an integral part of an airport's overall security system.

JACQUES BRUNELLE
ROYAL CANADIAN
MOUNTED POLICE

WHEN most people think of airport security, their thoughts naturally turn to procedures that include passenger screening and baggage inspection performed by trained personnel, and possibly devices like aerodrome perimeter fences to prevent trespassing. But a security programme can also encompass the participation of volunteer observers who report unusual or suspicious activities to the authorities, and airport watch programmes are increasingly a part of overall security at a variety of airports. The presence of these volunteer observers on the periphery of an aerodrome is especially important in an era of high security awareness. Depending on the locale, concerns may range from the relatively minor problem of petty crime to the potentially catastrophic criminal use of a man-portable air defence system (MANPADS).

The concept of the airport watch programme is a relatively new development. In Canada, the concept has been evolving for about five years, beginning with a basic programme that was initiated at Ottawa International Airport in late 1999. The Royal Canadian Mounted Police (RCMP) National Airport Watch Programme continues to expand to other major airports where the national police force is involved in maintaining security, and seems likely to grow further in the future.

The Ottawa airport watch programme was launched as a joint effort by the RCMP national security investigations unit and the Ottawa Police Service, as both entities were responsible for law enforcement at the airport. The concept implemented in Ottawa, and now in place at other airports in Canada, is similar to typical neighbourhood watch programmes in that it relies mostly on volunteer "spotters" to report questionable activity in the vicinity of the airport. While the concept may be similar, however, airport watch volunteers do not resemble the usual neighbourhood watch participants. They have joined airport security teams because of their special interests and the skills they can offer. In addition to a passion for aviation, many of the volunteers are experts in particular facets of airport operations and in aircraft recognition. Moreover, they are cognizant of the need for increased security at airports in recent years. Equipped with binoculars, flight schedules, aeronautical frequency scanners and aircraft type reference guides, they possess an intimate knowledge of the airport's perimeter layout and the businesses that operate within it.

As enthusiasts, airport watchers spend hours at a time in public access areas viewing aircraft from outside the perimeter fence — they do not usually have special access to the airport grounds. Some are interested in commercial airliners while others are more interested in military aircraft or helicopters. It is not uncommon for a spotter to be able to recognize sub-variants of a particular airliner type or even what make of engine is installed on an aircraft.

Because of their familiarity with the airport surroundings, many of the observers are keenly aware of airport visitors, both regular and irregular. Their strong sense of observation, perhaps gleaned from many years of enjoying their hobby, has

now been added to the airport's security network in a practical working arrangement. Over the past five years, Ottawa's Airport Watch Programme has become increasingly active because of the volunteer members, who comprise the bulk of the programme participants, which also includes airport-based employees who are encouraged to report suspicious activity.

Although the volunteer observers cannot supplement police operations even when security is heightened by a high-profile event, they are nevertheless highly valued by police and security forces. When Ottawa Macdonald-Cartier International Airport was used by Air Force One for an official visit to Canada by the U.S. President, airport watch members served useful functions such as observing the approach end of the runway. Having been made aware of the types of potential threats that may emerge on such occasions, the watch programme members were prepared to report any suspicious activity to the airport's Security Operations Centre (SOC) by cellular phone. Following their credo, "Observe, record and report," they never take any direct action themselves.

John Davies

Members of the five-year-old Ottawa Airport Watch view airport activities from beyond the perimeter fence. Volunteer observers normally do not have access to the airport grounds.

Crime prevention

Notwithstanding the attacks of 11 September 2001, the aviation industry is still a world leader in safety and security through prevention. Crime prevention programmes are a natural extension of this philosophy.

Often overshadowed by terrorism, the criminal threat to aviation remains chronic and difficult to eradicate in the long term. Dozens of crimes occur every year at airport facilities worldwide, mainly because of the high value commodities which are shipped by air. Often these criminal acts involve cash, diamond and gold shipments. The robberies usually occur in restricted airport facilities where transfers are made.

Acts of sabotage and vandalism against parked aircraft for reasons of crime, politics or disgruntlement have also been an issue worldwide, not to mention petty theft in and around passenger and cargo terminals.

Crime prevention at airports is not unlike home crime prevention. It is based on anticipating risks and dealing with them. Most crimes occur because the opportunity presents itself and there is a low risk of getting caught. An aggressive airport watch programme is an important means of eliminating, or at least reducing, the risk of most crimes that could occur at or around an airport.

A separate programme developed by the RCMP, and a predecessor to the National Airport Watch, is the successful interdiction initiative known as Coastal/Airport Watch. This is aimed at reporting smugglers who may try to use rural aerodromes and isolated coastal and border areas for their clandestine activities. The National Airport Watch compliments this protective measure by exploiting active volunteers at the larger international airports, where smuggling also continues to be a concern. The volunteers keep an eye on every form of activity, look out for unsecured gates or for obstructions or animals on an active runway, and even provide assistance if practical.

A cell phone call to the SOC is all that is required to report observances or help those in need. Although there is no set schedule for the volunteers, many of them call SOC when they are on location at their favorite viewing spot. This ensures that they themselves are not the source of suspicion and can be contacted if their view of the area is required.

In the spring of 2004, the Ottawa Police Service introduced the anonymous crime reporting programme, "Crime Stoppers," at the airport. This further deters crime, some of which — as at any large airport — may be carried out by airport employees.

Well-organized pastime

Enthusiastic observers like those involved in the Ottawa Airport Watch Programme are to be found at most large airports worldwide. The term spotter originated in England about 80 years ago during the height of the steam engine era. These spotters observed passing trains to record their engine numbers and exchange this information with other hobbyists. Today, a similar pastime involving aircraft is very well organized in much of Europe, to the point where participants hold formal meetings in clubhouses. In fact, many airport authorities have posted website guidelines for visiting spotters so that they have ready information about available viewing sites and local rules. In Canada, there are prime spotting locations at a number of international airports, notably Vancouver and Calgary, that are equipped with a car park, benches, garbage receptacles and colourful signs indicating the types of aircraft that operate from there. This positive development enhances security at airports even without a formal watch programme. Once organized enthusiast groups come into existence, however, it takes little extra effort to develop them into low-cost airport watch groups that benefit everyone.

At present, most of the 32 airport watch volunteers in Ottawa visit the airport locale several times a week, some on a daily basis. Of course, enthusiasts were visiting the airport prior to the creation of the watch programme, but now these enthusiasts all know each other, furthering mutual safety. In addition, they have been made aware of the relevant airport safety and security arrangements through local tours of the airport facilities. Another advantage is that the area police forces come to know the watchers and will not view them with suspicion.

In Ottawa, tours of the air traffic control centre and fixed-based operators (FBOs) have been organized, as have visits to view progress on the construction of the now completed new passenger terminal. Besides these tours, the volunteers hold a breakfast meeting at an airport restaurant once a month.

Aside from the comraderie and opportunities to learn more about their local airport, watch members can benefit in other ways. As members become known to the FBOs, for example, those who enjoy photography can sometimes arrange to take their cameras airside. Before the airport watch programme existed such enthusiasts would have to be satisfied with taking a photo of an aircraft over an FBO fence. Now they can enter the facility and ask permission to take a photo. So while the presence of the volunteer observers results in better corporate security for the FBOs, the observers are rewarded with better photo prospects.

In some respects, the group is more like a club. To commemorate the fifth anniversary of the Ottawa group's formation, for instance, a full-day tour of Montreal Trudeau International Airport, a 90-minute drive away, was organized. The outing included a visit to Air Canada's training and maintenance centres and a tour of the Bombardier Regional Aircraft plant, as well as an escorted tour of the airport's large apron area, an inside-perimeter drive and a 45-minute photo stop next to Runway 24R arranged by Aéroports de Montréal security.

Jacques Brunelle

Observers who participate in formal airport watch programmes in Canada carry cell phones to report suspicious activity to the airport's security operations centre.

Programme expansion

The success of the Ottawa programme has not been lost on other Canadian airports. Vancouver and Halifax International Airports, which are both under local RCMP jurisdiction, began similar programmes a few years ago. However, these airports have not made as much progress as Ottawa yet, resulting in fewer benefits to either the airport or the volunteers. This has been due to the lack of available police time to organize meetings and security awareness briefings. Higher priority police tasks are a reality at most busy airports, meaning that time for other activities such as an airport watch programme are at a premium. Nevertheless, observers in the Toronto area found a way around this obstacle last summer.

The Toronto Pearson Airport Programme arose when local enthusiasts grew frustrated with ineffective efforts to maintain their viewing sites during the airport's massive ongoing construction projects. Banding together, the spotters decided to set up a programme modelled after Ottawa's, which they had learned about from a radio programme on the subject of airport security. After an initial recruitment effort, 89 volunteers joined the Toronto Airport Watch initiative. The group subsequently presented a well-received proposal to the Greater Toronto Airports Authority (GTAA).

Rather than rely on a police force to help them establish the airport watch programme, the Toronto-based spotters took it upon themselves. After the initiative was embraced by the local police forces and the GTAA, the YYZ Airport Watch website (http://www.canairradio.com/airportwatch.html) was linked to the GTAA. By becoming organized without support from security or police agencies, the Toronto group is more self-sufficient

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Christian Brunelle

Besides being attuned to possible security breaches, airport watch members also report the presence of wildlife if it could present a threat to operations; these wild turkeys were photographed on the grounds of Ottawa's airport.

