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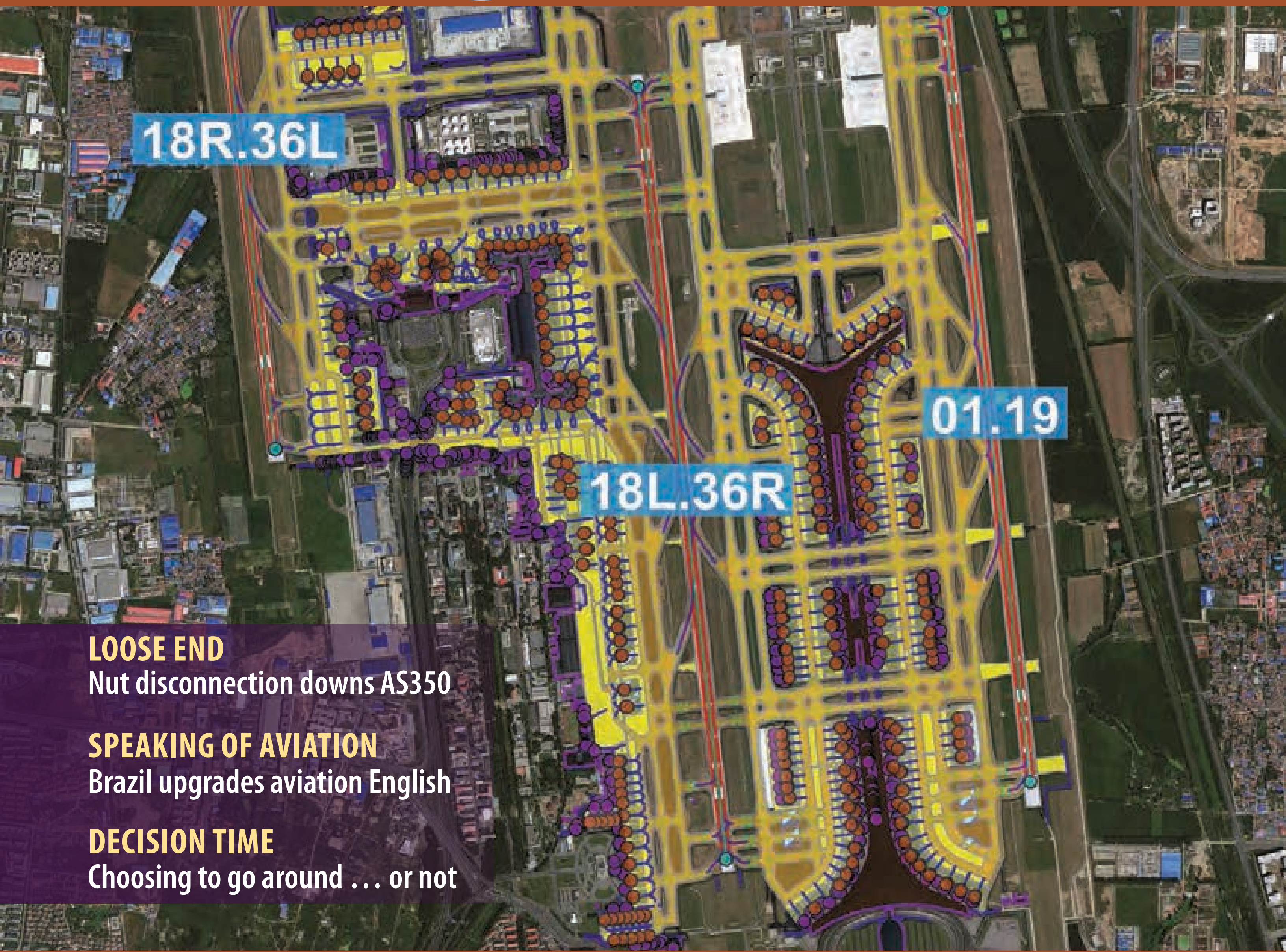

LOOSE END
Nut disconnection downs AS350

SPEAKING OF AVIATION
Brazil upgrades aviation English

DECISION TIME
Choosing to go around . . . or not

GEOGRAPHIC INFORMATION SYSTEMS

LOCATION, LOCATION, LOCATION

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

APRIL 2013

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LITHIUM-ION Batteries

Lithium-ion batteries commonly used in portable electronic devices, like cell phones, laptops and cameras, have commanded their share of attention in air transport, but it is the application of this technology in the Boeing 787 that has dominated aviation safety news for two months. As this issue of *AeroSafety World* is going to press, the U.S. National Transportation Safety Board and Japan Transport Safety Board are continuing to investigate the two battery-related incidents that occurred on 787s operated by Japan Airlines (JAL) and All Nippon Airways (ANA) in January. On March 12, the U.S. Federal Aviation Administration (FAA) approved Boeing's certification plan for a redesigned 787 battery system and the OEM started testing the system.

According to U.S. Transportation Secretary Ray LaHood: "This comprehensive series of tests will show us whether the proposed battery improvements will work as described. We won't allow the plane to return to service unless we're satisfied that the new design ensures the safety of the aircraft and its passengers."

I'm not going to wade into the pool of speculation about what happened on board the JAL and ANA flights in question. Nor am I going to venture a guess on how long testing of the redesigned battery system may take or when FAA is going to lift its grounding of the 787.

What I do want to address is the promise from Secretary LaHood and FAA Administrator Michael Huerta that FAA would review the 787 certification process. The Foundation agrees that this is a necessary step to ensure there were no oversights in making sure the aircraft design and operation are safe. However, this is not the only step the FAA needs to take. What also needs to be accomplished is an evaluation of FAA airworthiness-certification processes to make sure they are keeping up with modern-technology aircraft.

During the certification process, the FAA doesn't have enough organic resources to monitor and approve the building of the aircraft. In order to move the process along, the FAA uses "designees." These are individuals who work for the manufacturer but wear two hats. One is for the company function they perform, the other is for the FAA, to certify that what has been done by the company will be certified. This system works well and is used in other areas such as pilot training. My concern is about the standards the designees are required to meet. Have the standards been upgraded to reflect that designees must not only have the knowledge, but the experience, to do the job?

The FAA has a good system and reviewing this certification process will be another step toward taking the best and doing better.

Capt. Kevin L. Hiatt
President and CEO
Flight Safety Foundation

AeroSafety WORLD

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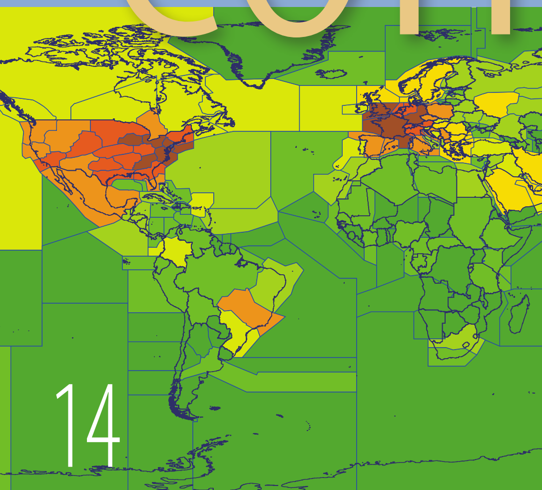

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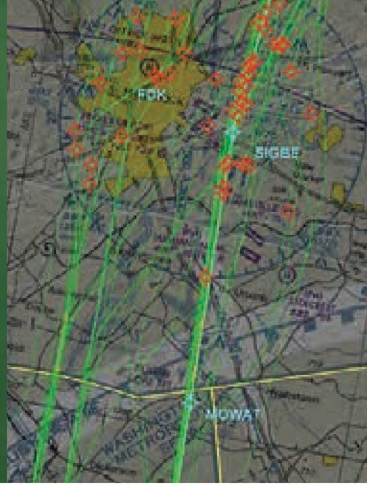

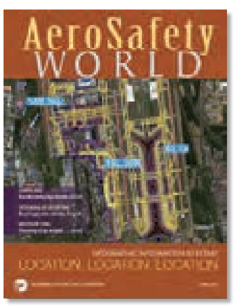

About the Cover
A GIS-based map depicts features at Beijing Capital International Airport.
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If you have an article proposal, manuscript or technical paper that you believe would make a useful contribution to the ongoing dialogue about aviation safety, we will be glad to consider it. Send it to Director of Publications Frank Jackman, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA or jackman@flightsafety.org.

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Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,000 individuals and member organizations in 150 countries.

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Safety Information PROTECTION

BY KENNETH P. QUINN

The aviation industry is the safest it has ever been, but must be improved to handle burgeoning demand. To get there, we must be more predictive and less forensic. Yet, national legal regimes and international guidance to protect safety information are lagging behind global efforts to gather, analyze and share voluntary and mandatory safety disclosures.

Basic safety management systems (SMSs) depend on a climate that is confidential, without fear of retribution. Yet the quantum safety leap envisioned by SMS is imperiled by the lack of legal protection from criminal attack, civil subpoena and administrative misuse.

As vice chair of the International Civil Aviation Organization's (ICAO's) Task Force on Safety Information Protection (SIP), I have worked with Chair Jonathan Aleck of Australia's Civil Aviation Safety Authority and other distinguished professionals for the past two years. We reviewed existing legal and cultural regimes, trouble areas, international guidance and possible fixes. We met with prosecutors and listened to plaintiffs and defense lawyers, aerospace companies, cargo operators, business aviation and victims' family groups.

We heard broad support for, and confusion over, notions of "just culture." Some thought just culture a euphemism for a free pass, even for egregious error, while others had vastly different understanding, and sought "justice" after a crash. To be clear: No responsible observer believes the industry should be immune from the ordinary application of criminal law, especially for acts of gross negligence or willful misconduct. Where do we draw the line?

These are tough calls, but it's clear that existing legal protection is inadequate to ensure the confidentiality of safety information. Exceptions that permit disclosure for the "proper administration of justice" are too vague and too subjective. Existing guidance is either misunderstood, or just ignored, inadvertently or purposefully.

As to solutions, no one size fits all. Many jurisdictions are loathe to approach their judiciary or law enforcement about training. Others seeking confidential treatment run up against government transparency. Most, however, see great value in advance arrangements, cooperative and respectful dialogue, and protective mechanisms to prevent a chilling effect, if required to provide safety information in legal proceedings.

Current ICAO guidance is intended to strike a balance that is not easy to achieve. When is the use or release of confidential safety information necessary? Who decides? If safety and occurrence reports are used in civil litigation, criminal prosecutions or administrative enforcement proceedings, will people be less likely to report? What are these appropriate uses?

The ICAO SIP Task Force has wound up its efforts. It will now be up to the Air Navigation Commission and the Council itself to decide on changes. In the meantime, contracting states are pushing the throttle forward. Brazil is considering new legislation and training its judges. The European Commission has promulgated and proposed several directly applicable laws, including its Regulation 996/2010 on accident investigation, and in December 2012, on occurrence reporting, to encourage the collaborative advance arrangements and safety information protection. New FAA reauthorization laws further protect voluntary reporting systems from freedom of information–type disclosure.

The top priority for states should be to create an environment where safety information can be shared without fear of retribution. This includes ensuring the availability and integrity of future accident and incident reporting and voluntary reporting systems, and swift action to prevent their misuse. Lives depend on it.

THE NEW Normal

The mere prospect of sequestration was supposed to be so unspeakably horrible that even a deeply divided and historically partisan U.S. Congress would never let it happen. The conventional wisdom was that sanity eventually would prevail and a compromise would be reached, thus avoiding billions of dollars in indiscriminate cuts in the federal budget this year and $1.5 *trillion* in cuts over the next decade.

We should have known better. Wisdom, conventional or otherwise, often doesn't play a role in U.S. politics. The country's two primary political parties are concerned more with emasculating each other than they are with governing, but we'll let someone else editorialize about that.

Here at Flight Safety Foundation and *AeroSafety World,* our focus is safety, and with $637 million to be slashed from the Federal Aviation Administration's (FAA's) budget *this year* (by Oct. 1), I think there is ample reason for concern. The budget cuts are going to mean furloughs, likely one day every two weeks, for nearly all FAA employees, and the closing of 238 air traffic control towers across the country, among other measures.

In early March, FAA Administrator Michael Huerta spoke at the Aviation Forecast and Policy Summit organized by the American Association of Airport Executives (AAAE), and I asked him about the impact sequestration will have on the safety of the aviation system. He responded that in order to maintain safety, the system may need to take a penalty in terms of efficiency. As an example, he offered that Chicago O'Hare International Airport has two control towers. If a situation should arise in which there are not enough controllers available to staff both, operations would be consolidated into one, meaning that one of the airport's runways would have to be taken out of use.

FAA's approach is to minimize the impact on the greatest number of travelers. The towers slated for closure are at airports that see fewer than 150,000 flight operations per year or fewer than 10,000 commercial operations per year. The FAA's strategy is understandable, but I shudder to think what this could mean for general aviation and corporate flying. And what about commercial flights scheduled into airports with unmanned towers?

Perhaps just as disturbing as the fall into sequestration is the notion, voiced more than once at the AAAE event, that this is the "new normal," that the U.S. aviation system is going to have to learn to make do with less from now on. The immediate pain, of course, will be felt in the form of long lines and flight delays, but what is this going to mean for the development and certification of new technologies and safety enhancements, or changes to existing equipment? How inefficient can the system get before it stalls?

Frank Jackman
Editor-in-Chief
AeroSafety World

APRIL 9–11 ➤ Heliport Evaluation Course. U.S. Department of Transportation, Transportation Safety Insititute. Okahoma City, Oklahoma, U.S. Lisa Colasanti, <AviationTrainingEnrollment@dot.gov>, <1.usa.gov/WD7WWR>, +1 405.954.7751. (Also JUNE 11–13.)

APRIL 10–11 ➤ 58th annual Business Aviation Safety Seminar. Flight Safety Foundation and National Business Aviation Association. Montreal. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/aviation-safety-seminars/business-aviation-safety-seminar>, +1 703.739.6700, ext. 101.

APRIL 11–13 ➤ Internal Evaluation Program Theory and Application. U.S. Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. Troy Jackson, <troy.jackson@dot.gov>, <www.tsi.dot.gov>, +1 405.954.2602. (Also SEPT. 17–19.)

APRIL 15–17 ➤ Ops Conference. International Air Transport Association. Vienna. <www.iata.org/events/Pages/ops-conference.aspx>.

APRIL 15–19 ➤ OSHA/Aviation Ground Safety. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

APRIL 16–18 ➤ World Aviation Training Conference and Tradeshow (WATS). Halldale Group. Orlando, Florida. Zenia Bharucha, <zenia@halldale.com>, <www.halldale.com/wats>, +1 407.322.5605.

APRIL 17–19 ➤ Passenger Risk Assessment. Green Light Ltd. Reykjavik, Iceland. Alessandra Martina, <amartina@avsec.com>, <www.avsec.com>, +44 20 8255 9447.

APRIL 18–19 ➤ Air Accident Investigation in the European Environment. European Society of Air Safety Investigators. Madrid. Lauren Kelly, <lauren.kelly@rtiforensics.com>, <www.esasi.eu/esasi2013.html>.

APRIL 22–26 ➤ Aviation Safety Program Management. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

APRIL 23–25 ➤ International Accident Investigation Forum. Air Accident Investigation Bureau of Singapore. Singapore. Steven Teo, <steven_teo@mot.gov.sg>, fax: (65) 6542-2394.

APRIL 29–MAY 3 ➤ Aircraft Accident Investigation. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

APRIL 29–MAY 10 ➤ Aircraft Accident Investigation. Southern California Safety Institute. Prague, Czech Republic. Denise Davalloo, <denise.davalloo@scsi-inc.com>, <www.scsi-inc.com/AAI.php>, +1 310.940.0027, ext. 104. (Also JULY 8–19 and SEPT. 30–OCT. 11, San Pedro, California, U.S.)

APRIL 30–MAY 2 ➤ Maintenance Management Conference. National Business Aviation Association. Fort Worth, Texas, U.S. <info@nbaa.org>, <www.nbaa.org/events/mmc/2013>, +1 202.783.9000.

MAY 2–3 ➤ Air Transportation of Hazardous Materials. U.S. Department of Transportation, Transportation Safety Institute. Anchorage, Alaska, U.S. Lisa Colasanti, <AviationTrainingEnrollment@dot.gov>, <1.usa.gov/VRFRYQ>, +1 405.954.7751. (Also JULY 30–AUG. 1, Oklahoma City, Oklahoma, U.S.)