Cpl. Jacques Brunelle is in charge of the Civil Aviation Protective Intelligence Unit and coordinator of the National Airport Watch Programme. He is based at RCMP headquarters, Ottawa (e-mail jacques.brunelle@rcmp-grc.gc.ca). Any views expressed in this article are those of the author and not necessarily those of the RCMP.

The Ottawa Airport Watch Programme, the first volunteer-based watch programme organized by a police agency in Canada, was launched through the joint effort of the author and Sr. Const. Gary Davidson of the Ottawa Police Service Airport Policing Section.

More information about the National Airport Watch Programme is available on the web (http://www.rcmp-learning.org/bestdocs/english/hd/enforcement/airport.html).

Cabin safety can be enhanced through application of human factors strategy

The concept of threat and error management is not limited to flight deck operations alone. Safety may also be improved by analysing incidents and developing strategies for managing threats and errors arising in the passenger cabin.

DAVID MAWDSLEY • MARTIN MAURINO
INTERNATIONAL AIR
TRANSPORT ASSOCIATION

A human factors concept that has been used successfully for enhancing flight deck safety, the threat and error management (TEM) model developed by the human factors team at the University of Texas at Austin, is also relevant to other operational areas. While the TEM model was designed originally with the flight deck in mind, it can be adapted for the passenger cabin as some airlines have demonstrated, and for air traffic services operations (see "ICAO examining ways to monitor safety during normal ATS operations," Volume 3/2004, page 14).

The TEM model is a conceptual framework that allows for interpretation of data obtained during routine operations. The first component of the model is the notion of threats, defined as external situations that must be addressed by personnel in everyday operations to maintain margins of safety. Threats increase operating complexity and can endanger flight safety.

An analysis of cabin operations through the TEM model offers a broad perspective since it is not limited to errors made by the cabin crew. The TEM model helps in understanding that, beyond people and their actions, cabin systems and the design of their components may present threats that the cabin crew must manage.

Threat categories

Applying the TEM model to cabin operations, threats can be classified in five broad categories, as described below.

The first of these categories, operational threats, includes elements such as adverse weather. Turbulence, for instance, is a threat to cabin safety that may result in injuries to passengers or cabin crew if the cabin and galley are not properly secured or if occupants are not seated in a timely manner. Another example of an operational threat is traffic congestion, as holding patterns or ground delays may create anxiety among passengers and require passenger management skills to maintain a safe cabin environment. Among other operational threats affecting cabin crew are time constraints, unfamiliar cabins or galley configurations, flight diversions and abnormal operational events such as rejected take-offs. Time pressures arising from delays may lead the cabin crew to involuntarily jump steps in pre-flight procedures, or execute such procedures with diminished attention, with a potentially adverse effect on safety.

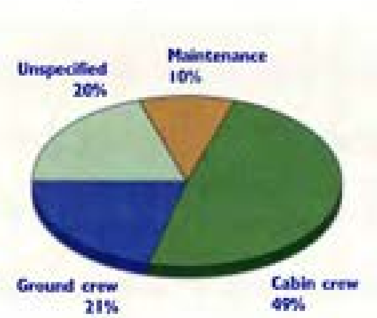


Figure 1. Source of inadvertent slide deployment on the basis of 436 reports, 1998-2002

Another category, flight deck threats, concerns events originating on the flight deck, or more specifically errors made by the flight crew. In high-workload situations, for example, pilots may omit to inform the cabin crew of anticipated turbulence, and consequently the cabin crew may have to respond unexpectedly to a dangerous condition. Although the cabin crew did not introduce the error, i.e. the omission of information, they still must manage its consequences for the cabin.

In line with the above, errors made by maintenance personnel, ground crew or dispatch personnel are considered threats to cabin operations, and are known collectively as crew support threats. Faulty equipment that has not been repaired, errors in passenger load paperwork, or omissions about cabin abnormalities in the defect logbook, can all produce situations that require cabin crew threat management. Cabin crew scheduling errors and incorrect or incomplete charts or manuals are also considered as crew support threats.

Aircraft threats involve malfunctions that can compromise cabin safety. Equipment malfunctions or abnormalities, such as an overheating oven, are typical of the threats in this category. Communication system problems, such as the failure of the public address system or interphone, can diminish cabin safety margins unless properly managed.

Safety can also be endangered by passengers who are violent, abusive or intoxicated, or who disregard instructions from the cabin crew. Passengers may attempt to smoke in the lavatories or try unlawfully to enter the flight deck. These situations pose threats to safety that require management by the cabin crew. Passenger threats not only have the potential to undermine safety, but may cause distractions that result in cabin crew errors.

Error types

The second component of the TEM model is the notion of errors. In terms of the model, cabin crew errors are considered as actions leading to deviations from organizational or cabin crew expectations that compromise flight safety.

As with threats, cabin crew errors can be classified according to five categories.

First, intentional non-compliance errors result from deliberate deviation from the standard operating procedures (SOPs) or regulations. Examples include intentionally disregarding the sterile cockpit rule, omitting to perform the safety equipment checklist prior to take-off, not executing a door arm/disarm cross-check,

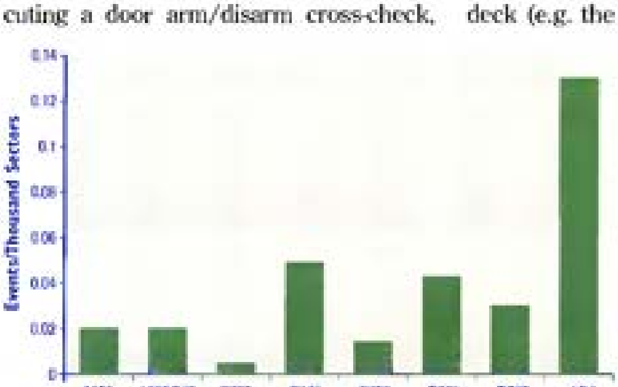


Figure 2. Inadvertent slide deployment by aircraft type, 2003

omitting the required safety briefing to passengers with special needs, not reporting missing or defective equipment, or standing for non-safety related duties during taxi out.

Procedural errors result when the cabin crew intent is correct but the execution of the task is flawed. They include involuntary deviations from the SOPs. Errors caused by forgetfulness or distractions fall in this category. Examples include setting an oven to a higher temperature than allowed, completing the pre-flight equipment checklist but forgetting to check one piece of equipment, or opening a door before disarming the slide.

Another type of error involves communication lapses. This category includes the failure to disseminate pertinent information among cabin crew members, or failure to communicate important information to the flight crew or external personnel (ground crew, security, etc.). It also includes miscommunication or misinterpretation of information. An example of this would be passing erroneous information about a cabin condition to the flight deck (e.g. the flight deck is advised of a fire in a forward lavatory when the alarm system indicates a fire in the aft lavatory).

Proficiency errors relate to a lack of knowledge or psychomotor skills. Examples include lack of systems knowledge (the cabin crew member is unable to work a control panel) or lack of knowledge of company procedures (the cabin crew member does not know the prescribed procedure to inform the purser that the slide has been disarmed).

Lastly, operational decision errors involve actions by cabin crew that unnecessarily compromise safety. An example of such an error would be a decision to continue with a meal service during a period of turbulence.

The third and last component of the TEM model is the notion of undesired cabin state. This arises when threats and/or errors place the cabin in a situation of unnecessary risk.

Undesired cabin states include incorrect systems configuration, such as doors left unarmed for flight, or galley equipment left unrestrained for landing. An undesired cabin state can also be associated with inadequate passenger management (unfit passengers sitting at over-wing exits) or ground states (leaving doors unattended while refuelling with passengers on board). Undesired cabin states can also be related to specific phases of flight; for instance, cabin baggage must be stowed during critical phases of flight, but not necessarily during cruise.

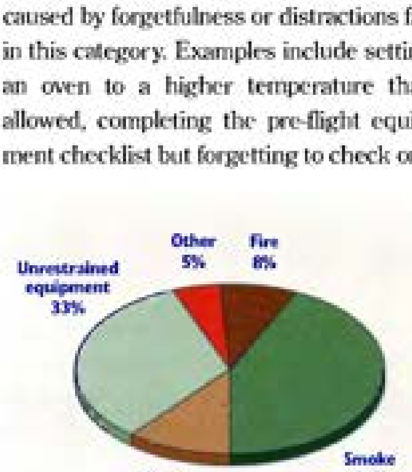
The International Air Transport Association (IATA) has undertaken incident analysis of cabin occurrences with the aim of enhancing safety. This activity stems from a six-point safety programme adopted by IATA to ensure its safety goal is met: to reduce the accident rate by a further 25 percent by 2006. The strategy integrates several areas to improve operational safety, with cabin safety a key element of the data-driven programme.

Case studies

Data from a safety database known as STEADES,* which includes a module for cabin safety reports, can be analysed through the use of the TEM model. Two case studies derived from STEADES data analysis are presented here to illustrate how threats and errors can be identified through proactive incident analysis and then countered through development of prevention strategies.