MAY 6–8 ➤ Asia-Pacific Conference. Civil Air Navigation Services Organisation. Jakarta, Indonesia. Anouk Achterhuis, <events@canso.org>, <www.canso.org/asiapacificconference2013>, +31 (0)23 568 5390.

MAY 6–10 ➤ Advanced Aircraft Accident Investigation. Embry-Riddle Aeronautical University. Prescott, Arizona, U.S. Sarah Ochs, <case@erau.edu>, <bit.ly/wtWHln>, +1 386.226.6000.

MAY 13–17 ➤ SMS Theory and Principles. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <maimail@mitre.org>, <bit.ly/14E7NFV>, +1 703.983.5617. (Also JULY 15–18, SEPT. 16–20, DEC. 9–13.)

MAY 14–16 ➤ Advanced Rotorcraft Accident Investigation. U.S. Department of Transportation, Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. Lisa Colasanti, <AviationTrainingEnrollment@dot.gov>, <1.usa.gov/ZM138r>, +1 405.954.7751.

MAY 16–17 ➤ Air Medical and Rescue Congress. China Decision Makers Consultancy. Shanghai, China. <info@cdmc.org.cn>, <www.cdmc.org.cn/2013/amrcc>,+86 21 6840 7631.

MAY 20–24 ➤ Unmanned Aircraft Systems. Southern California Safety Institute.Prague, Czech Republic. Denise Davalloo, <denise.davalloo@scsi-inc.com>, <www.scsi-inc.com/unmanned-aircraft-systems.php>, +1 310.940.0027, ext.104.

MAY 21–23 ➤ European Business Aviation Convention & Exhibition (EBACE). European Business Aviation Association. Geneva, Switzerland. <www.ebace.aero/2013>.

MAY 21–24 ➤ Aircraft Fire and Explosion Course. BlazeTech. Woburn, Massachusetts, U.S. Albert Moussa, <firecourse@blazetech.com>, <www.blazetech.com>, +1 781.759.0700, ext. 200.

MAY 30–31 ➤ 2Gether 4Safety African Aviation Safety Seminar. AviAssist Foundation. Lusaka, Zambia. <events@aviassist.org>, <bit.ly/TtMkqD>, +44 (0)1326-340308.

JUNE 4–6 ➤ Advanced Commercial Aviation Accident Investigation. U.S. Department of Transportation, Transportation Safety Institute. Oklahoma City, Oklahoma, U.S. Lisa Colasanti, <AviationTrainingEnrollment@dot.gov>, <1.usa.gov/XY6yet>, +1 405.954.7751.

JUNE 6–7 ➤ Overview of Aviation SMS and Proactive Hazard ID and Analysis Workshop. ATC Vantage. Tampa, Florida, U.S. <www.atcvantage.com/sms-workshop.html>, +1 727.410.4759. (Also NOV. 7–8.)

JUNE 21 ➤ Dangerous Goods Training Course for Safety Assessment of Foreign Aircraft Programme Inspectors. Joint Aviation Authorities Training Organisation. Hoofddorp, Netherlands. <jaato.com/courses/106/#>. (Also DECEMBER 13.)

JUNE 21–23 ➤ Flight Attendants/Flight Technicians Conference. National Business Aviation Association. Washington, D.C. Jay Evans, <jevans@nbaa.org>, <www.nbaa.org/events/fa-ft/2013>, +1 202.783.9353.

JUNE 24–28 ➤ Safety Assessment of Aircraft Systems. Cranfield University. Cranfield, Bedfordshire, England. <shortcourse@cranfield.ac.uk>, <bit.ly/TMAE39>, + 44 (0) 1234 754192. (Also NOV. 25–29.)

JULY 10 ➤ Hazardous Materials Air Shipper Certification Public Workshop. Lion Technology. Dedham, Massachusetts, U.S. (Boston area). Chris Trum, <info@lion.com>, <bit.ly/XNDWUv>, +1 973.383.0800.

Aviation safety event coming up? Tell industry leaders about it.

If you have a safety-related conference, seminar or meeting, we'll list it. Get the information to us early. Send listings to Rick Darby at Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or <darby@flightsafety.org>.

Be sure to include a phone number and/or an email address for readers to contact you about the event.

Who Has the Time?

The article (*ASW*, 12/12–1/13, p. 21) on the U.S. rules calling for increased experience for pilots seeking commercial airline positions included comments from Capt. Chesley Sullenberger, which I take some exception to.

Capt. Sullenberger argues that 1,500 hours of logbook time for airline applicants is not enough. He goes on to say that, had he had a first officer "with much less experience" than the 20,000 hours his F.O. had on the flight which ended with a ditching in the Hudson River, "we would not have had as good an outcome and people would have perished."

I take *nothing* away from the airmanship Capt. Sullenberger and his crew displayed that day. Yet it seems unreasonable to think that the majority of commercial airline first officers, most of whom have far fewer than 20,000 hours, would be so unable to assist a captain in dire circumstances that they would become a direct contributing factor to loss of life or limb. I don't suggest that first officers have not erred. But must they have 20,000 hours before they are able to do the job competently?

Suggesting that less-experienced first officers (and is he also implying captains with fewer than 20,000 hours?) could not deliver the safety demanded by the FAA, and expected by the flying public, seems a harsh judgment.

Alan Gurevich
MD-11 first officer,
former U.S. Navy Aircraft Commander

AeroSafety World encourages comments from readers, and will assume that letters and e-mails are meant for publication unless otherwise stated. Correspondence is subject to editing for length and clarity.

Write to Frank Jackman, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or e-mail <jackman@ flightsafety.org>.

Safety News

Boeing 787 Plans Approved

Boeing's certification plan for the redesigned battery system on its 787 has been approved by the U.S. Federal Aviation Administration (FAA) — the first step in returning the airplane to flight.

Boeing next will conduct testing and analysis to demonstrate that the battery system complies with applicable safety regulations.

"This comprehensive series of tests will show us whether the proposed battery improvements will work as designed," said Transportation Secretary Ray LaHood. "We won't allow the plane to return to service unless we're satisfied that the new design ensures the safety of the aircraft and its passengers."

The FAA grounded all U.S.-registered 787s in January after an in-flight battery problem on an All Nippon Airways domestic flight in Japan. Other civil aviation authorities around the world immediately took similar action.

Boeing subsequently redesigned the internal battery components "to minimize initiation of a short circuit within the battery," the FAA said. Other changes included improved insulation of battery cells and the addition of a containment and venting system.

Ray Conner, president and CEO of Boeing Commercial Airplanes, said the company's planned changes will "significantly minimize the potential for battery failure while ensuring that no battery event affects the continued safe operation of the airplane."

The FAA approved plans calling for limited test flights involving two 787s that will be equipped with the prototype versions of the new containment system.

The FAA said its final approval depends on whether Boeing "successfully completes all required tests and analysis to demonstrate the new design complies with FAA requirements."

FAA Administrator Michael Huerta added that the plan approved by the agency "includes all the right elements to conduct a comprehensive evaluation of the battery system redesign."

War Against the Wind

Airplane: © Ansonsaw/iStockphoto; Wind: © Anthony Hathaway/Dreamstime.com

European scientists are developing a new system to identify turbulence and wind gusts before an aircraft flies into them.

EADS Innovation Works says its scientists are using lidar (light detection and ranging) sensors, which use light to identify obstacles and measure their distance.

"The lidar sensor … radiates ultraviolet (UV) light pulses, typically at a rate of 60 per second, which are scattered by the nitrogen and oxygen molecules present in the air," EADS said. "In this way, a total of four rays measure the motion vector of the air 50 to 200 m [164 to 656 ft] in front of the aircraft's nose.

"Any turbulence that may be present alters the motion profile of the molecules and thus the signature received by the system."

The system might eventually also be used to measure wake vortices and aid in determining the correct separation between aircraft during takeoff and landing, EADS said.

Nikolaus Schmitt of EADS Innovation Works said that the lidar system could be used to send data to an airplane's flight control computer "so the aircraft can automatically react" by actuating wing control surfaces.

"What our lidar sees is at most a second ahead," Schmitt said. "That's long enough for a machine but not for the human brain. But our measurement of the airflow at that distance in front of the aircraft is extremely accurate, so the aircraft really will be able to automatically react to a vertical or horizontal draft on the basis of our advance information."

The system is currently being tested, and some tests were conducted in flight on an Airbus A340. Schmitt says the system might be ready for production in about 10 years.

R44 Fuel Tanks

Operators of Robinson R44s are being urged to equip the helicopters with modified bladder fuel tanks designed to reduce the risk of post-accident fires.

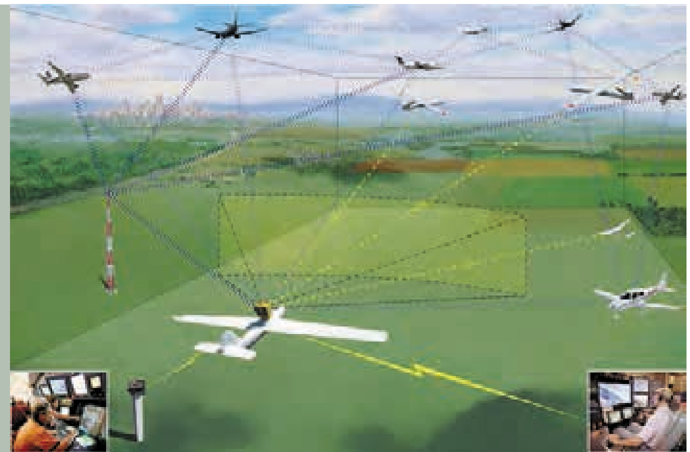
The Civil Aviation Safety Authority of Australia (CASA) has sent letters to all R44 operators to point out a revised Robinson service bulletin that calls for installation of the modified fuel tanks by April.

A CASA airworthiness bulletin "strongly recommends" that the operators comply with the service bulletin at their "earliest opportunity."

CASA noted several recent accidents and incidents involving post-crash fires on R44s with rigid aluminum fuel tanks.

Bidgee/Wikimedia Commons

UAS Site Proposals Wanted


U.S. National Aeronautics and Space Administration

The U.S. Federal Aviation Administration (FAA) is looking for proposals for the development of six unmanned aircraft systems (UAS) research and test sites across the country.

The FAA's request calls on state and local governments, universities and other public entities to submit their proposals for site development.

"The expanded use of UAS represents a major next step in aviation innovation and will present economic opportunities both for the communities that are selected for this pilot program and for the aerospace industry in general," the FAA said.

The FAA's evaluation of the submitted proposals will examine their geographic and climatic diversity, ground infrastructure, research needs, population density and air traffic density, and the proposed objectives.

"We expect to learn how unmanned aircraft systems operate in different environments and how they will impact air traffic operations," said FAA Administrator Michael Huerta. "The test sites will also inform the agency as we develop standards for certifying unmanned aircraft and determine necessary air traffic requirements."

The agency also requested public comments on FAA efforts to ensure that individual privacy is appropriately protected while the pilot programs are in operation. Privacy requirements will be included in formal agreements between the designated test sites and the FAA.

New ICAO Annex on Safety

The International Civil Aviation Organization (ICAO) has adopted a new Safety Management Annex — its first new annex to the Chicago Convention of International Civil Aviation in more than 30 years.

Annex 19 is intended to support ICAO's "global safety strategy, which calls for improved standardization, increased collaboration among aviation stakeholders, new information sharing initiatives and prioritization of investments in technical and human resources required to ensure safe operations in the future," ICAO said.

The ICAO annexes contain the standards and recommended practices that provide the framework for the international air transport system. Annex 19 encompasses provisions regarding state safety programs and safety management systems. The annex was developed over the past three years by ICAO, the ICAO member states and key international aviation organizations.

Adoption of Annex 19 coincided with ICAO's announcement of accident data that showed 2012 was one of the safest years ever for global aviation. The data showed that there were 99 accidents in about 31 million flights in 2012 — or about 3.2 accidents per million departures. Aviation fatalities in 2012 numbered 372, compared with 414 in 2011. The 2012 figure was the lowest since 2004, ICAO said. The data were submitted by the 191 ICAO member states and include aircraft with a maximum certificated takeoff weight of 2,250 kg (4,960 lb) or more.

International Civil Aviation Organization

End-Cap Fatigue Cracks

Martin Rottler/Wikimedia Commons

The manufacturer of the Beechcraft 1900D should take action to inspect nose landing gear end caps for fatigue cracking and replace those at risk, the U.S. National Transportation Safety Board (NTSB) says.

In issuing safety recommendations to the Hawker Beechcraft Corp. (now known as Beechcraft), the NTSB cited its investigations of several recent incidents involving 1900Ds, including the May 17, 2011, collapse of the left main landing gear on a 1900D during landing at Denver International Airport. The airplane sustained minor damage, but no one was injured in the incident.

The NTSB said the probable cause was the fatigue failure of the nose landing gear end cap, "which resulted in insufficient hydraulic pressure to secure the left [main landing gear] into the down-and-locked position."

The NTSB's examination of the fractured end cap and of a second end cap provided by Beechcraft showed that both end caps had failed because of fatigue "from multiple origins that initiated in the machined inner diameter and propagated outward toward the cap's exterior."

The end cap on the incident airplane had accumulated 29,533 cycles since manufacture, the NTSB said. The board noted that an inspection conducted during a 2008 overhaul, 4,585 cycles before the incident, found no discrepancies.

Beechcraft changed its recommended maintenance practices in 2010 and 2011, as a result of preliminary incident findings and earlier end cap fractures, the NTSB said, noting that the company currently recommends a repetitive ultrasonic inspection every 1,200 cycles beginning at 8,000 cycles, and an overhaul every 10,000 cycles.

The NTSB recommendations called on Beechcraft to determine the fatigue life of the nose landing gear end cap, develop a replacement program based on the fatigue life determination, and revise the repetitive inspection procedure and time interval "to ensure that fatigue cracks are detected prior to failure."

Warning on Large Height Deviations

Pilots of flights in oceanic airspace must be aware of the potential effects on safety of large height deviations (LHDs) — deviations of 300 ft or more from the cleared flight level, the U.S. Federal Aviation Administration (FAA) says.

In Safety Alert for Operators (SAFO) 13004, the FAA said that LHDs are the most common pilot errors.

"The evaluation of oceanic error reports shows LHDs present a potential hazard to continuous operational safety in the airspace," the SAFO said. "These deviations have caused some oceanic airspace to surpass the established target level of safety and resulted in an elevated vertical risk."

Common causes of LHDs include air traffic control (ATC) coordination errors; pilot deviations, "including improper execution of pilot contingency procedures"; and turbulence encounters, the document added.

The SAFO said data show that most crew-related errors involve misinterpretation or misapplication of conditional clearances typically used in allowing flight crews to fly to more efficient altitudes.

"Flight crews must be trained to utilize procedures that ensure that all ATC clearances are complied with correctly, particularly clearances with en route restrictions such as changing flight levels based on a coordinated time or a specific geographic position," the document said.

In Other News …

Patrick Ky, the executive director of the Single European Sky Air Traffic Management Research (SESAR) Joint Undertaking, has been named to succeed Patrick Goudou as executive director of the **European Aviation Safety Agency (EASA)**. Goudou has held the position since EASA was established in 2003. … New regulations in Australia will upgrade flight crew **licensing and training** requirements. The regulations, which will take effect in December, will give pilots four years to convert their licenses to the new Part 61 Civil Aviation Safety Regulations. … The Performance Review Body of the Single European Sky has produced an online Performance Dashboard to show actual and targeted air navigation services **performance data**.

Compiled and edited by Linda Werfelman.

Everything in Place

BY WAYNE ROSENKRANS

Updated geospatial data for terrain elevation and obstacles extend aviation safety margins.

Geographic information systems (GIS) — merging cartography, statistical analysis and database access — have existed for about 50 years, but their role in aviation safety soon will take a few leaps forward, experts told a December 2012 forum hosted by the U.S. National Transportation Safety Board (NTSB).

Concepts involved often are analogous to those in highway safety (such as intelligent routing of trucks carrying hazardous materials and smartphone apps for motor vehicle collision avoidance), infrastructure analysis, pipeline safety and positive train control. Impediments to expanded GIS uses in aviation safety, however, could include misinformed safety conservatism or delays within this transportation mode in recognizing the opportunities at hand, some presenters said.