The first case study focuses on aircraft door operation and the inadvertent deployment of evacuation slides. An analysis of STEADES data shows that cabin crew actions are associated with almost half the cases of inadvertent slide deployments. *Figure 1* illustrates the source of inadvertent slide deployments in incidents reviewed from 1998 to 2002.

Unintentional slide deployments are not just costly events, but raise an ulterior issue: if cabin crew deploy slides during normal operations, their ability to properly comprehend and operate door func-



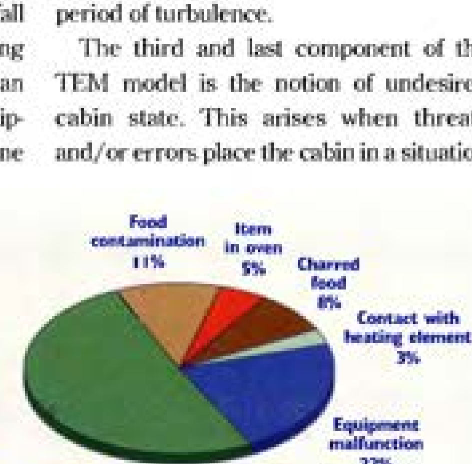


Figure 3 (left). Galley equipment-related incidents according to 61 reports, first quarter of 2003. Figure 4. Galley fire-related threats based on 38 reports, first quarter of 2003.

tions during an emergency situation may be in question.

The STEADES analysis focused on the number of inadvertent slide deployments by cabin crew, according to aircraft type. The statistical significance of the number of deployments during 2003 was determined by dividing the actual number of slide deployments by the number of sectors flown by each type of aircraft. The aircraft were grouped according to door design. The results of the analysis are illustrated in *Figure 2*. They show that inadvertent deployments occurred more frequently in specific aircraft types, with long-haul aircraft among the predominant types that experienced inadvertent deployments. This contradicts the common perception that a high frequency of door handling is usually linked to a higher number of inadvertent slide deployments.

Slide-arming mechanism interface design plays a role in slide deployment events. This is mainly because some design features of the door operation/slide arming mechanism system are not error-tolerant. A slide-arming mechanism has certain built-in defences to guard against inadvertent deployment. However, most deployments occur when the cabin crew accidentally activate the door-opening handle instead of the arm/disarm command lever. Once an armed door begins to open, the cabin crew cannot revert the action. Error tolerance in this case is non-existent. Since the door operating system does not tolerate errors, the cabin crew must operate the door without making an error, a very unlikely possibility over time.

From a TEM perspective, the slide-arming mechanism interface design and aircraft door design are considered as aircraft threats. Identifying threat and error producing situations can lead airlines to adopt countermeasures. For example, new training methods may focus on specific areas of concern. Cabin crew training could increase awareness about the threats inherent in door operation and slide-arming mechanism design.

Further interventions by the airline to support cabin crew in managing threats and errors could include the use of checklists to ensure that the proper sequence of actions is followed and that no action is omitted. Cross-verification is another important tool to counter threats. Similar to the flight deck, where flight crew members cross-check one another's actions to trap threats and errors, the airline can develop cross-verification sequences to be followed by cabin crew during door operation.

The second case study examines galley operations. An aircraft galley is a complex workstation that combines interconnected systems such as circuit breakers, power switches and water drainage. It also includes equipment such as ovens, coffee makers and chillers. A galley contains bins and carts which are used for meal service and which include specific devices, such as latches or brakes, for safe operation.

As with any complex system, a galley contains threats that can diminish safety. Furthermore, cabin crew errors in managing the galley can have a serious impact. A STEADES analysis of cabin safety reports conducted in 2003 identified a number of generic and specific threats associated with galley operations. The two topmost generic threats identified were fire-related events and damage and injuries caused by unrestrained equipment. These findings are presented in *Figure 3*.

Galley fire is the predominant specific aircraft threat to safety in galley operations. Galley fire is a major threat because it can fill the cabin with toxic smoke. Galley ovens, similar to slide-arming mechanisms, are not error-tolerant systems: if the selected oven temperature is too high and the food begins to char, the oven will not reset the temperature. A review of STEADES cabin safety reports highlights threats and errors associated with galley fire-related events. A breakdown of these threats is presented in *Figure 4*. In addition to identifying fire-related threats, Figure 4 reveals another

Jim Jorgenson

Using a database such as STEADES, the TEM model provides a framework for identifying and understanding the operational threats that cabin crews must face during everyday operations.

potential safety concern: 51 percent of galley fires are classified as unknown or unspecified, which suggests inadequate reporting of such events.

Equipment malfunctions contributed to 22 percent of galley fire-related events reported in STEADES during the first half of 2003. Equipment malfunction is a specific aircraft threat that remains latent until the equipment is operated. It can result in overheating and smoke throughout the cabin.

Analysis of STEADES cabin safety reports also identified oven rack grease

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* The safety trend evaluation, analysis and data exchange system (STEADES) is a global safety database managed by IATA. The data on operational incidents reported by over 45 participating airlines are analysed by IATA, and the de-identified aggregate data are held in custody at IATA headquarters, Montreal. STEADES can be used to identify trends and contributing factors in airline incidents, and proactively identify target areas requiring safety improvement.

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Technological advancements promise further improvements in icing and turbulence forecasts

It has been possible for some time to provide forecasts of wind and temperature at a greater resolution and accuracy than required by international standards, and in the near future it should also be possible to offer enhanced forecasts of icing conditions, clear air turbulence and cumulonimbus cloud formations.

WILL OWEN
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THE Met Office in the United Kingdom and the National Weather Service (NWS) of the United States currently produce a global forecast of atmospheric wind and temperature for the aviation industry through the world area forecast centre (WAFC) located in each country. In the United Kingdom this forecast is commissioned by the meteorological authority, the U.K. Civil Aviation Authority, on behalf of ICAO, and it fulfils the requirements stated in ICAO Annex 3.*

Forecasts are provided for a series of points on a grid calculated so that the number of grid points towards the poles is reduced, giving rise to the term "thinned." The grid has a horizontal spacing of approximately 140 kilometres at mid-latitudes. The grid is also three-dimensional, with 11 vertical levels. Forecasts are issued four times daily at approximately 0430, 1030, 1630 and 2230 UTC, and contain six hourly time-step forecasts out to 36 hours (T+36). This forecast product is prepared in gridded binary code (GRIB) form and is commonly referred to as the "thinned GRIB data." Use of this forecast is now routine and is the basis for the route, performance and fuel calculations of global air traffic. It is delivered to the world's flight briefing companies and airlines.

Current capabilities. The definition of the requirement for global wind and temperature data for the aviation industry, as contained in ICAO Annex 3, was established in 1984 and has not been updated since. The grid spacing, number of levels, time-step and forecast length were at the time the best compromise between the amount of data required, the volume of output and the time needed for calculation of the forecast. A denser grid, additional vertical levels, more frequent time-steps and a longer time series — while being more accurate — would have taken longer to calculate and deliver. Since 1984, however, there have been dramatic advances in computing power, communications bandwidth and software capability, and these have opened up a number of possibilities now and for the future.

Before reviewing these various possibilities, it should not be forgotten that the intervening years have seen a dramatic increase in the accuracy of upper wind and temperature forecasts that has offset the requirement to seek better information in other ways.

The Met Office global model, from which the thinned GRIB is derived, operates on a grid spacing of approximately 60 kilometres at mid-latitudes and is calculated with 38 vertical levels. In addition, it calculates forecasts more frequently than the six hourly time-steps and out beyond 36 hours. This offers the possibility of providing users with much more comprehensive coverage and with far greater detail, thus reducing errors of interpolation (especially in the vertical) that can occur when flight plan calculations are performed.

Obviously, there are several ways in which the product can be enhanced, whether by increasing the resolution, time-step or forecast length. In fact, some users already receive forecasts out to T+42. As a guide, the volume of data to be transmitted if a 60-kilometre horizontal grid were to be utilized would rise

Airbus photo

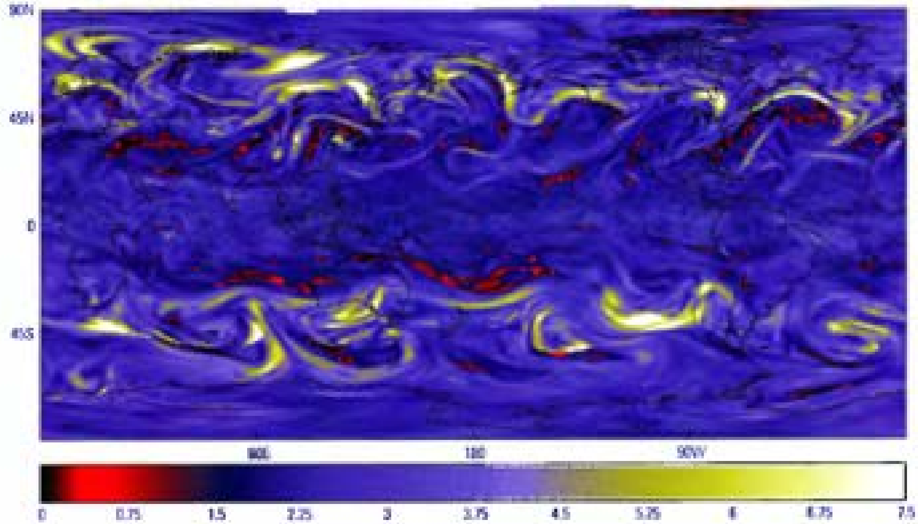
Anticipated improvement in the accuracy of forecasting data would allow users to compute the icing-related fuel penalty at different cruising levels and the likelihood of encountering icing when calculating ETOPS diversions. It would also give greater insight into the possibility of encountering turbulence both inside cloud and in clear air.