Enabling Aircraft Containment

Since the aviation industry cannot invent more airspace to satisfy its demands, the alternative is containment — reducing the space from aircraft to aircraft — and this became the basis of 21st-century air traffic management (ATM) systems, said Dejan Damjanovic, director, air and marine solutions, of GeoEye. Containment, however, entails critical safety concerns with respect to obstacles and the part that GIS plays, he said, adding, "If we are going to be flying more airplanes in the same cubic miles of airspace, we need to have a much better handle on how [GIS] information is acquired and maintained.

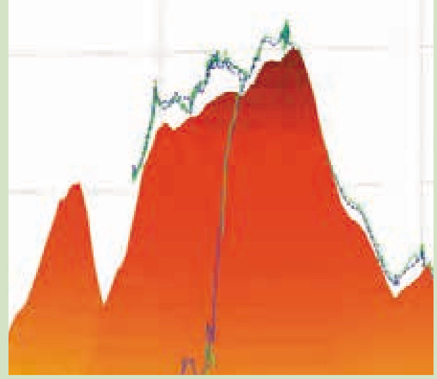
"The primary notion is message-based ATM with smaller containment to get, purely and simply, more airplanes per hour in and out of everyone's airspace and airports in order to improve travel, improve efficiencies and, of course, enhance safety at the same time. One of the predominant requirements … is that we must have a concise and clear idea of where are the terrain and the obstacles that affect flight, because fundamentally we will be bringing aircraft closer and closer to terrain and obstacles in order to increase the numbers [of aircraft] in a given [volume] of airspace. … The data standard [Eurocontrol Aeronautical Information Exchange (AIX)] … provides for an aeronautical information foundation that allows us to always come up with the same aeronautical answer … the exact same levels of quality and the same levels of accuracy."

GIS addresses absolute accuracy — where are you in the world — and relative accuracy, such as correctly depicting distance on a digital map from one part of a runway to another part, or from an obstacle to a runway or between runway centerlines within the same airport. "So relative accuracy is as important as absolute accuracy; both need to coexist within the same frame of reference," Damjanovic said. Key documents created to accomplish this are International Civil Aviation Organization (ICAO) Annex 15, *Aeronautical Information Services,* which defines how aeronautical information is collected, and the ICAO *Performance Based Navigation Manual.*

GIS data collection methods most relevant to aviation are aerial photography, U.S. National Aeronautics and Space Administration (NASA) Space Shuttle imagery, satellite imagery and light-detection and ranging (lidar) on ground and airborne platforms. He cited examples from GeoEye's work at San Diego International Airport.

"We're coming up with literally thousands of points around a single runway at San Diego — 2,700 points per runway — an astonishingly large number," he said. "[For] power lines and fences, we come up with close to 500 just for a single runway. … Polygonal obstacles — typically man-made buildings — are the most significant challenge. … We identified over 3,000 individual buildings or man-made structures off that one [San Diego] runway. In ballpark numbers, it's not uncommon in populated areas in the United States to identify between 5,000 and 10,000 obstacles around a single runway. … It's going to be even more critical in the NextGen [U.S. Next Generation Air Transportation System] future that we have an incredibly detailed and complete grasp of all the point features, the line features and the polygon features that constitute the obstacles around given airports. … You must have a prudent and well-thought-through plan … because you need to collect [and validate the data] — and maintain it forever."

Comparing GPS and Shuttle Radar Topography Mission data discloses the inaccurate ridgeline effect from averaging some GIS data.



U.S. National Aeronautics and Space Administration

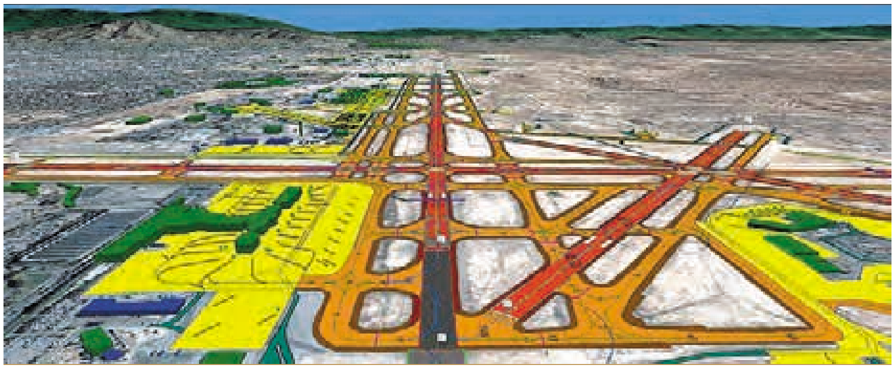
Safety Research Directions

Safety-related aviation analyses are inherently spatial, yet individual aviation professionals tend to work in different, limited topological frameworks, said Christopher Knouss, a geospatial computing specialist at MITRE Corp. "One of the things that I've discovered along the way [is] a lot of the individuals associated with the airspace or … procedures or … traffic have never actually seen [these] on a map," he said. "They don't understand what the relationships between some of the different airspaces are — surrounding airspace, special activity airspace — so [appreciating that] is often the first step. We will also take a look at some of the safety aspects" using maps. MITRE specialists, for example, will present runway excursion data and cases within a GIS and radar coverage context, he said.

However, efforts to conduct analyses combining GIS data and flight operational quality assurance data sometimes run into incompatibilities. "The simulation folks are using that data, but … having to convert it again into the modeling environment … then others who want to do additional data-mining are doing conversion after

© User: Swinnerr/Vectorstock

Three-dimensional imagery from GIS data depicts separate airport features, terrain and obstacles at Albuquerque Sunport Airport.


© GeoEye

conversion of the same data, which introduces resolution error, biases and inaccuracies," Knouss said.

ICAO's GIS Applications

Calculating global air carrier accident rates with state or region rates, then using maps to compare local rates with air traffic data for the associated flight information region, provides fresh perspectives on safety risks, said Marco Merens, technical officer, ICAO Air Navigation Bureau. Sometimes, however, such comparisons have revealed that it was "unfair to create a region [from states arbitrarily]," he said, adding, "That's actually a known problem in geography … it's called the modifiable unit area problem, and so GIS helps us to understand that."

ICAO's GIS Web portal complements its secure Internet platform for iSTARS group members to exchange safety intelligence, he said. These platforms help ICAO produce an integrated safety analysis that incorporates state-level results of its Universal Safety Oversight Audit Program (USOAP).

A second use of GIS is overlaying accident sites at latitude-longitude points on a world map depicting air traffic flows. Referring to such a map, Merens explained color-coding of fatal and non-fatal events, states and intensity of activity from departures data in the selected areas. For example, the United States has about 10 million departures a year versus some Western African countries with fewer than 7,000.

"ICAO has always grouped these states by ICAO regions, and West Africa is an ICAO region," Merens said. "Once we plotted the traffic, we [saw] that we could not have created a … more unfair [grouping of states for safety-analysis purposes] because it actually contains the lowest traffic in Africa, and [yet some states] actually have not many accidents. … A single accident in that region doubles or triples the rate, so we cannot really use it to measure state safety. So we've actually stopped doing that." Instead, use of United Nations regions often yields fairer comparisons, he said.

He also cited GIS color-coding of plotted points where losses of separation have occurred, and overlaying these with hazard-mitigation symbols on recorded aircraft tracks in specific state airspace of interest, such as a flight information region.

U.S. GIS Coordination

The U.S. Government Accountability Office (GAO) in November 2012 issued a report[1] citing insufficiently coordinated collection of GIS data by the U.S. Department of Transportation (DOT), said David Cowen, chairman, National Geospatial Advisory Committee. But efforts to establish a common, interoperable GIS platform for nearly all federal agencies have made progress, he said, noting, "We have the prototypes of a geospatial platform in place now. … So you can go in and get things … common data, common services, common applications through Web-based interfaces instead of buying desktop GIS [software] and staffing up. This is the way we are going, and this provides [the aviation community] a great way to enter the [GIS] field. … A robust GIS program would enable NTSB to improve the way it monitors and manages its safety programs. NTSB should take advantage of the platform that now exists and … help guide the stakeholders."

Also in response to the GAO report findings, Stephen Lewis, a director of GIS at DOT, said that the department is setting up a geospatial policy advisory council.

Proposed GIS-related infrastructure projects — including a three-dimensional terrain elevation program that addresses one of the major aviation risks in Alaska — would stimulate economic growth, Cowen said. "The pilots flying in Alaska are doomed in many cases," he said. "The [GIS] data is terrible in terms of trying to find a landing strip there because elevation data is bad."

More Accurate Elevations

GIS in the broadest sense can be "geographic information science or any spatially enabled or location-aware technology," said Reginald Souleyrette, a transportation engineer and University of Kentucky professor representing Data and Information Systems, Transportation Research Board of the National Academies. Specialists have watched their field evolve from what they call a map-view stage to a navigation-view stage to today's behavioral-view stage. "Transportation futurists see a world with billions of embedded sensors," he said, and human-machine and machine-machine interaction are affected.

NTSB's interest extends mainly to ways of using GIS to help identify trends and areas of growing risk in all transportation modes. "For example, if we start to see a series of accidents and incidents, with GIS we can identify patterns, understand relationships and use its capabilities to help develop countermeasures," said Chairman Deborah Hersman.

For transition to NextGen and the Single European Sky ATM [Air Traffic Management] Research (SESAR) program, GIS standards such as common geography markup language for geospatial data have become crucial to safe interoperability, said Nadine Alameh, director of interoperability programs, Open Geospatial Consortium (OGC).

"A few years back, the … global aviation community agreed to adopt [AIX,] an international framework of [GIS] standards specifically for the goal of improving air travel safety and operational efficiency," Alameh said. "Location is just so critical to all aspects of aviation that [the U.S. Federal Aviation Administration (FAA) and Eurocontrol] adopted as part of that framework the suite of OGC standards [using] the geography markup language to encode all aeronautical information."

She said OGC activities include developing a suite of Web services for aviation to "ensure that the right users get the right information at the right time — so you don't get everything [at once], you just get what you need." When a runway has been closed, for example, pilots need to know immediately — not in five minutes — through advances such as digital notices to airmen, she said.

Much has been published about how satellite-based aircraft navigation and ATM enable NextGen–SESAR capabilities, but sensor technology and GIS revalidation of terrain elevations and obstacle descriptions are less well known, added Jeffrey Danielson, physical geographer, Earth Resources Observation and Science Center, U.S. Geological Survey (USGS).

Before this century, methods for measuring elevations at map locations in the continental United States presumed users' needs of the 1960s. Now aviation safety margins can benefit from far greater data accuracy and resolution made possible by lidar, the gold standard for many GIS measurements. Most of the data going into the USGS National Elevation Dataset (NED) is based on lidar, so far representing about 28 percent of elevation data for the lower 48 states, he said.

"Lidar really is a way to map the whole vertical profile of a landscape," Danielson said. "We've seen drastic improvements in the accuracy of our terrain data using lidar … to map the feature much more precisely in terms of its position as well as the actual morphology of that feature."

The NED, envisioned 15 years ago, is a seamless raster database that functions as a layer of the official USGS continental U.S. map, with updates six times a year. Its dataset is "edge-matched with spatially referenced meta-data to know what source was used to make [each] piece of data," he said. The NED offers multiple resolutions,[2] bare-earth terrain imagery, contours and extensive data from

GIS Story Maps

For aviation training, Web-based geographic information systems (GIS) have potentially significant advantages for the curriculum developers, instructors and instructional media specialists who must cover subjects such as required navigation performance (RNP) area navigation (RNAV) in an engaging and clear way to pilots, dispatchers and other aviation professionals. The value of GIS story maps in particular has been demonstrated in other industries and media with free examples and templates available at websites such as <storymaps.esri.com>, said Allen Carroll, program manager for ArcGIS online content, Esri.

Safety professionals also can create or access interactive story maps blended with rich media such as audio, video, photography and Web maps, he said. "[Aviation] accidents don't just happen, they happen in a very rich, complex and interesting set of circumstances — many of them, most of them perhaps, having a key spatial component," Carroll said. "GIS, interpreted in the form of a story made understandable to the public [for example, could be a] key part of [a U.S. National Tranportation Safety Board] safety recommendation. All of us, without training, can find very rich and interesting datasets from many different sources, and be able to 'mash them up' into the form of a Web map, an intelligent map [distributed as multi-platform mobile] apps that can be used by everyone, everywhere."

To demonstrate the method, one Esri prototype intelligent map presented bird strikes in relation to seasons, geography, national wetlands data, bird migration data and passenger enplanement data for Santa Barbara (California, U.S.) Municipal Airport.

— WR

participating government agencies. The currency of the NED varies dramatically among U.S. states, however, so specialists color-code the 1960s contours separately from up-to-date, usually lidar-based, contours.

Whether mounted on an aircraft, ground vehicle or tripod, a lidar system records a point cloud comprising billions of three-dimensional mathematical coordinates as X, Y and Z points of the vertical structure scanned. "Towers are of concern for the FAA and people looking at obstacles, for example," he said. "Using traditional totalization and GPS [global positioning system] is still your most accurate way of measuring obstacles, but lidar does have the potential to be a tool to map obstructions [for an airport] landing approach."

Own-Ship Spotter for Mobile Devices

Some of the aeronautical charting specialists within the geographic information systems (GIS) community have worked toward low-cost alternatives to airport moving map displays as a countermeasure to runway incursions (*ASW,* 3/12, p. 27). They also are refining the accuracy and integrity of terrain/obstacle databases in avionics, says Rich Fosnot, senior manager for aviation safety, Jeppesen Aviation and Marine Safety.

GIS data sources play a key role in the continuing evolution of airport moving map technology, enabling the addition of airframe-specific "taxi routes, low-visibility routes, holding positions, tailored airline information, preferred routes, ramp communication frequencies and company-specific deicing areas," he said.

"Accurate airport diagrams is another project we're working on to make an airport moving map [-like product] available to general aviation and to corporate operators that do not have the Class 3 electronic flight bags with a [U.S. Federal Aviation Administration (FAA)–approved] airport moving map application," Fosnot said.

Jeppesen anticipates approval from the FAA in early 2013 "to be able to include the own-ship position on the traditional [static] airport map as displayed by an electronic charting service, but distinctly different from the airport moving map [because of its use of a] precomposed chart, not a data-driven chart," he said. "The [GIS] information available from airport authorities in some cases is not as accurate as required. Maybe not so much in the United States, but in other countries, we'll find errors in the location of taxiway intersections of up to 250 m [820 ft]. The use of geo-referenced satellite information allows us to locate these taxiway intersections accurately. In the future, we hope to introduce the airport moving map to mobile devices such as the [Apple] iPad."

Advances in GIS also have a role in reducing the risk of controlled flight into terrain, which continues to cause fatalities among industry segments in which aircraft typically do not carry a terrain awareness and warning system (TAWS), Fosnot said. "The terrain and obstacle databases that we provide the industry drive [TAWS,] aeronautical charts, moving map displays, synthetic vision, flight planning systems, flight procedure design and airspace and airport modeling software," he said. The basic safety role of these applications is enhancing pilots' situational awareness, which he defined as "perception of the elements in an environment of time and space, the understanding of their meaning and the projection of their status into the near future."

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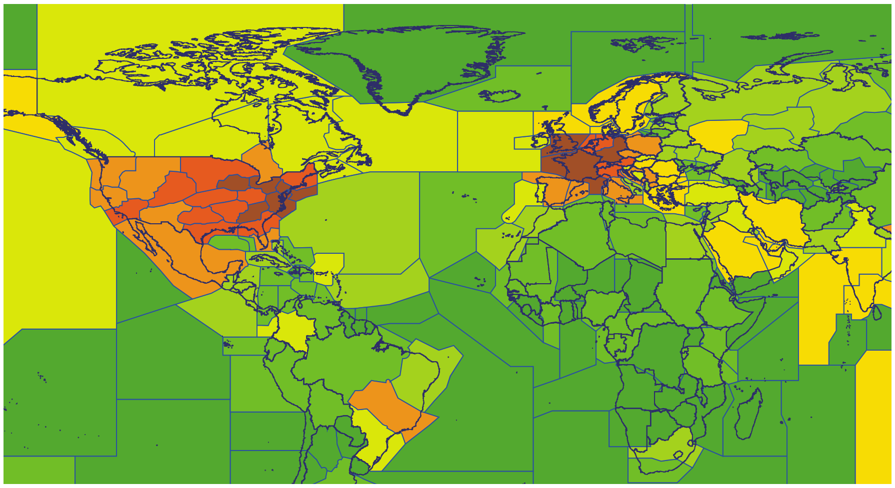
Upgrading Airport Data

Because the FAA provides funding through the congressionally approved Airport Improvement Program, the agency can require the recipient U.S. airports to use the latest GIS data submission standards, said Michael McNerney, assistant manager of FAA's Airport Engineering Division. The Airports GIS program covers about 3,300 such airports as part of the national plan of integrated airport systems, which includes 547 airports certified under Federal Aviation Regulations Part 139 standards for scheduled air service. "We are primarily developing a data collection program in GIS," he said. "Another benefit is improved safety by having better data, real-time data, corrected and traceable data. [We are supporting] NextGen [by] embarking on a program to do full-scale geospatial data collection at engineering-level accuracies [for the certified airports during 2013 and 2014]."