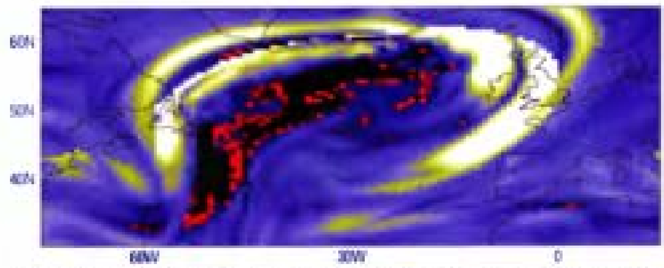
by a factor of five. It is also possible for users to receive even more detailed forecasts, for example on a 20-kilometre grid for Europe, but these higher resolution areas are not yet global and so would not meet the ICAO world area forecast system (WAFS) requirements. Nevertheless, some flight routing service providers are already showing interest in this capability so that they can provide a regional product for their customers.

Future capabilities. As well as wind and temperature, the Met Office global model will soon be producing forecasts for other parameters such as icing potential, turbulence and the presence of cumulonimbus (CB) cloud. At the moment a basic calculation of likely wind shear is provided at grid points, but this is of limited value. In recent months the Met Office has been working to enhance this capability and has managed to encode this data into GRIB. This offers the exciting possibility of routinely issuing data that can help to avoid in-flight turbulence and icing. The enhancement represents a dramatic improvement over the current graphical presentation, the significant weather (SigWx) chart, which is produced 24 hours ahead of the valid time. In the case of turbulence, the SigWx chart shows any areas where the probability of turbulence is expected to exceed 4 percent. At 24 hours before the valid time, these areas are often very large and as such offer only general guidance to pilots or flight routing companies. When asked, most flight routing companies report that routing decisions take no account of SigWx charts except where tropical cyclones are forecast.

With icing potential and turbulence added to the thinned GRIB product, these parameters will be available at much shorter notice and far more frequently. This will raise the accuracy of information on icing and turbulence dramatically, and will allow users to calculate the icing-related fuel penalty that they will face at different cruise levels, the likelihood of encountering icing when calculating diversions for extended range operations by twin-engined aeroplanes (ETOPS), and much greater insight into the possibility of encountering turbulence both inside cloud and in clear air.

The accompanying illustrations show a graphical representation of the probability of clear air turbulence (CAT) at the 250 hPa level (an altitude of approximately 34,000 feet), globally and for the North Atlantic region, generated from the Met Office global model. These images show a forecast for 24 hours ahead, as with the current SigWx chart, but in addition, the six intermediate hourly time steps will be available in the thinned GRIB product. Visualizations such as these will also be available to users and on the Met Office website.





Depicted at top is the global CAT forecast for an altitude of approximately 34,000 feet on 21 July 2004 (T+24). The white areas show where the probability of CAT is at its highest. Figure above depicts the North Atlantic CAT forecast for 21 December 2004 (T+24), showing a strong signal for CAT over the United Kingdom and Newfoundland.

More choices. As mentioned above, plans are in hand to introduce icing and turbulence indicators to the thinned GRIB forecast, and this will increase the data volume and necessitate a software enhancement by users. That said, because the number of points will not change, the alterations required should be limited.

The extra capabilities outlined in the preceding description of current capacity offer a number of other choices, all of which demand the transmission of much larger volumes of data and more significant rewriting of software systems, especially by users. Before now users have not embraced the concept of increased horizontal resolution for the "traditional" wind and temperature forecast, partly because flight routing companies and airlines perceive that the cost of software alteration exceeds the potential benefits. This reluctance also appears to exist because the flight times experienced by airlines correspond well to those predicted using the current forecast grid, especially for long-haul flights. However, this ignores the fact that the route chosen might not actually have been the optimum since the route calculation was based on incomplete data. Although airlines indicate satisfaction,

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* Annex 3 to the *Convention on International Civil Aviation*, also known as the Chicago Convention, contains standards and recommended practices for the provision of meteorological services for international air navigation. In all, 18 annexes to the Chicago Convention provide provisions for the safe, orderly and efficient development of international civil aviation.

Will Owen is the Commercial Aviation Manager at the Met Office in the United Kingdom, which operates the World Area Forecast Centre (London).

Improvised approach has catastrophic consequences for Ilyushin 76 freighter

An unapproved and unstabilized user-defined GPS approach, using erroneous chart data while flying in instrument meteorological conditions, set the stage for a fatal collision with terrain.

AUSTRALIAN TRANSPORT SAFETY BUREAU

ON 31 January 2003, at 1521 local time, an Ilyushin 76TD freighter impacted terrain near Baucau, Timor-Leste, during its landing approach to Cakung Airport. The aircraft was destroyed by impact forces and a severe post-impact fire, and the six occupants — the pilot-in-command, co-pilot, navigator, flight engineer and two loadmasters — were fatally injured.

At the time of the occurrence, there was low cloud near the aerodrome. Witnesses at the aerodrome estimated the cloud base to be about 1,000 feet (305 m) above ground level, and visibility to be about 1,500 metres (0.8 NM).

Before the aircraft's departure from Macau, the crew was provided with notices to airmen (NOTAMs) and a weather forecast for the planned flight. The weather information did not include a terminal aerodrome forecast (TAF) or an aviation routine weather report (METAR) for Baucau as this information was not available.

REPORT ON CFIT ACCIDENT

This article comprises abbreviated extracts from the final report on a controlled flight into terrain (CFIT) accident during approach to the Cakung Airport near Baucau, Timor-Leste (formerly known as East Timor) on 31 January 2003. The report, produced by the Australian Transport Safety Bureau (ATSB) at the request of the Government of the Democratic Republic of Timor-Leste, was released in June 2004, and may be viewed in its entirety at the ATSB website (www.atsb.gov.au/aviation/occurs/occurs_detail.cfm ?ID=552). The report is based on an accident investigation that was conducted by the ATSB for and on behalf of the Civil Aviation Division of the Ministry of Transport, Communication and Public Works, Timor-Leste.

The investigation determined that the flight crew's compliance with procedures was not sufficient to ensure safe aircraft operation. Before the descent into Baucau, the pilot-in-command briefed the crew that he would conduct a non-precision instrument approach with reference to the Baucau non-directional beacon (NDB). The flight instruments fitted in the aircraft provided readings of height, speed and distance in metric units. The pilot-in-command's briefing included information on the relevant heights for the missed approach procedure expressed in feet, and not in their metric equivalents. None of the other crew members commented on this fact. The cockpit voice recorder (CVR) data revealed that the pilot-in-command did not refer to the source of data that he used for the briefing on the intended NDB approach. The pilot-in-command's arrival briefing also contained no information or discussion on:

- the altimeter subscale settings for the descent into Baucau;
- the minimum sector altitude (MSA) within 10 NM (18 km) of the Baucau NDB; the MSA was 9,300 feet (2,834 m);
- the commencement altitude for the Runway 14 NDB approach at Baucau, which was 5,500 feet (1,676 m) above mean sea level (AMSL);
- the lowest safe altitude for the last en-route sector into Baucau, which was 4,500 feet (1,372 m) AMSL;
- the applicable minimum descent altitude (height) (MDA(H)) for the approach;
- the expected weather at Baucau; and
- the Baucau NOTAMs.

The CVR data revealed that none of the other crew members commented on the omission of this critical information. As a result, the arrival briefing was not effective.

Controlled airspace was established at Baucau, but air traffic services (ATS) were only available for United Nations aircraft on UN troop rotation days (information that was included in the NOTAMs for Baucau). The occurrence aircraft was not engaged in UN troop rotation operations.

When the aircraft was about 300 kilometres from its destination, the pilot-in-command instructed the co-pilot to call Baucau. Over the next 23 minutes the co-pilot called Baucau Tower 25 times, but received no response. The navigator then called Baucau Tower. A controller who was at the aerodrome at the time, but not on duty, advised the flight crew that air traffic control (ATC) was not available and that a landing would be at the crew's discretion. The navigator acknowledged the controller's advice but did not seek information about the prevailing weather. Had the crew sought and received such information, it might have improved their situational awareness.

During descent in Timor-Leste airspace, none of the flight crew monitored the Timor "common high" frequency while the aircraft was above 10,000 feet (3,048 m). They also did not monitor the Timor "common low" frequency while below 10,000 feet or broadcast their intentions and traffic information on that frequency. Therefore, the flight crew had no assurance that there was no conflicting traffic. The flight crew's disregard of the requirement for traffic information broadcasts within Timor-Leste airspace increased the risk of an in-flight collision.

The pilot-in-command diverted the aircraft from the published inbound track to the Baucau NDB and descended below the published MSA. The aircraft continued descending through the commencement altitude for the published NDB approach for Runway 14 and through the lowest safe altitude. None of the other crew members commented on the fact that the pilot-in-command had breached these safety heights.

The Baucau NOTAMs included information that instrument approach charts for Baucau were available from the Civil Aviation Division (CAD) of the Ministry of Transport, Communication and Public Works, Timor-Leste. However, the investigation determined that the flight crew used Jeppesen approach charts, and not the CAD-issued charts.

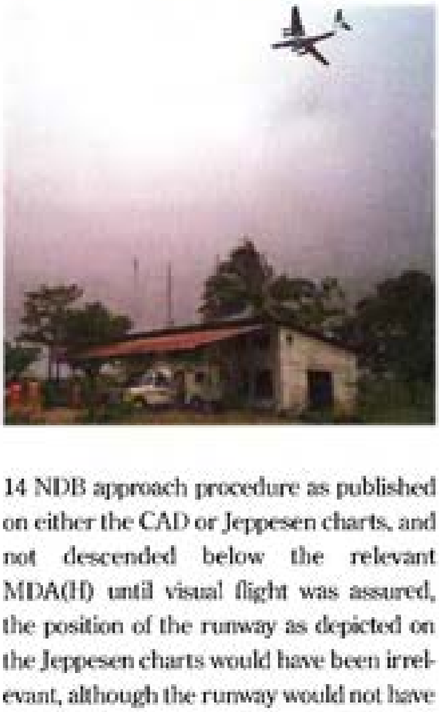
As the aircraft approached Baucau, the crew decided to conduct an overflight of the aerodrome before making a landing approach, and during this manoeuvre they realized that the runway was not where they expected it to be.

The investigation determined that the flight crew did not conduct the overflight of the aerodrome or either landing approach with reference to the Baucau NDB. The crew used selected data from their approach charts to formulate a user-defined, non-precision approach using the on-board global positioning system (GPS). The user-defined approach [an instrument approach that is not in accordance with an approved published instrument approach procedure] was non-approved and deviated from normal practice, bypassing all the safety criteria built into the design of the published non-precision approach procedures.

During the overflight and first landing approach, the navigator provided the pilot-in-command with distance to run and the lateral offset distance from the runway centreline. The navigator's reference to distance and lateral offset during those manoeuvres corresponded to the position of the aircraft in relation to the Runway 14 threshold as depicted on the Jeppesen charts. However, erroneous data on the Jeppesen charts meant that the information provided by the navigator was inaccurate. The crew's reliance on the incorrect chart data therefore increased the risk of a CFIT event.

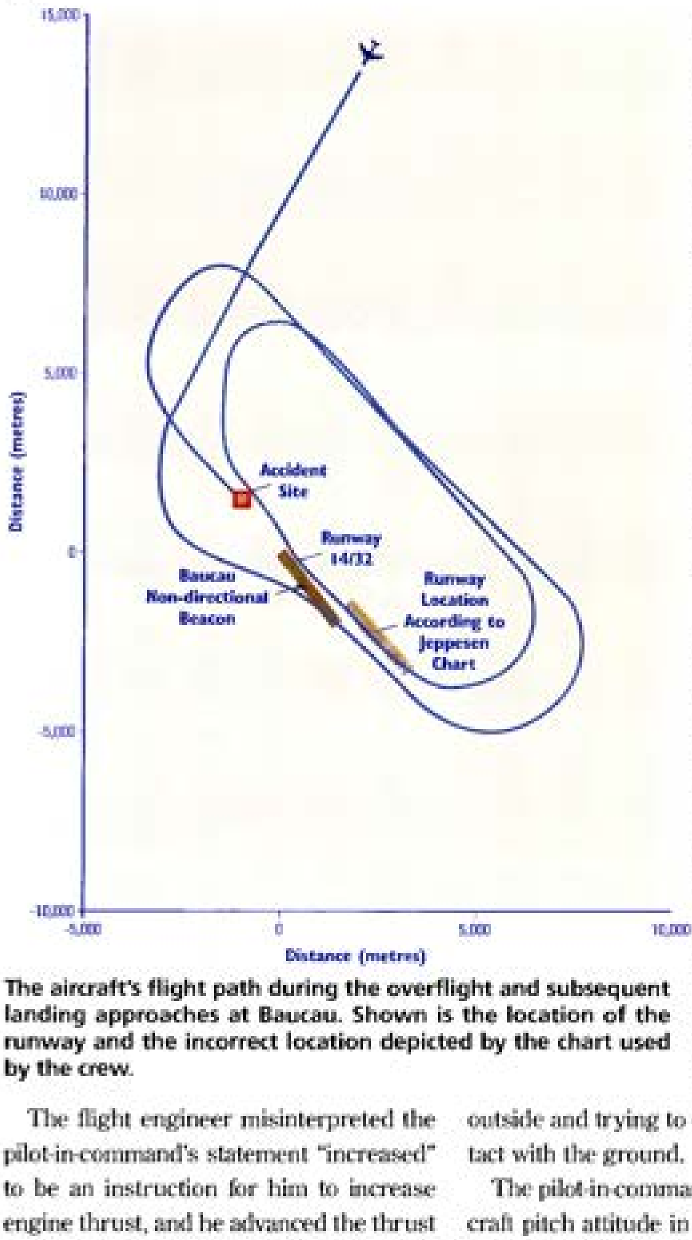
Had the flight crew followed the Runway 14 NDB approach procedure as published on either the CAD or Jeppesen charts, and not descended below the relevant MDA(H) until visual flight was assured, the position of the runway as depicted on the Jeppesen charts would have been irrelevant, although the runway would not have appeared where the flight crew expected it to be on reaching the MDA(H). In visual meteorological conditions (VMC), a safe approach could have been conducted. Alternatively, if a visual approach could not be made from the relevant MDA(H), a safe missed approach could have been conducted by following the published missed approach procedures.

During the overflight and the subsequent first landing approach, the flight crew realized that the runway was not where it was depicted on the Jeppesen charts. The pilot-in-command discontinued the landing approach and the navigator stated that he would apply a four-kilometre correction to position the aircraft for a second approach. By applying such a correction, the navigator provided the pilot-in-command with inaccurate data, resulting in the aircraft being positioned towards a point about 1.65 kilometres (0.88 NM) north-west of the actual runway threshold. That incorrect data substantially increased the risk of the user-defined approach procedure. The flight crew did not appear to identify the hazards associated with the improvised approach procedure, and was therefore not in a position to manage the associated risks.



The accident site is shown in relation to Runway 14. The Ilyushin 76TD freighter was photographed overflying the aerodrome (left) moments before it impacted terrain.

As the aircraft turned onto the final approach heading during the second landing approach, the navigator stated that it was high on the approach profile, based on his assumption of the runway threshold's location. The pilot-in-command, who flew the aircraft during both approaches, increased the rate of descent to about 18 metres per second (3,543 fpm) and stated "increased." None of the other crew members commented on this high rate of descent or drew his attention to the fact that the approach was unstabilized. The risk of a CFIT event is reduced by a stabilized approach, and the high descent rate in close proximity to terrain increased the risk of a CFIT event to the point where impact with terrain was almost certain. The CVR provided no evidence that the crew was monitoring the increasing risk or evaluating whether to discontinue the approach.



The aircraft's flight path during the overflight and subsequent landing approaches at Baucau. Shown is the location of the runway and the incorrect location depicted by the chart used by the crew.

The flight engineer misinterpreted the pilot-in-command's statement "increased" to be an instruction for him to increase engine thrust, and he advanced the thrust levers. The flight engineer's action in increasing engine thrust was a significant distraction to the pilot-in-command at that stage of the flight and probably diverted his attention from the primary task of flying the aircraft to restoring the thrust to the proper setting.

At about the same time, the aircraft descended through 162 metres, which was the published MDH for a straight-in landing on the Runway 14 NDB approach. Neither the pilot-in-command nor the co-pilot appeared to notice that the aircraft had descended through the MDH, and it is probable that both were distracted by the flight engineer's action. The risk of a CFIT event is increased if an approach is flown lower than the published MDA(H) of an instrument approach procedure before visual flight can be assured and maintained. Descent below the MDH, in instrument meteorological conditions (IMC) and with a high rate of descent, meant that the risk of a CFIT event had increased to an unacceptably high level.

The high rate of descent continued unchecked until less than two seconds before impact. It is probable that the pilot-in-command and the co-pilot were unaware of the high rate of descent because neither was monitoring the flight instruments while they were looking outside and trying to establish visual contact with the ground.

The pilot-in-command increased the aircraft pitch attitude in response to the co-pilot's urgent expression of concern, but did not simultaneously increase the engine thrust. His attempt to avoid impact with terrain was unsuccessful because of the inertia of the aircraft and its close proximity to terrain.