The accuracy improvement enables FAA airport specialists to measure on a digital airport layout plan the distances between runways, parallel taxiways or two adjacent buildings, for instance. "By 2016, we expect to go full digital/electronic on airport layout plans and all of our digital data," McNerney said.

The program is collecting data for more than 100 features of each airport sufficient for standards-compliant drawings. "[This has] many different layers, and has tools to measure distances among a lot of GIS tools," he said. "One of our outputs is 1.0-ft [0.3-m] elevation contours in the airport area; our consultants that use the data think that's one of our best products."

McNerney said that FAA Airport GIS now collects data for airport airside and groundside operations — the movement and non-movement areas — to provide a complete geospatial picture



Overlaying flights, color-coded by total-number categories, enables ICAO to assess traffic density-hazard level by flight information region.

of an airport. This is much different from discrepancies of the past.

"When I was an airport consultant and was doing the master plan for Houston Intercontinental [Airport], we were siting a new runway, and the FAA was telling us that the runway was too far away from the tower, [saying,] 'You can't site it there," he recalled. "We said, 'Yes, it's within limits.' And so they said, 'Show us your data.' When we showed them the data, they said, 'Oh, *that's* where the tower is.' They were still using an old airport layout plan that did not have the correct tower location. [Elsewhere,] a building would be located in the general area, but [on the map] it might be … 50 ft [15 m from] where it really is. So it's important to have everybody looking at the same data, having safety-critical data for runways and taxiways, having a very rigorous verification and validation program."

Building Instrument Procedures

A new instrument procedure development system (IPDS), developed and deployed in the last five years, gradually is replacing a legacy system to develop procedures for U.S. and some non-U.S. flight operations under instrument flight rules (IFR), said George Gonzalez, representative of mission support services, aeronautical navigation products, technology and air traffic control products, and the IPDS at the FAA Air Traffic Organization.

FAA staff currently uses IPDS solely for space-based navigation procedures, specifically those using GPS area navigation (RNAV) and required navigation performance (RNP) levels of technology. Because different layers of data are provided using a GIS format, procedure development specialists instantly can show/hide overlay data from accurate databases for elements such as obstacles, fixes, airports, runways and navaids with colors assigned as needed.

"This new system uses [AIX] to push and pull [GIS] Web services and data; there's just about everything a procedure specialist would need," Gonzalez said. "[I believe IPDS will] become useful for NTSB when it comes to trying to evaluate a procedure that may or may not have been involved with an aircraft crash. … A module being delivered within the next 12 to 18 months will provide ground-based [navigation aid] procedure development. … We're also looking at providing flight path data on this system." The ground-based module streamlines manual processes for building diverse standard instrument departure procedures and obstacle evaluation assessments.

The system includes two-dimensional and three-dimensional views of locations. In three-dimensional view, the specialist instantly can set the viewer's position at any direction and elevation to study terrain and obstacles. "Cylinders [drawn by IPDS show each] obstacle with its accuracy, which has to be taken into consideration when there are procedures being built because some obstacles don't have a very exact accuracy of the height or the position [data]," Gonzalez said.

In closing, the USGS's Danielson stressed the need for GIS data users in aviation to ask about "whatever quality assurance methods that an organization or group is using in collecting and then processing the data. … From the USGS perspective, we produce a lot of [terrain] data, and definitely the meta-data sometimes is lagging behind the data, but we're striving to match that up with the data in terms of currency. … Metadata probably is one of the most challenging aspects to geospatial data."

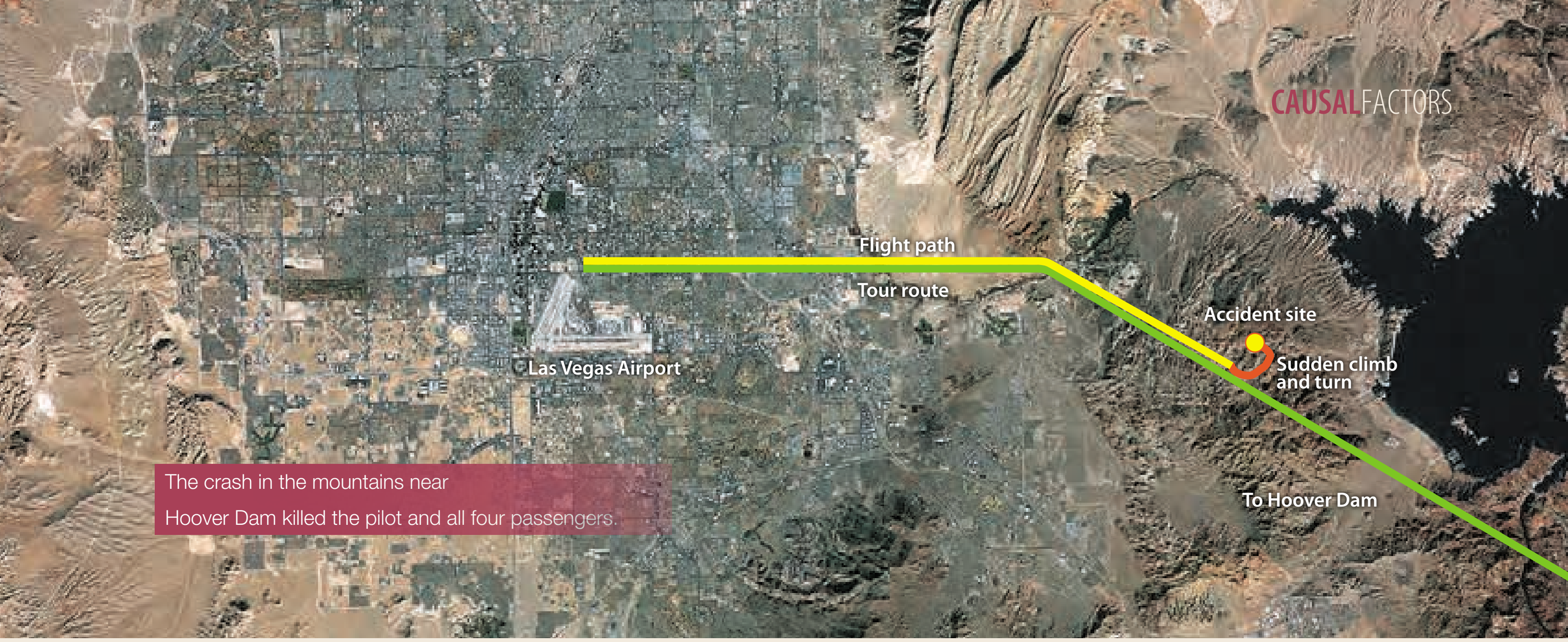
Notes

1. GAO. *Geospatial Information: OMB [Office of Management and Budget] and Agencies Need to Make Coordination a Priority to Reduce Duplication*, GAO-13-94, November 2012.
2. Current resolutions possible are 1 arc second, about 30 m (98 ft); 1/3 arc second, about 10 m (33 ft); and 1/9 arc second, about 3 m (10 ft). "Bare earth" refers to lidar measuring/depicting the elevations of points on the contour surface as opposed to capabilities such as "first return" from the top of a surface (such as a man-made structure) or the "top of canopy" of trees.

‘Inadequate Maintenance’

Improper use of connection hardware began a chain reaction that led to the crash of an AS350 on a sightseeing flight, the NTSB says.

BY LINDA WERFELMAN



The crash in the mountains near Hoover Dam killed the pilot and all four passengers.

A series of maintenance errors was responsible for the Dec. 7, 2011, crash of a Sundance Helicopters Eurocopter AS350 B2 in the mountains east of Las Vegas, the U.S. National Transportation Safety Board (NTSB) says.

The pilot and all four passengers on the "Twilight Tour" sightseeing flight were killed in the crash, and the helicopter was destroyed.

At an NTSB meeting convened to review the accident, Chairman Deborah Hersman noted that research has shown that the primary category of maintenance error is "failing to carry out necessary actions.

"And that is our finding from this investigation. Inserting a small pin, smaller than a paper clip, and just one small step in a routine maintenance procedure, was the necessary action. The omission of this action was the difference between an uneventful flight and tragedy."

The flight began at 1621 local time, when the helicopter took off at dusk from Las Vegas McCarran International Airport in visual meteorological conditions with good visibility. The pilot planned to fly to Hoover Dam, about 30 nm (56 km) southeast and then to return to the airport.

The helicopter was not equipped with flight data recorders, and they were not required. However, radar data from the U.S. Federal Aviation Administration (FAA) showed that the helicopter had been level at 3,500 ft, with a groundspeed of 120 kt, until about one minute before impact, and then climbed to 4,100 ft, turned 90 degrees left and slowed. The helicopter descended to 3,300 ft and tracked northeast for 20 seconds before entering a left turn and plunging toward the ground "at a rate of at least 2,500 ft per minute," the NTSB said in its final report on the accident. Parts of the helicopter were destroyed by a post-impact fire. The wreckage was found in a ravine about 14 mi (23 km) east of Las Vegas.

The NTSB said the probable causes of the crash were Sundance Helicopters' "inadequate maintenance of the helicopter, including the improper reuse of a degraded self-locking nut, the improper or lack of installation of a split pin and inadequate post-maintenance inspections, which resulted in the in-flight separation of the servo control input rod from the fore/aft servo and rendered the helicopter uncontrollable."

Contributing factors were the mechanic's and inspector's fatigue and the "lack of clearly delineated" steps for the maintenance task and the inspection, the NTSB said.

Maintenance Personnel

The mechanic who installed the fore/aft servo received his airframe and powerplant (A&P) mechanic certificate in December 2008 and worked on maintaining general aviation airplanes and business jets before being hired by Sundance in June 2011. After his hiring, he received indoctrination training in record keeping, maintenance procedures and use of the Eurocopter manuals, as well as on-the-job training, but he had yet to attend any helicopter-specific training.

His schedule typically included four days of 11-hour shifts, followed by three days off, three days of 12-hour shifts and four days off. Each shift began at 1200.

He estimated that he previously had performed about six fore/aft servo installations before he began work on the accident helicopter on Dec. 6. He had been off duty on Dec. 4 and 5, and initially was scheduled to be off on Dec. 6 as well, but was asked during a telephone call the previous afternoon to report to work. He said that he went to bed about 2200 — four hours earlier than his normal bedtime of 0200 — but fell asleep around 0000 and awoke at 0500, feeling good.

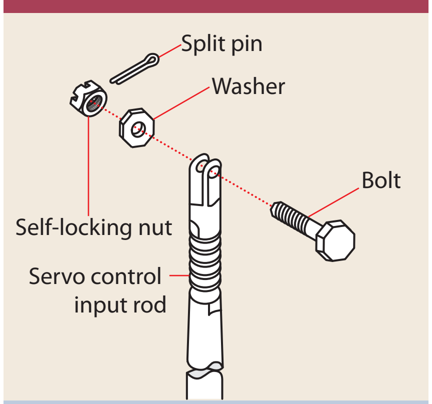
He reported to work about 0550 and was assigned the fore/aft servo replacement, which he said he performed without difficulty and without feeling rushed.

The mechanic who inspected the servo replacement had been named a quality control inspector about six months earlier. He also was one of three lead mechanics who directed maintenance tasks when management personnel were not present. He received an airframe and powerplant mechanic certificate in 2002, and had spent about two years in commercial aircraft maintenance and seven years in helicopter maintenance before he was hired by Sundance in 2010.

Like the mechanic, he was not originally scheduled to work on Dec. 6 but was asked during a telephone call the previous day to report to work in the morning. He told accident investigators that he felt rested after about seven hours of sleep. He completed the inspection of the servo replacement work about 1800, near the end of his 12-hour shift.

A review of Sundance maintenance records showed that the inspector, working as a mechanic in June 2011, "failed to properly re-install the chin bubble" portions of the windshield on a helicopter.

Servo Control Input Rod Assembly



Source: U.S. National Transportation Safety Board

Figure 1

Sundance determined in a root cause analysis that "the inspector's perception of the need to expedite the repair to avoid aircraft downtime was a contributing factor leading to this failure."

The NTSB said its review of maintenance logs for the four months before the accident revealed no discrepancies.

The check pilot, who received an A&P mechanic certificate in 2000 and worked as a mechanic on Robinson helicopters for about six years, was hired by Sundance as a line pilot in 2010. He had 2,400 flight hours, including about 1,400 hours in rotorcraft. Before the accident, he had conducted 10 to 12 flight checks at Sundance.

Flight Control System

The AS350 B2 has a mechanical flight control system, assisted by one hydraulic tail rotor servo and three hydraulic main rotor servos. Of the main rotor servos, two are lateral servos, "which transfer the lateral inputs to the nonrotating swashplate (roll)," and one is the fore/aft servo, "which transfers the fore and aft inputs to the nonrotating swashplate (pitch)," the report said.

A system of control rods, bellcranks and levers transfers the pilot's collective and cyclic control inputs to the "mixing unit," where the inputs are delivered "through the appropriate servo control input rod to a servo input rod assembly," the report said.

Each servo is connected to the main rotor transmission case, the nonrotating swashplate and the servo control input rod. A bolt, washer and self-locking slotted nut connect the servo control input rod to the servo input lever; the nut also is secured with a split pin (also called a cotter pin), which prevents it from unthreading (Figure 1).

The report said that Eurocopter had noted in a certification document that "the loss of control of the fore-aft servo would most likely result in a catastrophic failure of the helicopter."

Investigators found the fore/aft main rotor servo control input rod in the wreckage, disconnected from the input lever; its connection hardware was not found.

Sundance Helicopters

Sundance Helicopters had 22 helicopters and 50 pilots at the time of the accident and, during the off-season when the crash occurred, averaged 35 tour flights and 40 shuttle flights a day to Grand Canyon West Airport. In 2011, the company operated 31,350 flight hours and transported more than 200,000 passengers.

All maintenance, except for component overhauls, was performed at the operator's maintenance base in Las Vegas.

The last maintenance on the accident helicopter — which included a 100-hour inspection and replacement of the tail rotor servo, the engine and the main rotor fore/aft servo — was completed the day before the crash. The fore/aft servo was replaced with a new unit, and the mechanic said after the accident that he had no difficulties with the installation.

Eurocopter, in its *Standard Practices Manual*, specifies that a locking nut may be reused only if it is "not excessively damaged," is hard and cannot be tightened by hand.

The mechanic said that, when deciding whether any nut could be reused, he removed it, cleaned it and inspected it for damage, then threaded it onto the bolt "to see if it will thread all the way down, and if he is able to turn the nut down to where the shank is visible, he replaces the nut," the report said. In assessing the nut on the accident helicopter, "he deemed the hardware airworthy," the report added.

After the accident, Sundance directed maintenance personnel to replace the self-locking nut and other connection hardware at the next scheduled inspection of all of its helicopters with more than 5,000 flight hours and then at 5,000-hour intervals. The company also said that the nut must be replaced with a new nut any time an input rod is disconnected from a servo.

Most Likely Scenario

The report noted that, "because proper functioning of the control input rod is necessary for takeoff," it was clear that the bolt and the control input rod were in place when the accident flight began. Laboratory analysis revealed no evidence, however, that the connection hardware was present at impact.

"Based on the evidence," the report added, "the NTSB concludes that the most likely explanation for the in-flight loss of control is that the fore/aft servo bolt disengaged in flight, which resulted in the separation of the control input rod to the fore/aft servo's input lever, rendering the helicopter uncontrollable."

The report said accident investigators evaluated several scenarios to determine how the connection hardware became disengaged and concluded that the most likely explanation was that "the self-locking nut became separated from the bolt, allowing the bolt to work its way out of the joint due to normal in-flight vibratory forces."

The report noted a Eurocopter letter that said that, because the nut had two locking devices — the self-locking feature and the split pin — it was designed to remain tight. Even if the split pin had not been in place "behind an airworthy self-locking nut," the nut should not have loosened as long as it was properly torqued, Eurocopter said.

Sundance inspected all of its AS350s after the accident and found all fore/aft servo connection hardware was properly connected and safetied. At the same time, the connection hardware was examined on the main rotor servos of all Sundance helicopters with at least 5,000 flight hours; the examinations showed that about half of the self-locking nuts on the 13 helicopters that had been inspected by January 2012 had no locking capability, the NTSB said.

On two helicopters, self-locking nuts "could be easily and fully tightened or loosened on the accompanying bolts with finger pressure," the NTSB said, adding, "This indicates that the nuts … were not suitable for reuse."

This prompted the NTSB's conclusion that, "at the time of the accident, Sundance Helicopters was not following Eurocopter and FAA self-locking nut reuse guidance, which led to the repeated improper reuse of degraded nuts on its helicopters," the report said.

The Sundance *General Maintenance Manual* requires independent inspections of specific maintenance procedures, including procedures that require use of a split pin, by a designated company quality control inspector.

The inspector who checked the work on the fore/aft servo installation said he found no problem during his inspection of the accident helicopter.

The company's check pilot, who conducted a postmaintenance check flight the morning of the accident, told accident investigators that he "saw nothing in the left [main gear box] cowl area during his preflight inspection that indicated that the helicopter was not in a condition to fly."

The report added, "The NTSB concludes that the mechanic, inspector and check pilot each had at least one opportunity to observe the fore/aft servo self-locking nut and split pin; however, they did not note that the split pin was installed improperly or not present."

Maintenance Human Factors

Although maintenance personnel were under no time pressure to complete their work, the mechanic and the quality control inspector both met criteria for "susceptibility to the debilitating effects of fatigue," the report said. "Because both the mechanic and the inspector had insufficient time to adjust to working an earlier shift than normal, they were experiencing fatigue. … In addition, the mechanic had an inadequate amount of sleep and the inspector had a long duty day, both of which also contributed to the development of their fatigue."

Although the report said that fatigue alone could not explain the maintenance errors, it noted the NTSB's "longstanding concerns about the effects of fatigue on maintenance personnel."

In particular, the NTSB cited the extended duty time that contributed to the inspector's fatigue, adding that it "continues to believe that establishing duty-time limitations is a key strategy to reducing the risk of fatigue-related errors in aviation maintenance."

The report included several safety recommendations to the FAA, including one that called for the establishment of duty-time regulations based in part on start time, workload, shift changes, circadian rhythms and adequate rest time.

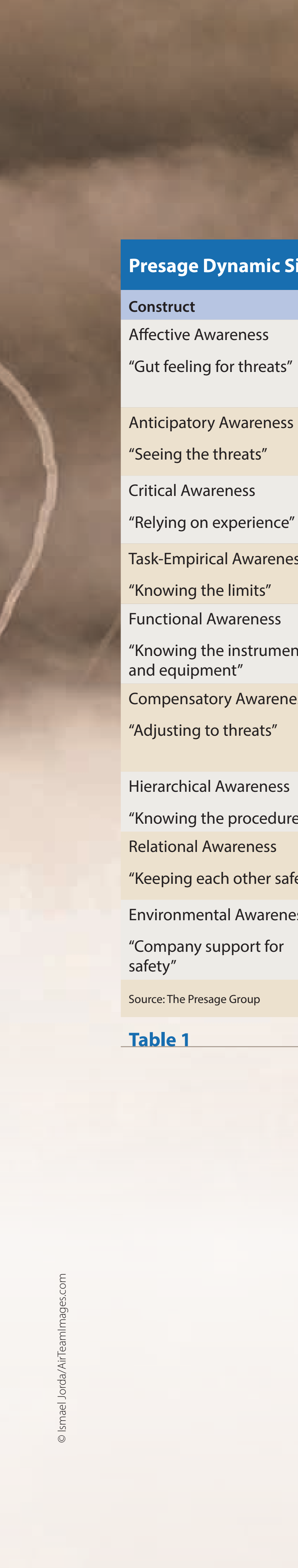
This article is based on NTSB Accident Report AAR-13/01, "Loss of Control; Sundance Helicopters Inc.; Eurocopter AS350-B2, N37SH; Near Las Vegas, Nevada; December 7, 2011." Jan. 29, 2013.

Why Do We Forgo the Go-Around?

BY J. MARTIN SMITH, DAVID W. JAMIESON AND WILLIAM F. CURTIS

As reported in the first article in this series (*ASW*, 2/13, p. 22), Flight Safety Foundation analyzed 16 years of aircraft accident data and found that the most common type of accident is the runway excursion. We noted that the almost complete (97 percent) failure to call go-arounds (GAs) as a preventive mitigation of the risk of continuing to fly unstable approaches (UAs) constitutes the no. 1 cause of runway excursions, and therefore of approach and landing accidents.[1]

In this second article, we report on a large study of pilots conducted by Presage Group Inc. as one part of the Foundation's ongoing Go-Around Decision Making and Execution Project. The study was designed to aid in understanding the psychology of compliance and noncompliance with GA policies when pilots decide to continue to fly UAs rather than call for GAs. After briefly describing the research approach used in the Presage study, this article will discuss three aspects of the research results: the pilot characteristics that differentiate the two decisions, the objective conditions that were most associated with continuing to fly UAs and GAs, and awareness competency



Presage Dynamic Situational Awareness Constructs

Construct	Description
Affective Awareness "Gut feeling for threats"	Pilot's gut feelings for threats; seat-of-the-pants experience, which is characterized by an emotional, sensory experience that triggers further cognitive analysis
Anticipatory Awareness "Seeing the threats"	Pilot's ability to see and/or monitor real and potential threats as they move and change over time and space
Critical Awareness "Relying on experience"	Pilot's ability to draw from personal and professional experience bank as a means to assess here-and-now events as "normal"
Task-Empirical Awareness "Knowing the limits"	Pilot's expert knowledge of the operational envelope of his/her equipment
Functional Awareness "Knowing the instruments and equipment"	Pilot's expert knowledge of knowing how to read and translate what his/her instruments are indicating
Compensatory Awareness "Adjusting to threats"	Pilot's ability to know how and when to compensate or adjust correctly for present and anticipated future operational conditions in order to ensure safe, compliant operations
Hierarchical Awareness "Knowing the procedures"	Pilot's expert knowledge of operational procedures, their order and correct sequencing
Relational Awareness "Keeping each other safe"	Pilot's ability to accurately assess and engage crew-member relationships in a manner that protects safety and compliance
Environmental Awareness "Company support for safety"	Pilot's experience of how their company supports and encourages safety and how this in turn shapes his/her commitment to safe and compliant behavior

Source: The Presage Group

Table 1

differences as measured for each of the nine Presage Dynamic Situational Awareness Model (DSAM) constructs that we described in our previous article (Table 1). In order to thread together the relationships between pilot characteristics and objective conditions on the one hand with our nine awareness constructs on the other, we will report the results of the former and overlay, where appropriate, those awareness constructs that differ in the two event recall scenarios (GA versus UA), showing how they shape and ultimately drive the decision to continue to fly UAs instead of pursuing the GA option. Here's our spoiler alert: In the moments leading up to a decision on whether to continue a UA or execute a GA, pilots reporting their recall of UAs were less situationally aware than pilots remembering GA experiences on every one of the nine DSAM constructs we assessed.

Pilot Survey

Presage conducted an online survey of more than 2,000 commercial pilots between February and September 2012. Pilot respondents for this Foundation-sponsored survey were solicited through direct communication with both safety personnel at various pilot associations and FSF-member and non-member airlines globally, as well as through various social media forums. The goal was to recruit and administer the survey to as many pilots as possible from around the world, representing a variety of fleets, aircraft types, flight operations, physical geographies, respondent experience levels, pilot nationalities and cultures. Participants' anonymity was assured to inspire honest and complete self-reports of pilots' experiences, as well as to stimulate participation.

Among the 2,340 pilots who completed the survey, we achieved a good range of pilot experience and operational types, as well as wide geographical representation, suggesting our results can be generalized to pilots worldwide (Table 2, p. 26).

In the main part of this study, we asked pilots to recall specific instances of unstable approaches, at or below stable approach heights (SAH), that were recent and therefore highly memorable (in fact, we asked pilots to remember the last instance of a UA they had experienced within the last five years). The vivid information that this special "situated recall" task would elicit was necessary for what we needed pilots to report in detail, namely, their experiences during the minutes leading up to and including a decision on whether to call for a GA while flying a UA.

Sample Characteristics of 2,340 Pilot Respondents

Variable	Category	Percentage
Continent of operations	Africa	1%
	Asia	25%
	Europe	28%
	North America	34%
	Oceania	0%
	South America	12%
First language	Non-English	56%
	English	44%
Initial Training	Non-Military	74%
	Military	26%
Current Position	Captain	66%
	First Officer	33%
	Relief Pilot	1%
Flight Hours (Career)	Median	10,000 hours
	Range	200–31,000 hours
Aircraft Operation	Passenger	88%
	Charter	4%
	All-cargo	7%
	Inactive	1%
Type of Operation	Short-haul	62%
	Long-haul	38%

Source: The Presage Group

Table 2

These experiences include their own subjective states (their situational and risk assessments, social pressures, fatigue, beliefs about their companies' GA policies, etc.) as well as their psychological representations of the objective factors characterizing the aircraft and the environment during their approaches (flight instabilities, visual reference conditions, environmental factors, etc.). These variables constitute a full and in-depth recounting of the objective factors in each situation and their resulting psychological representations during the critical time leading up to pilots' decisions. These representations, which constitute pilots' states of dynamic situational awareness, were hypothesized to be the main drivers of pilots' assessments of the risks of continuing to fly a UA rather than conduct a GA (Figure 1). To encourage full reporting, pilots were guided though a set of structured questions to elicit their recall of events.

In addition, to help refine the analysis, pilots also reported a variety of basic demographic information (such as rank, time on type, base of operations, etc.) and flight operational characteristics (long haul versus short haul operations, aircraft type, etc.). The content of the entire survey was reviewed, commented upon and amended in accordance with the recommendations made by members of the Foundation's International Advisory Committee, its European Advisory Committee and other advisory team members.

Among pilots who had experienced both GAs and UAs, we randomly assigned some to recall a UA, and others to recall a GA event. This random experimental assignment allowed us to more confidently identify those objective and psychological situational factors associated with noncompliance with GA policies. Pilots who reported they had only flown GAs or UAs simply recalled their last event of those respective types. While paying particular attention to the factors influencing a pilot's decision to continue with a UA, in the results below, we discuss differences between GA and UA events independent of a pilot's prior history of having flown them. Therefore, in the findings to be reported, 57 percent of the pilots gave accounts of a UA they had participated in, while 43 percent discussed a UA that resulted in a GA.

UA Group Findings

First, our results showed that pilots flying UAs were more often first officers (FOs). In looking through our DSAM lens, and in particular, at the lower scores on keeping each other safe (relational awareness) for UA events, it makes sense that FOs, who are vulnerable to the authority structure of the cockpit and therefore less likely to assume authority from the captain to call a go-around, are more likely to continue with an unstable approach. It is important to note that pilots' total flight hours reported at the time of the event (an average of 9,250 hours across the sample), as well as total time on type (average 3,000 hours), did not show any differences in the likelihood of having recalled a GA or UA event, reinforcing the argument that the differences between these groups lie not primarily in their pilot characteristics, but in their situational awareness readiness to follow the procedures (hierarchical and task-empirical awarenesses) should an instability occur at or below decision height. Geographically, there was a strong tendency for pilots based in South America and Asia to report more GAs than UAs, while those from North America and Europe recalled more UA than GA events. This suggests that operational environments, such as airport elevation or complexity of approach procedures, or cultural differences, or both, may play a part in these findings.

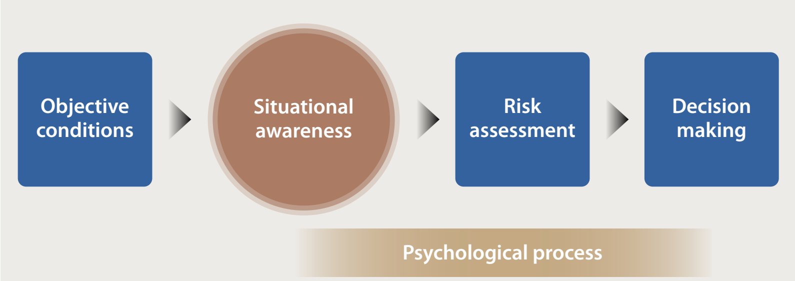
Our results show a host of effects and non-effects associated with reporting UAs versus GAs (Table 3, p. 28). Among the flight characteristics more associated with choosing to fly UAs are approaches in visual meteorological conditions (VMC) and already being unstable when reaching SAH. By contrast, recalled GA events were more associated with becoming unstable after SAH, and in instrument meteorological conditions (IMC) and non-precision approaches. These findings suggest that VMC may trigger a lack of discipline across two of our awareness constructs, most notably the gut feel for threats (affective awareness) and seeing the threats (anticipatory awareness). It is as though the UA pilots are seduced into thinking that because of the VMC they can literally "see" their runway miles and miles from touchdown and a stable landing will not be problematic. IMC and more complex approaches such as non-precision require, by definition, a heightened sense of situational awareness across a number of our dimensions in order to ensure the aircraft remains on profile.

In accordance with our DSAM explanatory model, the GA pilots will, in IMC with a pending non-precision approach, "see" these event characteristics as potential threats (anticipatory awareness) early in the descent profile, and should the aircraft become unstable after the SAH, an immediate "gut feel for this threat" (affective awareness) will be triggered with an accompanying compensatory action (compensatory awareness) initiating a go-around.

Pilots reporting on a UA experience noted more instances of excessive airspeed and inappropriate power settings. These results suggest that these pilots feel that although the aircraft is unstable on these flight parameters, they still have the ability to "manage" the aircraft energy prior to landing. Such a belief naturally requires the active suppression or silencing of a number of our situational awareness constructs, such as denying the alarms from the gut (affective awareness), not seeing the threat (anticipatory awareness) and dismissing the standard operating procedures ([SOPs], hierarchical awareness) that state that under these conditions one should be initiating a GA. Conversely, deviation in flight path and low airspeed were more often reported by pilots recalling a GA event. The DSAM model suggests that this makes sense given that their gut is actively engaged and sensing these threats, and that the risks associated with these factors are more accurately measured. These processes trigger the correct adjustment to compensate, that is, by initiating a GA.

Finally, all the environmental factors we assessed were more associated with the decision to go around: presence of tail wind, wind shear, turbulence, wake turbulence,

How Situational Awareness Plays a Role in Decision Making



Source: The Presage Group

Figure 1

Flight Scenario Characteristics

	Recall of GA Events	Recall of UA Events	Statistically reliable difference?
Flight characteristics			
Recency of event (mean number of months in past)	31	35	No
% Short-haul	66	70	No
% Long-haul	34	30	No
% VMC approaches	70	85	Yes
% IMC approaches	17	8	Yes
% Precision approaches	44	39	No
% Non-precision approaches	18	12	Yes
% Approaches with active instrument reference	32	34	No
% Approach without active instrument reference	9	8	No
% Manual approach to recognition of instability	42	43	No
% Automated approach to recognition of instability	32	27	No
% Combined manual and automated approach	26	28	No
% Unstable at stable approach height	71	86	Yes
% Unstable after stable approach height	29	14	Yes
% Respondents who were flying	45	48	No
% Respondents who made the decision to go around	80	—	—
% Respondents who made the decision to continue unstable approach	—	57	—
% Respondents who discussed a go-around	—	44	—
Mean altitude at which decision was made (ft agl)	750	814	No
Incidence of instability factors (%)			
Flight path deviation	66	51	Yes
Aircraft speed exceeded V_{REF} +20 knots	53	63	Yes
Aircraft speed was less than V_{REF}	9	4	Yes
Sink rate exceeded 1,000 feet per minute	48	50	No
Power setting was not appropriate for the aircraft	44	53	Yes
Aircraft was not in the correct landing configuration	28	27	No
Briefings and checklists were not complete	15	15	No
Incidence of environmental factors (%)			
Tail wind	37	29	Yes
Wind shear	23	11	Yes
Turbulence	30	19	Yes
Insufficient visual reference	21	9	Yes
Contaminated runway	14	5	Yes
Incidence of ATC factors (%)			
Occupied runway	6	5	No
Inadequate separation on approach	12	12	No
Wake turbulence	6	3	Yes
Late clearance or poor approach vectoring	38	39	No

agl = above ground level; ATC = air traffic control; GA = go-around; IMC = instrument meteorological conditions; UA = unstabilized approach; VMC = visual meteorological conditions; V_{REF} = reference landing speed

Source: The Presage Group

Table 3

insufficient visual reference and contaminated runways. Our intuitive assumption is confirmed empirically — the more complex the operational environment, the more engaged the pilot's situational awareness. The fact that these environmental factors are less associated with UAs is consistent with the notion of the psychological seduction of fair-weather flying. Pristine flight conditions invite a greater tolerance for the belief that the absence of complex environmental factors equates with little or no risk to be managed, and suggest to the UA pilot that on one hand, there is a low probability of the aircraft becoming unstable, and on the other hand, should it become unstable, the environmental conditions nonetheless lend themselves to "managing" the instability correctly and landing uneventfully. The processes that lead to these seductive assumptions, however, require the active numbing or passive tuning out of the nine DSAM constructs.