The aircraft's impact with terrain was a direct consequence of the aircraft descending below the published minimum descent height for the non-precision instrument approach procedure in an unstabilized manner. Furthermore, it was also as a result of poor planning by the flight crew and ineffective crew coordination. During the landing approach the actions and inactions of the flight crew steadily increased the risk of a CFIT to an extreme level, however, they seemed unaware of the likelihood of impact with terrain until about 2.5 seconds before this occurred.

Research conducted by an aviation industry task force under the patronage of ICAO has determined that the main reasons for aeroplane hull losses are CFIT and approach-and-landing accidents. In recent years CFIT accident reduction has been the focus of organizations such as ICAO and the Flight Safety Foundation (FSF). The findings of the FSF approach-and-landing accident reduction (ALAR) task force resulted in a number of conclusions and recommendations, and from these, the production of the FSF ALAR tool kit.

As highlighted by the accident report, deviations from standard operating procedures are a potential hazard, particularly during the approach and landing phase, and increase the risk of CFIT. Also highlighted is the fact that crew coordination is less than effective if crew members do not work together as an integrated team in which support crew members have a responsibility to ensure that the safety of a flight is not compromised by non-compliance with approved procedures.

The potential risk of CFIT can be diminished by using current technology and equipment, by implementing adequate standard operating procedures, by assessing and managing CFIT risk factors, and by developing effective crew decision-making and risk management processes.

Safety recommendations from the investigation of numerous CFIT events have been instrumental in the prevention of CFIT and approach-and-landing accidents. The Australian Transport Safety Bureau (ATSB) and CAD Timor-Leste endorse such recommendations and their implementation.

One of the IL-76TD's four engines. The flight crew did not appear to identify the hazards associated with their improvised approach procedure.

Report conclusions

Among the report's conclusions were findings related to the aircraft, flight crew, instrument approach procedures, provision of air traffic services, organizational factors and CFIT risk exposure. The conclusions include the following.

- There was no evidence of airframe failure or system malfunction before the accident.
- The aircraft was intact before impact and did not break-up in flight.
- There was no evidence of in-flight fire.
- There was no evidence that the cargo had shifted during the flight and led to controllability problems.
- The position of the relative bearing pointers on both of the recovered course indicators was consistent with them pointing to the Baucau NDB, suggesting that the NDB had been operating at the time of the occurrence and was available to the flight crew to conduct either of the published NDB instrument approaches at Baucau.
- The aircraft was in controlled flight when it impacted terrain.
- All damage to the aircraft was attributable to the severe impact forces and the fuel-fed post-impact fires.
- The pilot-in-command and the co-pilot did not hold instrument ratings that entitled them to pilot the aircraft under instrument flight rules.
- The landing approaches were conducted in instrument meteorological conditions.
- Flight crew coordination was not effective and compromised the safety of the flight.
- None of the flight crew commented on any of the information omitted from the descent approach briefing, although such comment was required by the procedures contained in the operator's operations manual.
- The flight crew conducted the overflight and two landing approaches at Baucau in poor visibility conditions.
- The flight crew conducted the two landing approaches in weather conditions that were below the relevant minima specified in the IL-76TD Flight Manual for NDB and visual approaches.
- The flight crew did not use the CAD-issued instrument approach and landing charts for the landing approaches at Baucau and instead relied on selected, but incorrect navigation data from the Jeppesen charts for user-defined GPS approaches.
- The flight crew did not comply with the published NDB approach procedures at Baucau with respect to the published MDA(H).
- The pilot-in-command permitted the aircraft to descend below the MDA(H) published on both the Jeppesen and CAD Runway 14 instrument approach charts during flight in instrument meteorological conditions.
- The flight crew formulated a user-defined GPS instrument approach procedure for the approaches at Baucau based on an incorrect assumption about the location of the Runway 14 threshold.
- The user-defined approach procedure formulated by the flight crew deviated from normal practice and bypassed the safety criteria built into the design of the published non-precision instrument approach procedures.
- The approaches into Baucau were not stabilized and increased the risk of a CFIT event.
- During the second landing approach, the descent was conducted at a high rate of descent in close proximity to terrain, thereby increasing the risk of a CFIT event.
- None of the flight crew recognized the need for a missed approach until collision with the terrain was almost certain.
- There was no procedure in place to provide flight crews of aircraft engaged in non-UN operations with an altimeter subscale setting for Baucau.
- The destination risk factors, type of operation, area of operation, weather conditions, and flight crew non-compliance with published procedures increased the CFIT risk to an above-average level.
- The flight crew did not comply with the published instrument approach or missed approach procedures at Baucau.

Safety action

The ATSB released a number of safety recommendations addressed to various entities including the Government of Timor-Leste, United Nations Air Operations, and ICAO. The report also identified safety actions that had been initiated as a result of the occurrence. These actions were initiated by CAD Timor-Leste, Jeppesen Sanderson Inc., and the United Nations Mission of Support in East Timor Air Operations (UNMISET).

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Unified strategy will ensure optimum safety, Council President informs global summit

Heralding a major change in policy, safety oversight audit reports will now be made available in their entirety to all ICAO member States, ICAO Council President Dr. Assad Kotaite informed a global summit held recently in Washington, D.C.

The audit report, which assesses the level of a State's implementation of ICAO standards and recommended practices (SARPs) as well as its safety oversight capability, is currently disseminated to member States only in the form of a summary. Dissemination of the full report will foster safety by providing for greater transparency of audit results and the sharing of important safety information.

Together with a new policy of support for more regional cooperation among States and stakeholders, the initiative is a key element in ICAO's unified strategy for resolving safety deficiencies.

Dr. Kotaite highlighted the policy change in his opening address to the Global Summit on Regional Aviation Safety Oversight, held in Washington from 1 to 3 February 2005. Attended by 152 high-level officials from 32 States and 10 international organizations, the Washington summit was also opened by Marion Blakey, Administrator of the U.S. Federal Aviation Administration (FAA).

The unified strategy was adopted by the 35th ICAO Assembly in the fall of 2004 (see "The Way Ahead," Issue 9/2004, page 5), which also approved the expansion of the Universal Safety Oversight Audit Programme (USOAP) to all safety-related annexes to the *Convention on International Civil Aviation*, ICAO's charter. The systematic and harmonized implementation of ICAO standards around the world is deemed essential to optimum aviation safety.

Dr. Kotaite predicted that expansion of USOAP under a comprehensive systems approach, a process which has already begun, should contribute substantially to further identification of deficiencies and safety concerns.

Dr. Kotaite at the recent global summit in Washington D.C. Looking on is FAA Administrator Marion Blakey.

As a result of the decision to disseminate full audit reports, he pointed out, ICAO member States will be able to review all audit findings, recommendations for remedying shortcomings, the action plan proposed by the State concerned, and ICAO's comments on the action plan.

"Transparency and sharing of safety information are a fundamental tenet of a safe air transportation system," the Council President explained.

The unified strategy being implemented by ICAO is clear and direct in urging member States to share with other States critical safety information which may have an impact on the safety of international air navigation, and to facilitate access to all relevant safety information. The strategy is also important because it stresses that aviation safety is the collective as well as the individual responsibility of Contracting States.

Assistance in addressing known safety deficiencies is available from ICAO through existing programmes such as the Technical Cooperation Programme and the International Financial Facility for Aviation Safety (IFFAS), which was established in 2003 to assist States in financing safety-related projects. But another option that has great potential, and the focus of the Washington summit, is the establishment of regional and sub-regional safety oversight organizations, a possible solution that was emphasized by the recent ICAO Assembly.

"Any improvement in safety on a worldwide basis depends on the collaboration of all stakeholders," Dr. Kotaite stated. "I encourage all stakeholders to forge better relationships with their counterparts in order to support countries and regional organizations in their various endeavours to comply with international standards."

The goal of the Washington summit, hosted by the George Washington University Consortium, was to foster the development and effective implementation of regional organizations for civil aviation safety oversight. Speakers from ICAO

ATM AUTHORITIES MEET

In preparing for implementation of reduced vertical separation minimum (RVSM), the Caribbean/South American Regional Planning and Implementation Group (GREPECAS) organized the last of a series of meetings and workshops for air traffic management authorities and planners in Lima, Peru, from 15 to 19 November 2004. RVSM implementation became effective throughout the Americas in January 2005 (see article, page 27). The GREPECAS meeting was attended by 102 participants including representatives of 24 States of the two regions plus five international organizations.

addressed different aspects of safety oversight, regional cooperation and national sovereignty, and other speakers focused on economics and on the scope and roles of international institutions. Panels were also established to discuss different themes related to regional cooperation and regional oversight organizations.

The Global Summit on Regional Aviation Safety Oversight, the President added, will provide substantive material for discussion at a forthcoming meeting of existing and prospective regional safety oversight groups at ICAO headquarters in October 2005.

While in Washington, the Council President and ICAO Secretary General Taïeb Chérif, who also attended the global summit, met with the FAA Administrator, the Under Secretary of Transportation for Policy, the Deputy Assistant Secretary of State for Transportation Affairs, and other high-level officials from the FAA and the State Department. Discussions covered the implementation of the ICAO safety and security audit programmes and environmental matters, specifically the possibility of market-based measures to limit or reduce the environmental impact of aircraft emissions. In addressing this subject last fall, the ICAO Assembly urged Contracting States to refrain from unilateral implementation of greenhouse gas emissions charges prior to the Assembly's next regular session in 2007, at which time this matter will be considered and discussed again.