Psychosocial Factors

Given that these objective, situational risk factors existed in the events pilots described, how were those factors perceived, explored and managed by flight crews prior to the decision to continue to fly UAs? What levels of situational awareness did pilots report that they and their crewmembers developed in these scenarios, were these accurate, and how did they contribute to their assessments of the risks of continuing UAs? Finally, did aspects of situational awareness differ in the moments leading up to the GA–UA decision in a patterning that might help explain those decisions to call or forgo a call to go around?

The findings of the study on situational awareness and the other psychosocial variables we measured are pervasive and robust (Table 4, p. 30). Working backward from the decision to continue to fly a UA (Figure 1, p. 27), a highly significant difference existed between GA-recall and UA-recall pilots in terms of the most immediate cause of their decision whether to call a GA, namely, their perception of the manageability versus unmanageability of the risk confronting them: UA pilots perceived far less risk lurking in the instabilities they were experiencing than did GA pilots. This difference is perhaps not so surprising given what they eventually decided to do (that is, to go around or not) based on these very risk assessments, but the strength of the difference is large. What our research sought to discover was why these strikingly different assessments of risk occurred. What factors were reported to be stronger or weaker in the situational awareness profiles of pilots leading up to their judgments of risk? Which of these could be implicated in leading directly to the lowered perception of risk among pilots in the group continuing to fly UAs? In fact, we see evidence that on all nine of the DSAM dimensions of situational awareness, the awareness competencies affecting their judgments of risk, pilots who continued a UA reported having less situational awareness than those who initiated a GA. Many of these effects are very strong (defined as half a point difference on our measurement scales or greater) and were observed across the range of items used to assess each construct.

Certain elements of the psychological situation were or were not present in the two event recall cases in the moments leading up to pilots' decisions. Whether these situational aspects were sufficiently pursued by conscious exploration and deliberation (and whether they were pursued alone or with other crewmembers) is likely to have played a key role in whether pilots and their crews developed the kind of complete, dynamic and shared picture of the situation that would have allowed them to reach full and accurate competency across each of these nine dimensions of situational awareness that we have described. For example, we established that fatigue, while present in many of the events, did not differ between the two types of scenarios. However, the effectiveness by which a pilot adjusted to the threat (compensatory awareness) by implementing proper fatigue management procedures did differ. This illustrates another example of how, when situational awareness remains high, the pilot sees

Pristine flight conditions invite a greater tolerance for the belief that the absence of complex environmental factors equates with little or no risk to be managed.

DSAM Dimensions and Psychosocial Factors

	Recall of		Statistically reliable difference?
	GA Events	UA Events	
Mean perceived risk score (6-pt scale; higher= higher perceived risk)			
Assessment of the instability as risky/unmanageable	4.40	2.37	Yes
Mean scores on Presage dynamic situational awareness model constructs (6-pt scale; higher= higher awareness)			
Affective awareness (gut feeling for threats)	4.35	3.31	Yes
Functional awareness (knowing the equipment)	4.65	3.33	Yes
Critical awareness (relying on experience)	4.24	3.82	Yes
Anticipatory awareness (seeing the threats)	3.99	3.32	Yes
Task-empirical awareness (knowing the limits)	4.92	4.77	Yes
Compensatory awareness (adjusting to threats)	3.54	2.46	Yes
Relational awareness (keeping each other safe)	4.54	4.19	Yes
Hierarchical awareness (knowing the procedures)	4.61	4.20	Yes
Environmental awareness (company support for safety)	5.20	5.06	Yes
Mean scores on key psychosocial factors (6-pt scale; higher=higher score on dimension)			
Presence of fatigue	2.81	2.85	No
Proper fatigue management	4.12	3.69	Yes
Ability to listen to/understand gut feeling warnings about risk	4.73	4.18	Yes
Ability to anticipate a GA	4.18	3.19	Yes
Confidence in GA performance abilities	5.34	5.32	No
General willingness to challenge crew	4.99	4.92	No
Event challenges to authority	2.95	2.93	No
Appropriate crew influence on GA decision making	4.99	4.70	Yes
Passenger pressure to land	4.02	3.79	No
Agreement with company UA/GA policies and procedures	4.59	4.29	Yes
Intolerance for deviance from GA policy and procedures	4.91	4.30	Yes
Anticipated company support for a GA decision	5.18	4.98	Yes
Company incentivization			
% Who say their company reprimands pilots for performing UAs	47	45	No
% Who say their company reprimands pilots for performing GAs	4	4	No
Incidence of active consideration/discussion of instability factors (% among those aware)			
Flight path deviation	79	69	Yes
Aircraft speed exceeded V_{REF} +20 knots	85	69	Yes
Aircraft speed was less than V_{REF}	67	73	No
Sink rate exceeded 1,000 ft per minute	73	64	Yes
Power setting was not appropriate for the aircraft	68	59	Yes
Aircraft was not in the correct landing configuration	81	64	Yes
Briefings and checklists were not complete	63	56	No
Incidence of active consideration/discussion of environmental factors (% among those aware)			
Tail wind	65	70	No
Wind shear	73	82	No
Turbulence	61	52	No
Insufficient visual reference	62	67	No
Contaminated runway	72	56	No
Incidence of active consideration/discussion of ATC factors (% among those aware)			
Occupied runway	74	66	No
Inadequate separation on approach	63	69	No
Wake turbulence	50	69	No
Late clearance or poor approach vectoring	70	68	No

ATC = air traffic control; DSAM = Presage dynamic situational awareness model construct; GA = go-around; IMC = instrument meteorological conditions; UA = unstabilized approach; VMC = visual meteorological conditions

Source: The Presage Group

Table 4

and feels the fatigue threat and then adjusts or compensates for it.

Similarly, the frequency of actual challenges to authority as reported by pilots in the UA or GA cases did not differ, whereas the quality of the influence the crew had on decision making did. When we examined our findings for the factor, "appropriate crew influence on GA decision making," we saw that pilots who made a GA decision reported that in the moments leading up to the decision they experienced what we judge to be more appropriate crew discussion and behavior. Pilots reporting their experiences in flying a UA, on the other hand, were more likely to report that the authority structure in the cockpit was influencing their decision to call a GA or not; that they felt less comfortable in challenging or being challenged about conducting a GA; that they were feeling less support from their crewmembers for calling a GA; that they felt more pressure from other crewmembers to continue the approach and land; and that they were feeling more concern about a loss of face in calling a GA. In other words, unlike UA pilots, GA pilots had leveraged their relational awareness competencies to keep each other safe by creating a more supportive, non-judgmental and challenge-accepting cockpit environment and engaging in the appropriate conversations around operational and flight risks.

This awareness of keeping each other safe spilled into other areas of risk assessment for the GA pilots when we looked at how deliberately pilots recalled having "actively considered and discussed" various objective situational factors. While there were no differences in personal consideration and/or active crew discussion between GA and UA pilots on any of the environmental factors or air traffic control factors assessed, when considering five of the seven instability factors we measured, GA pilots considered them more thoroughly and had more communication between crewmembers than UA pilots, providing information that most certainly would have better informed their situational awareness and influenced their assessments of risk and its manageability.

Also of interest are pilots' perceptions of their companies' attitudes about performing UAs and GAs. When asked in general whether their companies reprimand pilots for performing either UAs or GAs, pilots in the two event recall types reported no differences in the consequences their employers would impose for compliance or lack of compliance with their companies' policies. But when asked about these matters in the context of the events they were recalling, UA pilots reported that in those moments, they anticipated less company support for a GA decision. In addition, they were less likely to agree with their companies' UA/GA policies and procedures and reported more personal tolerance for deviations from them. Although this is a topic we will explore further in our next article, it is worth noting that if pilots perceive that there will be less support from the company for a GA decision, and basically disagree with that company's GA/UA policies and are more tolerant of deviations, they are primed for non-compliance.

Pilots … were more likely to report that the authority structure in the cockpit was influencing their decision to call a GA or not.

Normalization of Deviance

Deficits in situational awareness that would lead to continuing an unstable approach can now be seen more clearly, and prompt the following conclusions about how effectively objective situational factors are all too often translated to a psychological representation before a decision is made. A very specific situational awareness profile emerges for the pilot who continues an unstable approach. Within the UA pilot group, this profile was characterized by a consistent and comprehensive denial or minimization of situational awareness competencies. In much the same way a dimmer switch can be used to illuminate a room to varying degrees, the UA pilots have selectively turned down or dimmed their situational awareness competencies and, in so doing, dulled their sensory and cognitive processes when assessing and evaluating operational risks. Because our nine DSAM dimensions of situational awareness are by definition

inseparable and intrinsically interactive, it is fair to ask the question, "Which of the nine gets turned down first?"

Well, on one level it doesn't matter, principally because once one dims, it naturally ripples across all of the other constructs, dimming them all in the process. This is exactly what we see in the results, namely an effect across all nine dimensions of the DSAM. On another level, and taking into account the totality of our findings, it can be argued that the dimming of one's situational awareness competencies actually begins with the collective collusion on behalf of pilots in non-compliance with go-around policy and procedures. Others have referred to this type of comprehensive "buy-in" as an example of the "normalization of deviance."[2] Another way to state this is that a group's non-compliance with a policy or procedure over time becomes the "new normal" within a culture or organization.

As lived through our DSAM for pilots reporting instances in which they continued to fly UAs, the normalization of deviance taps into the most fundamental level of situational awareness, namely the company's support for safety (environmental awareness). When a pilot has the experience that his/her company and/or regulatory body is seemingly uninterested in protecting and monitoring compliance with procedures, he or she naturally personalizes this by becoming undisciplined or uncaring. The tendency then is for a pilot to be less strict about personal compliance with the company's GA policy. There is a moment for every pilot flying a UA, whether at top of descent or at 5,000 ft, where his or her situational awareness competencies may begin to dim. Once a pilot's commitment to a policy has shifted in general, almost immediately his or her gut feel for threats (affective awareness) shifts, too; with this now-absent awareness competency is the pilot's increasing inability to see (anticipatory awareness) and adjust (compensatory awareness) correctly to the threats. Added to that will be the pilot's active denial of his professional experience bank (critical awareness) as a means to assess present risk, as well as the minimization of his or her need to keep each other safe (relational awareness). The psychological landscape now lends itself to the pilots being less disciplined about what their instruments are telling them (functional awareness) and less concerned about knowing the procedures (hierarchical awareness) and aircraft operational limits (task-empirical awareness).

So why do pilots forgo the GA decision in 97 percent of UAs? We have discovered that continuing to fly a UA is associated with much lower levels of perceived risk about the unmanageability of instabilities experienced at and below SAH. These lowered risk assessments are in turn associated with a lowered level of situational awareness on each of the dimensions of the DSAM we have described. For pilots continuing to fly UAs, threats and risk associated with the objective flight conditions are inadequately translated to a compelling psychological risk understanding through a comprehensive, up-to-date and accurate set of dynamic situational awareness competencies. Owing to their interdependent nature, weakness in situational awareness in any of these competencies leads to a rapid undermining of other dimensions and a fast deterioration in accurate risk perceptions. With lowered risk assessment comes the decision to continue to fly a UA rather than execute a GA. And because most of the time we "get away with it," managing the aircraft's energy to a successful landing, this reinforces the belief that the risks of instability are manageable and perpetuates the cycle of chronically forgoing the GA.

The Presage Group specializes in real-time predictive analytics with corrective actions to eliminate the behavioral threats of employees in aviation and other industries. Further details of the methodology of their survey, experiments and results are described at <www.presagegroup.com>.

Notes

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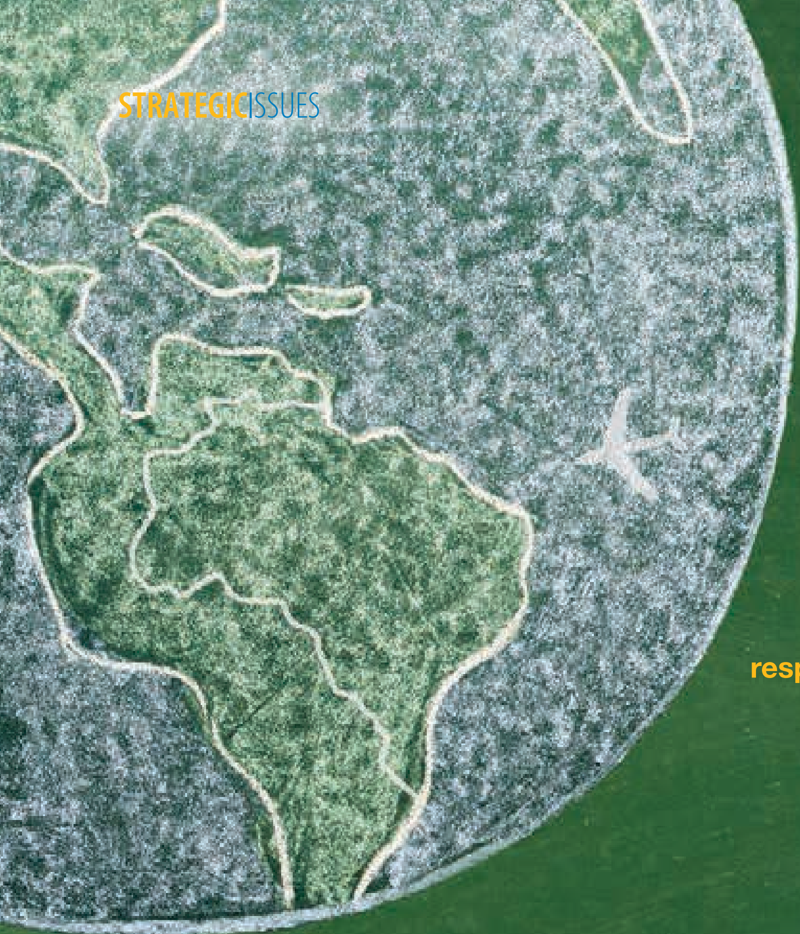

Brazil is leading in the development of responsible programs for teaching aviation English.

CLOSING THE GAP

BY ELIZABETH MATHEWS

Photo illustration: Jennifer Moore; Photos: © Cristian Baitg/istockphoto

In a world where progress in the teaching and testing of aviation English often has stalled, the aviation industry in Brazil has turned a significant corner, making safe aviation communication a priority.

In remarks to an aviation English conference in Brasilia in November 2012, Carlos Eduardo Magalhães da Silveira Pellegrino, the director of Brazil's National Civil Aviation Agency (ANAC), said Brazil has made a full-scale commitment to improving aviation English in its airspace. Other representatives of ANAC and the Airspace Control Institute (ICEA) also demonstrated the progress that can be made when senior administrators understand the relationship between best practices in aviation English and safe communications.

The progress is especially noteworthy in light of the possible role played by inadequate language proficiency in the Sept. 29, 2006, collision of an Embraer Legacy 600 and a Boeing 737-800 over the Amazon (*ASW*, 2/09, p. 11; *ASW*, 12/11–1/12, p. 22; *ASW*, 2/12, p. 41). All 154 people in the 737 were killed in the crash; the seven people in the damaged but controllable Legacy were uninjured. In its final report on the accident, the Brazilian Aeronautical Accident Investigation and Prevention Center (CENIPA) recommended that the Department of Airspace Control "immediately ensure that [Brazilian air traffic] controllers have the required level of English language proficiency."

Three years before the accident, in 2003, the International Civil Aviation Organization (ICAO) had adopted its requirements for English language proficiency testing of pilots and air traffic controllers; however, they were not applicable until 2008, and little infrastructure was in place to support their implementation.

In the 10 years since the language standards were adopted, ICAO has held international and regional seminars, developed speech sample tool kits and rating aids, and published supporting documents. Nonetheless, until very recently, aviation English conferences and seminars were relatively basic, addressing questions such as "Who can teach? What content should they teach? How should they teach, and for how long?" Progress was halting and uneven, with more reports of missteps and failures than successes.

In that context, Brazil's civil aviation authorities and the English language training community focused at the November conference on progress made and solutions that are being implemented.

Their presentations, as well as the information from representatives of ICAO and the International Federation of Air Line Pilots' Associations (IFALPA), provide information that is helpful to organizations still struggling with their own implementation of ICAO language requirements.

ICAO Standards

By the time ICAO organized its Proficiency Requirements in Common English Study Group (PRICESG) in 2000, English had long been both a de facto and an official aviation safety requirement embodied in a number of ICAO standards and recommended practices (SARPs). Nonetheless, despite the obvious safety need for proficiency in a common language, and despite the existing ICAO requirement that pilots and controllers "speak the language used for radiotelephony communication," there was much evidence — including the "trail of wreckage" of accidents in which language proficiency was a contributing factor — that for many pilots and air traffic controllers, English language proficiency was limited to memorizing ICAO phraseology contained in Document 4444, *Air Traffic Management: Procedures for Air Navigation Services*. Without formal ICAO plain language and testing requirements, the industry had not invested in the development of the needed aviation-specific English language programs.

Complicating the scenario, commercial testers and training providers rushed to the market; from my perspective, some had more business acumen than commitment to safety or to best practices in language teaching. Even some otherwise responsible aviation organizations have tended toward ICAO minimum standards in aviation English — skimping on teacher training, ignoring best testing practices or using

materials that do not correspond closely to the operational requirements. Similarly, but coming from the opposite direction — moving from an existing position within the language teaching industry into aviation — some language organizations have capitalized on the lack of standards by repackaging existing materials into "aviation English" programs.

Again, from my perspective, whether through ignorance or intent, whether drawn by lure of quick profit or a drift into complacency, the effect has been the same: Even some name-brand programs do not deliver acceptable results, maintaining a greater focus on marketing than on content development. This has only added to the confusion and frustration within the industry.

Understanding the many challenges to best practices in aviation English instruction underscores the importance of developments that were recently exhibited at the International Civil Aviation English Association (ICAEA) Aviation English Conference, with its theme of "Testing and Training: A Common Aim?"

Brasilia Conference

Presentations from ANAC, ICEA and the Brazilian academic community demonstrated that Brazil's efforts since 2009 in aviation English proficiency have been dedicated, sophisticated and mature. So it is worth examining what Brazil is doing right.

Effective language programs share certain characteristics. Successful programs involve understanding the nature of language learning and having realistic expectations for learner progress, as well as providing the conditions that allow for language learning, and for assessment of progress.

Being a native speaker of English does not qualify an individual to teach English.

The first requirement in an effective large-scale corporate or work-oriented language program is an executive-level commitment to the process. No matter how well-prepared or well-intended instructors or testers are, without a commitment from senior administrators, it is difficult to achieve much progress. The presentations from Pellegrino and others at ANAC and ICEA demonstrated such a commitment from the top.

The next important indicator that Brazil has made safe aviation communication a high priority is found in the academic qualifications of the leadership team implementing the testing and training programs. In keeping with ICAO recommendations, the individuals leading Brazil's aviation English testing and training have masters degrees or doctorates in applied linguistics or English language teaching.

This matters because English language teaching and testing are unregulated industries, and too many programs do not adhere to best practices. Sometimes this is due to aviation professionals' lack of specialized knowledge; a close reading of ICAO Document 9835, *Manual on the Implementation of ICAO Language Proficiency Requirements*, is the remedy for that. ICAO included minimum qualifications in its recommendations because some regions have lacked academically well-prepared language instructors. In those cases, the solution is to ensure a team leader has the best qualifications and to commit to ongoing professional development for teachers.

Most distressingly, too many commercial providers — even those based in English-as-a-first-language countries, with access to well-qualified English language teaching or testing professionals — have tended toward ICAO minimum standards, providing teachers or program managers who have only minimal qualifications to teach English. Being a native speaker of English does not qualify an individual to teach English.

However, the aviation English industry has become competitive. Organizations should insist that the provider either supply instructors with ICAO's "best" qualifications or commit to providing ongoing, high-quality training to their instructors until all instructors meet these qualifications.

Academic Qualifications Matter

In contrast to the qualifications of many people working in the aviation English field, the applied linguistics and language teaching academic backgrounds of the aviation English specialists who spoke at the conference in Brazil reflected the country's commitment to best practices. The expertise of their aviation English leadership teams was evident in the programs and the research presented.

Their initial success is a reminder of the importance of ICAO's recommendation that academic qualifications matter, that the intention is to protect the end user and that the programs offered to pilots and controllers must be effective and efficient. Whether a country or organization is, like Brazil, growing its own in-house programs, or subcontracts the program to an external aviation English provider, the first step is to identify an individual or team representing ICAO's best qualifications for language teaching or testing to guide the entire process.

Team Approach

The third indicator of the quality of the Brazilian aviation English program was evident in its team approach. Again, in adherence to ICAO guidance materials, English instructors are working with aviation subject matter experts. Each presentation was co-presented by a language specialist and a subject matter specialist.

As essential as English language teaching expertise is, English teachers working alone will almost certainly miss the mark on aviation content. In fact, much experience in aviation English development has proved that more than simply a team approach is essential. Best practices in aviation English require not just that English teachers collaborate with subject matter experts but also that both sides understand one another and learn what is important from their colleagues' perspectives. Academics need to learn about the culture of aviation safety and have more than a passing familiarity with flight operations. Operational experts need to understand the basics of adult language-acquisition principles and to trust their academic colleagues to deliver aviation English content in ways that encourage learning and stimulate acquisition. Finally, a team approach helps generate organizational buy-in.

Brazil's aviation English programs take such an approach. The program presented for controllers, in particular, by Patricia Tosqui Lucks and Jairo Roberto da Silva of ICEA, demonstrated this commitment to cross-training, as controllers who achieve ICAO Level 5 English proficiency[1] or better can be invited to cross-train as co-teachers to work in partnership with English instructors in the classroom — a resource-intensive but effective technique, demonstrating an extraordinary commitment to best practices.

Research and the Future

Particularly gratifying is that the comprehensive approach to aviation English in Brazil centers on "home grown" programs being developed and led by Brazilian English language experts and aviation subject matter experts. External providers and experts can add meaningful value or direction, but the focus, naturally, should be on developing in-house expertise and capability.

Among the presentations was the discussion by Ana Monteiro of ANAC of her analysis of challenges to oral comprehension in aviation. She recommended that existing taxonomies of communication factors be revised, considering that new categories are coming to light as our understanding of language as a human factor improves.

Overall, the research presented by Monteiro, as well as the programs presented on pilot training by Ana Bocorny of Pontifical Catholic University of Rio Grande do Sul in Porto Alegre, Brazil — responsible for much pilot English training — and on testing by ANAC and ICEA representatives, suggests that Brazil's aviation English community is taking a leadership role in the industry.

If the academic standards and commitment to best practices that have been demonstrated at the top of Brazil's aviation English infrastructure are carried down to the base, if the teachers in the classrooms are as well prepared as the leadership teams presenting at the Brasilia conference, then the classroom teaching can be expected to be communicative, interactive and

Best practices in aviation English require not just that English teachers collaborate with subject matter experts, but also that both sides understand one another.

engaging to learners — essential conditions for language learning.

One remaining question that was not entirely clear at the conference is the content focus of aviation English classes in Brazil. ICAO recommends content-based aviation English, an approach that has not yet been well enough understood or embraced by most commercial providers of aviation English. Again, because language teaching is an unregulated industry, material providers sometimes claim a content-based approach, but the claim is based on a tenuous understanding of content-based language teaching, or materials present a haphazard application of content-based learning. However, as the effort matures and as programs undergo revision and development, the industry may grow to better understand and apply content-based aviation English.[2]

ICAO and IFALPA

Adding to the sense that aviation English is maturing was the presentation by Nicole Barrette-Sabourin, a technical officer with ICAO, who explained ICAO's recently launched language test endorsement program. Dozens of aviation English tests, as noted, have come into the unregulated language testing market. There have been evidence of poorly designed or inadequately implemented testing, and reports of cheating and outright fraud. Thus far, among at least nine testing programs that have undergone the ICAO review, four have been either endorsed or conditionally endorsed. A voluntary, low-cost program, this ICAO effort represents an important step, pushing the industry toward better language testing and excluding the worst testing offenders.

In another presentation, Rick Valdes, a Boeing 767 captain for United Airlines and the IFALPA representative on the PRICESG, reviewed obstacles to best practices in aviation English in the context of threats to safety.

"We know there are companies out there that rely more on name brand recognition than on delivering quality programs," Valdes said, adding that the requirements are not only about speaking English well but also about using English to enhance flight safety. Aviation English teachers must also be safety advocates, he said.

Progress

Although progress is being made, that does not mean that aviation English standards have been fully implemented, nor does it mean that progress will be rapid, or that the teams will not encounter rough air. The sheer amount of training time required to achieve pilot and controller compliance with language-testing SARPs also can exceed that of other new safety-training requirements. Implementing large-scale language training and testing programs required by a country as large as Brazil demands commitments of time, effort and resources by individuals and organizations.

Considering the difficulties the aviation industry has experienced in the first decade after adoption of the ICAO language requirements, it is only right to celebrate what looks to be a country heading toward aviation English success. From these indications, Brazil has established the conditions to make language-learning programs successful: a commitment from the top, well-qualified linguistic teams guiding the effort and close cooperation between language specialists and operational experts.

Elizabeth Mathews, an applied linguist who led the international group that developed ICAO's English language proficiency requirements, researches the role of language as a factor in aviation communication and advocates for improving the quality of aviation English training and teacher training.

Notes

1. ICAO's requirements, which define six levels of language proficiency ranging from Level 1 (pre-elementary) to Level 6 (expert), say that Level 5 (extended) is characterized by, among other traits, pronunciation and intonation that "rarely interfere with ease of understanding," vocabulary that is sufficient for effective work-related communication and responses that are "immediate, appropriate and informative."

2. The Center for Applied Linguistics <www.cal.org> and the Center for Advanced Research in Language Acquisition <www.carla.umn.edu> provide information on content-based language teaching and are useful resources.

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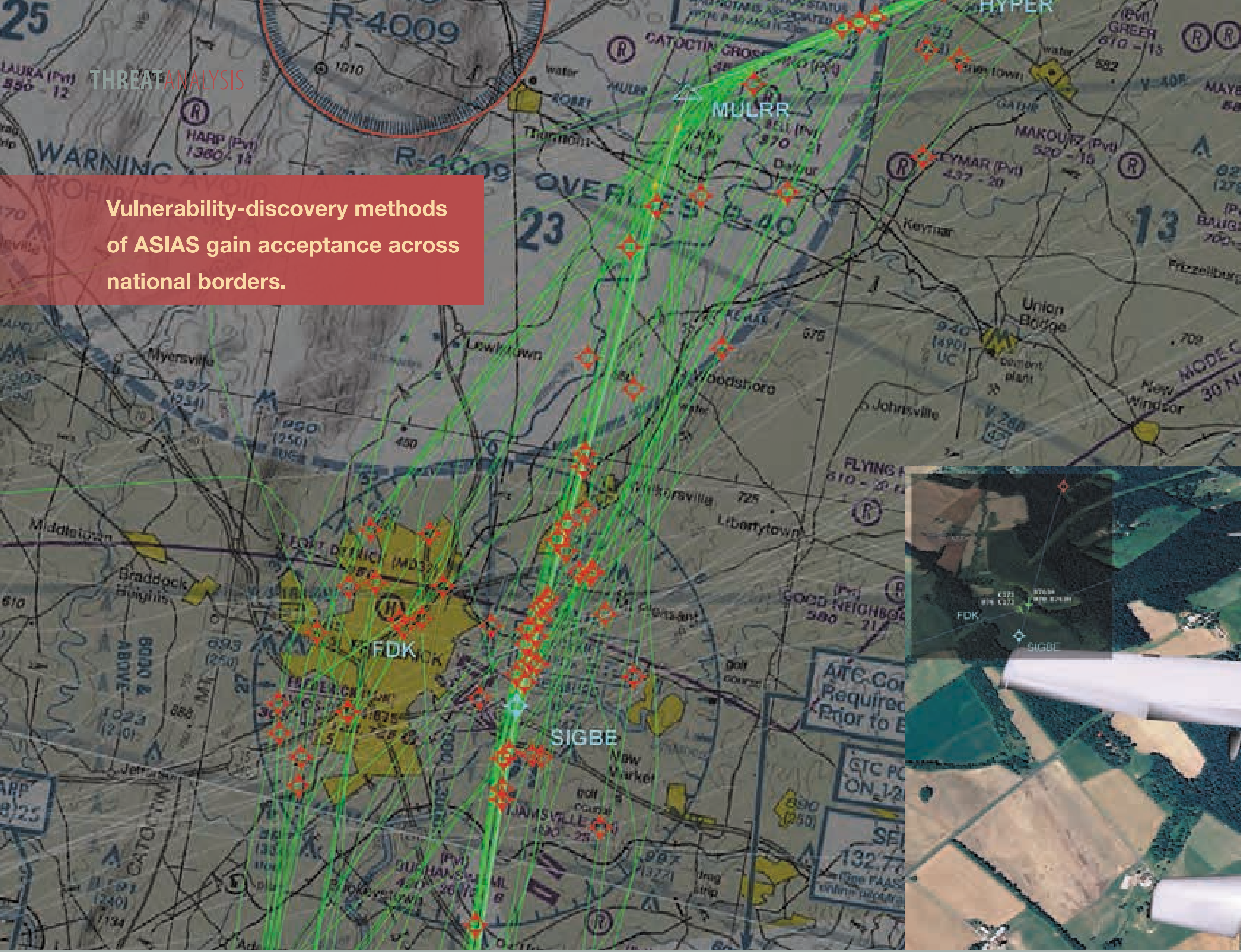


Vulnerability-discovery methods of ASIAS gain acceptance across national borders.

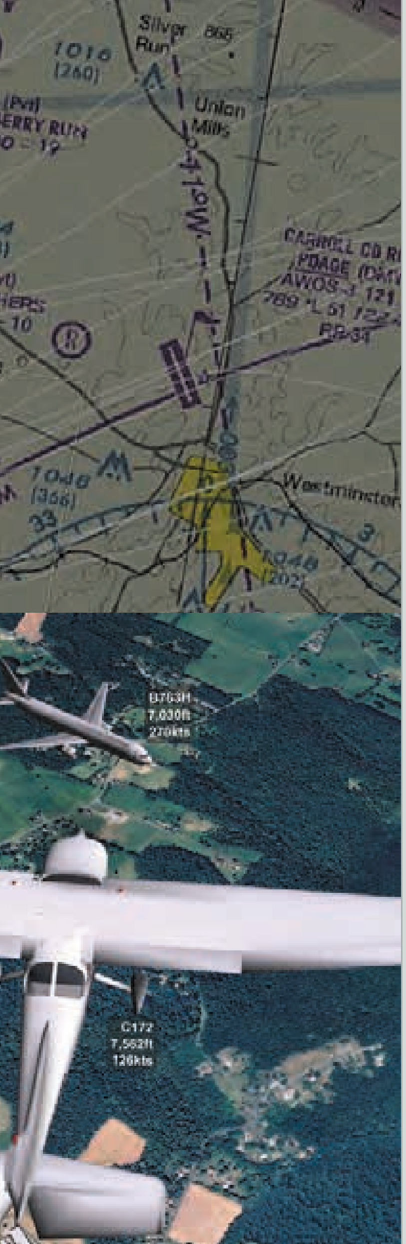
Sharing the Wealth

BY WAYNE ROSENKRANS

Creators of the Aviation Safety Information Analysis and Sharing (ASIAS) program in the United States imagined years ago that their methods could be a good fit for other countries and their airlines and possibly non-airline interests within aviation. Currently, this government-industry partnership funded by the U.S. Federal Aviation Administration (FAA) has about a year of experience working closely with a number of similar international partnerships, said Jay Pardee, the FAA's chief scientific and technical advisor for vulnerability discovery and safety measurement programs, in a recent briefing for *AeroSafety World*.