The Council President also met with the Under Secretary of State for Economic, Business and Agricultural Affairs and the Deputy Assistant Secretary of State for Transportation Affairs to discuss the adverse safety and security impact of trade embargoes on U.S.-made equipment and spare parts and on the ability of certain States to participate in international air transport. □

Panel to study aerodromes

ICAO has established a new panel to undertake specific studies related to aerodrome design and operations. The ICAO Aerodromes Panel (AP), which held its first meeting in Montreal in December 2004, will initially focus on a review of aerodrome design specifications in light of the need to accommodate new larger aeroplanes. The panel's work will also cover visual aids, airport operational safety issues and heliport design, with several tasks scheduled to be completed in 2006. □

Americas implement RVSM

The minimum vertical distance between aircraft operating in the airspace of North, Central and South America and the Caribbean has been reduced by half, resulting in more efficient flight operations and related benefits for airlines, passengers and the environment, ICAO announced in January.

By providing for 1,000 feet of separation for aircraft flying between flight level (FL) 290 and FL410, RVSM offers access to more efficient cruising levels when responding to changing operating conditions. The benefits include less fuel burn and related cost savings for airlines as well as reduced pollution from engine emissions. The creation of six more flight levels also increases overall airspace management efficiency, leading to better on-time performance and fewer delays on major air traffic routes.

RVSM was first implemented in 1997 in North Atlantic airspace, and has been introduced successively over Europe, the Pacific, Asia, the Middle East, and in the Europe-South America corridor. It took effect throughout the Americas on 20 January 2005, and will eventually be expanded to all airspace, achieving worldwide implementation.

A cost-benefit analysis related to North Pacific operations has shown a fuel cost reduction of 0.5 to 1 percent, representing a savings of approximately U.S. $8 million per year. In Europe, a similar analysis indicated that airlines could save close to 60 million euros annually.

For the Caribbean and South and Central American regions, it is expected that airlines will save approximately U.S. $400 million over a 15-year period in fuel consumption on international flights alone. In North America the estimated cost savings is approximately U.S. $5.3 billion over the same period.

RVSM implementation followed extensive coordination and preparation for more than three years. The preparatory work, under the leadership of ICAO's regional offices in Lima and Mexico City, involved 35 States and 13 territories, and required the cooperation of major stakeholders in the air transport industry.

"This latest achievement," emphasized ICAO Council President Dr. Assad Kotaite, "is another significant step forward in ICAO's global cooperative effort with its Contracting States, airspace users and service providers to maximize operational benefits for all concerned while at the same time ensuring that safety remains our top priority." □




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ICAO Council appointment

H. A. Wilson
(Saint Lucia)

Herald Alexander Wilson has been appointed Representative of Saint Lucia on the Council of ICAO. The tenure of Mr. Wilson commenced on 15 November 2004.

Mr. Wilson has acquired 36 years of experience in the field of civil aviation following his successful completion of an air traffic controller's course in Trinidad and Tobago in 1968. He holds a bachelor of science degree in aviation management from Embry-Riddle Aeronautical University in Florida, and a post-graduate diploma in professional aviation business management from McGill University of Montreal. His aviation training has taken him to the United Kingdom, Lebanon, the United States, Canada and Singapore, and has covered a wide range of subjects, among them aviation security, aircraft accident investigation, airport management, airworthiness administration, air transport and aviation safety oversight.

In 1984, Mr. Wilson was appointed Deputy General Manager of the Saint Lucia Air and Sea Ports Authority, where he was responsible for the operations and development of the two international airports on the island.

Mr. Wilson currently holds the position of Director General of Civil Aviation in the newly established Eastern Caribbean Civil Aviation Authority of the Organization of Eastern Caribbean States (OECS), which is a grouping of several small island States.

Mr. Wilson, the holder of a private pilot's licence, has represented Saint Lucia at many regional and international meetings, including bilateral and multilateral air services negotiations. □

ADS-B implementation

continued from page 8

the support of air traffic management. These may include:

- improved airport surface surveillance using ADS-B and multilateration;
- improved operational control and fleet management for all aviation sectors once surveillance data can be more easily shared;
- improved safety through surveillance data sharing between States, particularly at flight information region (FIR) boundaries;
- possible use of ADS-B for precision runway monitoring at Sydney;
- progression of airspace reform, giving greater freedom to recreational and glider communities;
- improved flow management; and
- the deployment of more advanced applications, such as the air-air applications being examined by Eurocontrol and the U.S. Federal Aviation Administration. □

ATC simulation

continued from page 12

valuable for training, but can also be used in other applications, thereby maximizing the purchaser's investment. For example, airport authorities can use the simulator to assess the traffic flow effects of new runway, taxiway and holding area configurations, and can even employ its "eye point" technique to optimally position a proposed new control tower or other visual or radar surveillance facilities. The eye-point feature is a unique tool which allows the controller to display the view seen from literally any location, including the flight deck of a selected aircraft, either in the air or on the ground, or from the cab of an airport surface vehicle or even a nearby mountain top.

Conversely, the eye-point feature can be used to assess whether a planned new terminal or other building — the location, shape and size of which can be simply, yet accurately, programmed into the tower's visual scene — will create unacceptable blind spots from the tower. In one such application, a European customer has already used Raytheon Canada's FIRST*plus* to help determine the optimum location of a soon to be constructed new tower and other airfield buildings. In a tower location study, of course, the eye-point feature allows controllers on the planning team to put themselves in the virtual tower at the appropriate height above the ground, where they can then assess the visual coverage of the airport from that location: an extremely helpful and potentially cost-saving planning capability. And perhaps even more valuable, air traffic specialists can use the simulator's radar displays to evaluate changes in airspace design, and assess the advantages and disadvantages of proposed reconfigurations and associated new procedures prior to their introduction.

Yet the simulator's training benefits are not limited to air traffic control applications. The airport visual scene, with its runways, taxiways and service buildings, coupled with the system's ability to simulate aircraft accidents and other airport emergencies, allow crash, fire and rescue personnel, airport security managers and others to create a wide range of adverse situations in order to assess current response strategies and, if necessary, develop new procedures.

When initially installed, the simulator's computers are normally configured to cover the user's airspace and airports as well as the current radar and tower control configurations although, as indicated above, any of these data can be readily modified by user personnel. The options available are too numerous to list but, to mention just two examples, paper or electronic flight strips in user-definable formats can be selected and military features, from arrester barriers to overhead formation breaks and even to the inclusion of unmanned aircraft, can be incorporated.

Advanced simulators also store virtually all recent civil and military aircraft types, together with their performance characteristics in various operating conditions and configurations. In the case of civil airliners, careful attention to an individual air carrier's distinctive paint scheme is also important, for it allows quick recognition by tower personnel of aircraft both on the aerodrome surface and in the air. In the case of a distant aircraft, a simulated binocular feature can be pointed at the target, allowing its type and colour scheme to easily reveal its identity.

The future. Clearly, air traffic controller training today is a far cry from those early days when a student's classroom instruction was simply a precursor to an extended apprenticeship within an operational organization.

Modern, realistic simulation training can now produce highly qualified individuals who not only understand the requirements and protocols of the various control positions at an ATC facility, but also can be more quickly integrated into the facility's staff. Perhaps more importantly, however, they will have already demonstrated their ability to handle the pressures that go with being a member of one of the most demanding professions in aviation today.

The anticipated long-term increase in air traffic, accompanied by the worldwide transition to new technologies like controller/pilot data link communications (CPDLC), automatic dependent surveillance (ADS) and spaceborne navigation satellites, lead us to an air traffic management concept where controllers serve as system managers. Accordingly, training establishments are increasingly adopting advanced air traffic control simulators as the most efficient medium to produce high-quality graduates who will in turn assure the safety of air transportation in the years ahead. □

Airport watch programme

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and will remain so in the future.

As with the Ottawa group, the Toronto volunteers are subject to basic police checks. The group has now formed an executive committee and continues to enjoy a growing membership list.

Overall, airport authorities are pleased with the emergence of volunteer airport watch programmes. The Ottawa authority is, in fact, so pleased with its positive relationship with this community group that it has funded numerous projects including the purchase of all-season aviation jackets for the volunteers. They are marked with the airport authority's logo and have the name of the programme emblazoned in reflective letters on the back. Such support is important since airports are often at odds with local communities over issues such as aircraft noise. More recently, the Canadian Air Transport Security Authority (CATSA), which is responsible for screening operations at 89 airports, has agreed to support a number of the volunteer groups by funding apparel and other items branded with the groups' respective local airport watch insignia.

Over the years at Ottawa, the volunteers have participated in security activities during air shows, and a number of them have become part-time ambassadors for the airport authority and FBOs. Some facilities even display their photographs. Interest in harnessing volunteers continues to grow. The RCMP and the Ottawa Police Service, for instance, have provided information on the programme to enthusiasts and officials at airports as far away as Glasgow, Melbourne and Johannesburg, and the topic was presented to the U.S.-based Airport Law Enforcement Agencies Network (ALEAN) by the RCMP in 2002.

In summary, the Ottawa Airport Watch has provided valuable assistance in reporting suspicious activity near runway departure or approach paths as far away as 10 kilometres. This is especially of value during high-profile State visits, of which Ottawa, being a national capital, has many. The RCMP, Transport Canada and the Canadian Department of National Defence have promoted the watch programme during presentations to airport authorities across Canada as a beneficial airport perimeter security initiative. In Canada, the programme has also

been recognized and supported by the federal Minister of Transport.

Clearly, aviation enthusiasts at many airports around the world could benefit from such a programme, as would the respective airport authorities and the public at large. □

Cabin safety

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build-up as a specific crew support threat, where catering personnel board racks that are not clean enough for use. The threat remains latent until cabin crew switch on the oven and the grease ignites.

Once specific threats related to in-flight fire events are identified by data analysis, prevention strategies can also be developed. In this case, individual threat management strategies may include a thorough inspection of equipment, assuring it has not been labelled unserviceable by a previous crew, a review of the cabin defect log book, and monitoring of equipment during use. Formal airline interventions to support cabin crew threat management may include developing and implementing properly designed SOPs and discussion of both individual and formal safety action during initial and recurrent training.

Analysis of STEADES data also identified unrestrained galley equipment as both a crew support and aircraft threat. Cabin safety reports show that specific threats in this area include poorly maintained equipment with worn-out brakes or defective latches or overweight bar carts or bins. Defective restraining devices combined with cart overload may result in a runaway cart. Cabin crew errors are also evident in unrestrained equipment events such as equipment left unsecured or incorrectly handled by cabin crew.

Individual threat management strategies include properly conducted pre-flight checks and coordination with flight and ground crews to ensure that defective equipment is off-loaded prior to flight. Formal airline intervention to support cabin crew threat management may include development of specific verification procedures for ground crew and periodic maintenance inspections.

Conclusion. Using a valuable source of data such as STEADES, the TEM model provides a framework for identifying and understanding the operational threats that cabin crews must face during everyday operations, as well as the errors such threats may generate. Understanding threats and errors may lead to formal interventions such as the development or revision of SOPs or the refinement of existing practices. Knowledge of operational weaknesses can be used to develop initial and recurrent training courses for cabin crew that target areas of concern. □

Improved forecasting

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their perception does not consider the evidence of error, especially for flights at levels that are interpolated rather than directly supplied from the WAFS data, and also for some short-haul flights. Given the well-known difficulty in interpolating wind forecasts in the vertical (and the fact that most flight routing companies run their own calculations), the WAFCs have concluded that the provision of thinned GRIB data in greater vertical resolution (i.e. with more levels) would provide significant benefits, especially with greater use of reduced vertical separation minimum (RVSM).

Looking at a road-map for future developments for thinned GRIB forecasts, it seems likely that the addition of icing, turbulence and cumulonimbus will occur first, followed by the addition of more levels. Shall we ever see an increase in the horizontal resolution? The answer would appear to be yes, but possibly not as part of the global WAFS product. A more likely evolution would be the development of a short-term "nowcasting" product combining numerical modelling, radar, satellite and aircraft observations. This would generate forecasts on a localized basis in a way that maximizes the benefits and minimizes the additional data volume.

Scientific workshop. ICAO, through the WAFS Operations Group, has set up a workshop at the Met Office in Exeter, United Kingdom, in late February 2004 to examine ways in which the algorithms used to calculate icing and turbulence could be improved. By the time this article appears in print, work to incorporate the workshop results into the forecast process will be under way. It is expected that a trial product will be available in mid-2005. Subsequent operational use will depend on the results of trials, verification, and the addition of the product to the requirement specified in ICAO Annex 3.

In summary, the ongoing work to add forecasts of turbulence, icing and CB presence to the thinned GRIB product is on the verge of delivering real benefits to the global aviation industry, and the Met Office now looks forward to the operational trials. □

CFIT accident report

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Among several safety recommendations addressed to the Government of Timor-Leste were those concerning the development and promulgation of approved instrument approach and aerodrome charts for the Baucau airport, the provision of current and approved data for use in charts, and the provision of air traffic services including current weather details and altimeter subscale settings for non-UN operations at Baucau. The report also recommended that the CAD liaise with UN Air Operations concerning ways to improve the safety of aerodrome operations by non-UN aircraft.

A safety recommendation addressed to UN Air Operations called for assistance for the Government of Timor-Leste in developing and promulgating approved instrument approach and aerodrome charts for Baucau.

The report also contained a recommendation calling for ICAO to publicize the safety information contained in the final report, and to encourage all Contracting States, where English is not the native language, to translate and distribute the accident report in the native language.

Among a number of safety actions taken as a result of the accident, the CAD in October 2003 issued updated approach and landing charts conforming with ICAO standards and recommended practices for Runways 14 and 32 at Baucau. Jeppesen Sanderson and the UN Mission of Support in East Timor Air Operations had also implemented safety action by early 2003.

The full report, including findings and safety recommendations and action not cited here, is available at the ATSB website. □

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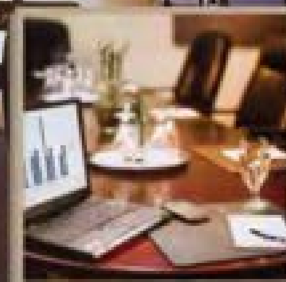

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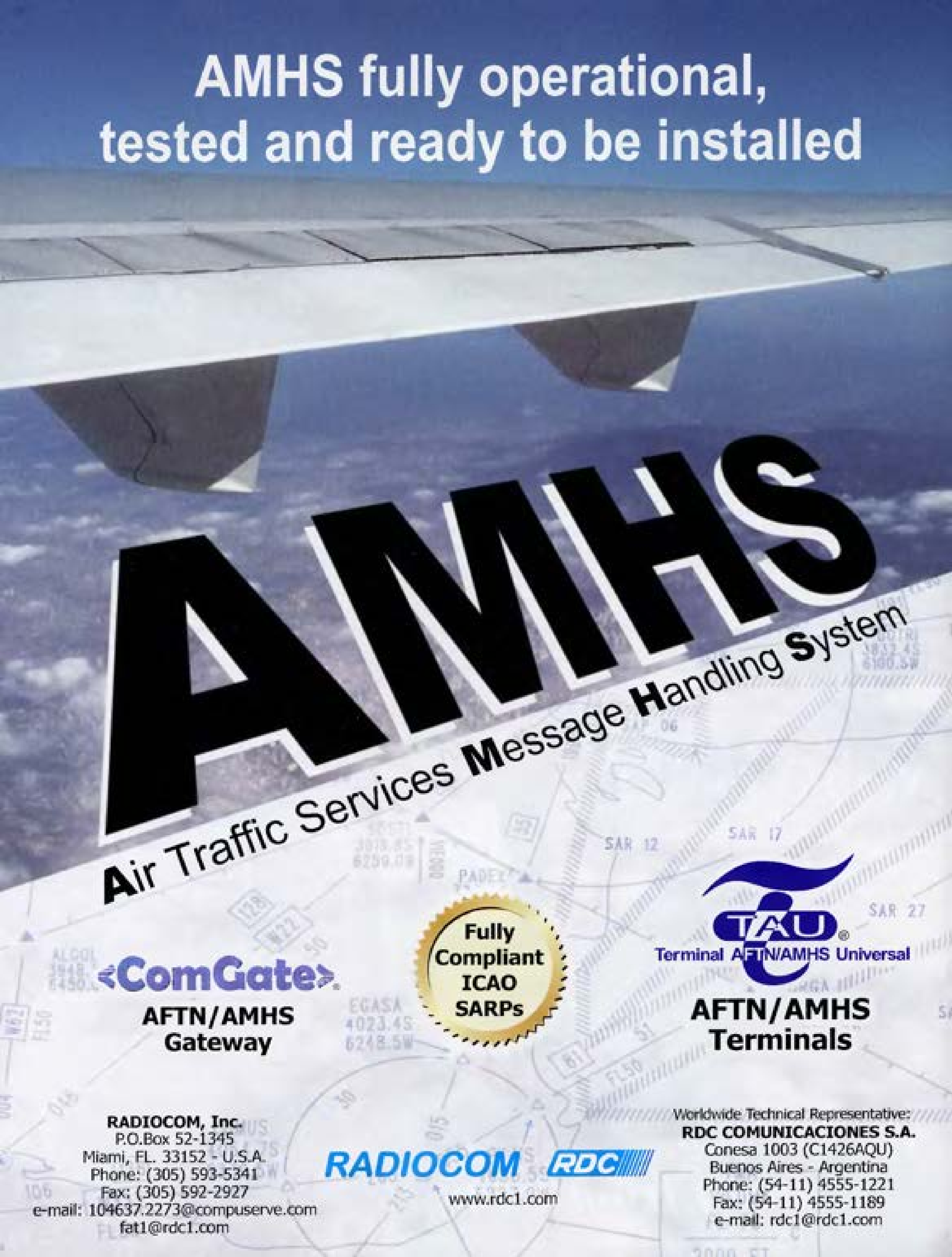
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