According to FAA, ASIAS leaders also expect to fulfill their intention to "increase the numbers and types of participants following a phased expansion plan to include other parts of the aviation community. ASIAS will include domestic corporate general aviation, military, helicopter, manufacturers and other government agencies." An example of effect on another government entity is the relationship forged a few months ago with the National Transportation Safety Board (NTSB;

Center for Advanced Aviation System Development, The MITRE Corporation



ASIAS analysts applied the TCAS RA algorithm to surveillance-radar tracks while exploring for any systemic risk after a Boeing 767-300 flight crew responded to a non-safety-critical "DESCEND" RA while passing 7,600 ft on the HYPER STAR into Washington Dulles International Airport.

see "Agreement Launches ASIAS–NTSB Working Groups," p. 42).

As when it launched in October 2007, ASIAS continues to focus on known-risk monitoring, vulnerability discovery and directed studies typically prompted by findings of ongoing safety data analyses, the needs of the Commercial Aviation Safety Team (CAST) and concerns raised by the U.S. airline industry during semi-annual Aviation Safety InfoShare meetings (*ASW*, 5/08, p. 25). The system's techniques, data sources and algorithms have appealed to several countries, but patterns and structures recently created for the Latin American and Caribbean Region have yielded an especially sound model, Pardee said.

"We've forged a relationship with some additional regions and countries around the world," he said. "The Regional Aviation Safety Group–Pan America [RASG-PA] uses the same principles that we use in ASIAS and CAST; it is an industry-government partnership [*ASW*, 2/13, p. 42]. The ASIAS Executive Board has agreed to share our U.S. airline member experience flying into some 22 airport locations" with RASG-PA's industry-government teams representing those airports. A memorandum of understanding effective in January 2012 defines the ASIAS–RASG-PA working relationship.

"The information is in an aggregated, protected, de-identified state, which is the way we use it under our governance within ASIAS," Pardee said. "They've adopted at this point in time 11 CAST safety enhancements. Many of them were built based on knowledge from ASIAS, which we share to assist RASG-PA in implementing solutions for problems we have knowledge about, that we have experienced in our own country. They've agreed they will adopt 33 starting with those elements that are the most logical for their safety issues."

The focus during most of the first year of the relationship was providing quarterly safety information reflecting ASIAS member airlines' experience operating into the 22 RASG-PA airports, as an indication of the effectiveness of their risk-reduction solutions. Members of a U.S. government-industry issue analysis team provide technical data that identify the safety issues relevant to unstabilized approaches, terrain awareness and warning system (TAWS) alerts, traffic-alert and collision avoidance system (TCAS) resolution advisories (RAs), runway excursions and other potential threat indicators.

"We help measure the effectiveness of actions in their region's airports by looking at our own ASIAS information and — in a protected fashion … a de-identified fashion — sharing that with the [RASG-PA] industry-government cochairs," Pardee said. "The advantage is, from the ASIAS airline member perspective, we can achieve improvements in the safety of airports that our airline members fly into within Pan-American countries. It has been a very successful experience for ASIAS and the RASG-PA organization — a model we do intend to use around the world. We periodically review the data with them, look at the progress they've made, and it's a relationship that continues to prosper. "

The ASIAS–RASG-PA collaboration has been able to delve deeply into threat detection and mitigation monitoring partly because of mutual trust, he said. "We get down to looking discretely at the details of those types of precursors, and we monitor the frequency and location jointly with RASG-PA helping them to take corrective action," Pardee said. "Airlines that are domiciled in that region benefit from the same improvements as U.S. airlines in safety, CFIT [controlled flight into terrain] reduction, improvement in unstabilized approaches, reduction in TAWS alerts, reduction in TCAS RAs, so we are using the data effectively."

NextGen Safety Assurance

One of the most recent ASIAS directed studies — focused on operations using area navigation (RNAV) off the ground (*ASW*, 3/12, p. 28) — was completed, and study-based safety enhancements currently are under development by CAST, said Michael Basehore, FAA's ASIAS program manager.[1] The latest directed study — focused on STAR (standard terminal arrival route) RNAV operations — is looking at risk factors in the context of a wider NextGen research program that began in 2010, Basehore

Agreement Launches ASIAS–NTSB Working Groups

The U.S. National Transportation Safety Board (NTSB) has gained access, on a case-by-case basis, to a vast store of summarized safety data gathered, analyzed and protected within the Aviation Safety Information Analysis and Sharing (ASIAS) program to prevent airline accidents (Table 1, p. 44).

When a formal NTSB request is approved under the November 2012 memorandum of understanding, the board reciprocates by granting ASIAS access to archived digital flight data recorder (DFDR) data specifically related to the request. Regardless of whether an accident occurs, ASIAS is working with the NTSB to acquire archived DFDR data that, when added to the ASIAS databases, might reveal accident precursors or indications of systemic risks. Various restrictions preserve the U.S. airline industry's voluntary — and now indispensable — flows of safety information from routine flight operations, according to the NTSB and the U.S. Federal Aviation Administration (FAA).

Collaboration under this highly structured and controlled framework stands to enhance all parties' predictive methods (*ASW*, 3/13, p. 43; *ASW,* 11/11, p. 32), said Paul Morell, a captain and vice president, safety, security and environmental programs, US Airways, and industry co-chair, ASIAS Executive Board (AEB). From his perspective, most noteworthy is that the memorandum's provisions only apply in an accident involving a U.S. air carrier in the United States.

"In essence, we're expanding the database for ASIAS in order to do our research," Morell said. The ultimate advantage to ASIAS members will be gaining new insights from the NTSB relationship and carrying over data that help the Commercial Aviation Safety Team to develop effective risk mitigations, he added.

Any accident that meets these criteria provides "NTSB an opportunity to talk to our IAT [ASIAS initial analysis team tri-chairs] and AEB co-chairs, and to see if there could be something, some kind of information we may have where we can help them in their investigation," Morell said. Ideally, knowledge will expand beyond an isolated case being investigated by NTSB, he said.

NTSB-ASIAS interaction for a given event begins with these investigators. "First of all, there's a protocol within the NTSB to determine whether they will ask ASIAS to engage," Morell said. "Once they make a determination within the NTSB, then there is the informal query, NTSB talking to the IAT tri-chairs. We either determine 'we can probably help you' or 'we really don't have what you're looking for.' Once we get the formal request, then we engage and we meet at MITRE Corp. [the not-for-profit, FAA-funded research center that has stewardship of ASIAS data]. We have the NTSB representatives and we have the IAT representatives create a working group."

The working group uses the formal request as its scope of work but with a practical degree of flexibility and adjustments that are made possible — but not guaranteed — by another mechanism. "If they say 'we need to take this little turn over here because we discovered something related during the investigation,' and if it's within the line and the framework of the initial permission that was given for the setting up of the work group, then they can continue doing that," he said. "If it's outside of that scope, then the ASIAS Executive Board will make a determination whether to allow them to do that."

The memorandum bars any of the parties from using FOQA data, aviation safety action program reports, air traffic safety action program reports or non-publicly available data to measure an individual data contributor's performance or safety. ASIAS protocols already had limited FAA analysts' access to aggregate and/or de-identified information for purposes outside of ASIAS.

"One of the benefits I see in looking at the NTSB DFDR data archives is that we can use those signatures, those digital data patterns, bring them into our vulnerability discovery activity within ASIAS, and then digitally look across all of the digital databases to see if we see any indication of that same pattern," said Jay Pardee, the FAA's chief scientific and technical advisor for vulnerability discovery and safety measurement programs. "Not necessarily [studying] the accident itself, but we're interested in the precursors that would be in that DFDR trace prior to an event."

"The absolute cornerstone of ASIAS is that nothing leaves the working group until the NTSB and the IAT make a determination that it should become part of a public record or part of their investigation," Morell said. "At that point in time, all that is brought to the AEB, and the Executive Board will make a determination whether or not that can be released. If not, then the NTSB can't use it in their report but they still have an idea of where they should go or what they should do."

For example, if the NTSB investigates a commercial jet runway overrun accident involving excessive time elapsed between touchdown and the flight crew's spoiler deployment, the NTSB will not be permitted to use any aggregate ASIAS information that could be used to compare the accident crew's performance with the industry norm.

However, if a commercial jet landed short of a runway after experiencing fuel system icing during approach to an airport — and ASIAS-member airlines' FOQA and engine data were accessed to support this investigation — these circumstances likely would be favorable for concurrence by the AEB in NTSB's desire to publish comparisons of the accident scenario with multi-airline experience.

"There's a perfect example where you're using information from all these sources but you're not comparing an airline or a crew, you're looking at a generic view of how a system operates," Morell said.

— WR

said. Called Optimization of Airspace and Procedures in the Metroplex (OAPM), the program has been studying the benefits of changes to airspace and procedures through local teams in 21 NextGen-defined metroplexes.[2]

"[ASIAS works] with these OAPM teams as they look at the different metroplex areas, and shares with them the information that we've gained from a directed study, known-risk monitoring or benchmarks that we've already identified for their metroplex," Basehore said. Notably, he added, this input — unlike retrospective safety analysis — occurs before airspace, route or procedure redesign is even initiated. ASIAS has collaborated to date at three metroplexes, raising awareness of issues such as non-safety-critical TCAS RAs when general aviation and commercial air transport operators operate in adjacent airspace (*ASW,* 8/09, p. 34).

"ASIAS, in a protected fashion, contributes what the known tactical threats are in those areas, whether they are TAWS warnings, TCAS alerts or unstabilized approaches," Pardee said. "We provide that safety information to metroplex teams along with the tools that ASIAS developed to detect them in the first place." Two software modules identify TAWS-warning hotspots and TCAS RA hotspots, patterns detected through analysis of radar tracks.

The modules are plug-ins to the NextGen airspace redesign software called Terminal Area Route Generation Evaluation and Traffic Simulation (TARGETS). "As a new airspace or route or procedure is developed, it's done with knowledge of where the current tactical safety concerns from ASIAS are using this airspace-design tool, which has the detection algorithms built into it" for preemptive risk reduction, he said.

A similar activity recently begun by ASIAS to strategically "design risks out of the system" throughout NextGen implementation has been detection of tactical safety concerns during local adjustments to new arrival procedures based on performance-based navigation (PBN), Pardee said. "As new RNAV arrivals, as an example, are being designed, we take advantage of the opportunity to address our TAWS issues, and lead airline members are part of that activity," he said. Another activity has been the preparation of safety-assurance metrics for NextGen, defining evidence of the required level of safety.

"Over the past eight months we've reached out to the different NextGen portfolio managers," Basehore said. The message for them covered ASIAS capabilities relevant to NextGen planning, risk baselines, and conducting the post-implementation determination of successes/failures and associated risks.

Throughout ASIAS, new safety metrics — for example, geographic distribution of anomalies and adverse trends such as TCAS RAs with their contributing factors — also are undergoing refinements to ensure useful information can be produced as NextGen precision evolves. "We could then get a better handle on understanding locations, flows and maybe more importantly, to categorize or classify the severity of the various penetrations of these safety barriers. That's a strategy that I see us delving into further this year," Pardee said.

Among raw materials that ASIAS analysts recently have begun to fuse with other sources are recordings of automatic dependent surveillance–broadcast system (ADS-B) messages, and voice communication between pilots and air traffic controllers, FAA said in its 2012 NextGen implementation report.[3] "We're starting to look into the possibilities of digital voice-track data," Basehore said. "In some of the studies not knowing the conversation that was occurring between the controller and the pilot has left us in a lurch. For example, we'd see in a departure an aircraft leaving the procedure, but without analysts knowing whether there was a conversation where the controller said 'yes, you can cut the corner short' or the pilot said that he was turning for avoidance conditions. We're in the research phase of actually acquiring voice-track data to meld it with data for particular potential safety issues that we have seen."

Fully understanding an altitude deviation during an arrival, as another example, could require this capability. "Our research right now is about getting that voice data and being able to 'pin it' to that particular radar track to get the full realm of what's going on," he said.

Although not new to ASIAS, data mining of narrative texts — including auto-classification of reports by computer algorithms — has become more sophisticated for sources such as aviation safety action program (ASAP) reports. "We have seven ASAP trends that we monitor on a regular basis, and probably five or six more under development so that we can mine the text data just the way we mine the numerical digital data" except for calculating trends not rates with ASAP reports, Basehore said.

The NextGen implementation report cited ongoing work by ASIAS, including "helping the FAA and stakeholders with better characterization and understanding of missed approaches, runway overruns, rejected takeoffs, autobraking and energy states on final approach. This nuanced understanding is expected to aid in accident prevention." The report pointed to ASIAS initiatives to develop a new method to query multiple databases with one search directive; add air traffic control (ATC) facility-performance data from FAA's Air Traffic Organization to analyze safety effects of unplanned service interruptions; develop data standards and integration capabilities to add digital flight data from voluntary sources in general aviation, especially de-identified aggregate data from corporate flight operational quality assurance programs (C-FOQA); improve the query and visualization software on secure Web portals used by ASIAS members; and revise data standards for FOQA data sources and sources of voluntarily submitted text reports.

Winning Over Airlines

Venues long used by U.S. airline directors of safety to confidentially share lessons learned, methods, anecdotes and trends among peers have not been superseded. But one airline's perspective illustrates the relative influence of ASIAS, said Paul Morell, a captain and vice president, safety, security and environmental programs, US

ASIAS by the Numbers, February 2013

Fact	Figure
Airline members of ASIAS	44
Safety databases	46
Hybrid databases	78
Standards datasets	7
Airlines providing FOQA data	24
Total flight operations in FOQA data	10 million
Airlines providing ASAP safety reports	44
ASAP reports accessible to ASIAS	125,000
ATSAP reports accessible to ASIAS	50,000
CAST safety enhancements from ASIAS	6
Metrics monitored by ASIAS for CAST	51

ASAP = aviation safety action program; ASIAS = Aviation Safety Information Analysis and Sharing; ATSAP = air traffic control safety action program; CAST = U.S. Commercial Aviation Safety Team; FAA = U.S. Federal Aviation Administration; FOQA = flight operational quality assurance (routine flight data monitoring); TCAS = traffic-alert and collision avoidance system

Note: ASAP reports originate from airline pilots, flight attendants, maintenance technicians and dispatchers; ATSAP reports originate from air traffic controllers. Examples of non-airline data sources are the aircraft analytical system; airport surface detection equipment, model X; airspace performance metrics; National Flight Data Center; National Offload Program radar tracks; traffic flow management system; and TCAS operational performance assessments.

Source: FAA

Table 1

Airways, and industry co-chair, ASIAS Executive Board.

"At US Airways, our SMS [safety management system] deals with FOQA, ASAP, a lot of the things that are going on with ASIAS," Morell said. "But we're very limited in the scope of what we're looking at." For him, the key advantage of ASIAS has been the company's ability to tap ASIAS databases "to look at aggregated data or different airports or different types of data and to also compare and use the Web portal dashboards" to analyze issues such as unstabilized approaches.

He explains, "I might be thinking we're doing really well, but I can compare US Airways against the aggregate. … I can see that maybe I have a problem at one airport, but am I the only one that has that problem?"

For Morell, the second advantage is the ability to contribute effectively to the safety of the entire airline industry, without diminishing the value of sharing experiences with safety committees of airline associations, academia and industry initiatives. "ASIAS analysts can go in there, and look, and see where I might not even think I have a problem personally at our airline but by the small amount that I'm contributing, and different airlines are contributing now, I'm enabling a 'larger SMS' — because that's what ASIAS is."

All told, this cycle — threat identification by ASIAS and InfoShare, then risk mitigation and systemwide solutions through CAST safety enhancements, and finally ASIAS measurement of risk mitigation effectiveness — has been a widely welcomed advancement, he said.

Notes

1. FAA. *NextGen Implementation Plan.* March 2012. In 2012, ASIAS was involved in a directed study of risks while FAA validated the safety and capacity benefits of implementing RNAV off the ground in three of 21 NextGen metroplexes, designated as Houston, Memphis and North Texas.
2. FAA. The report says, "OAPM is a systematic and expedited approach to implementing PBN procedures and associated airspace changes in major metropolitan areas. Expected improvements from OAPM include efficient descents, diverging departure paths and decoupling of operations among airports within the metroplex airspace."
3. FAA. The report says, "The aim of [OAPM] is to have study groups identify near-term PBN improvements coupled with airspace sector adjustments that can be completed in major metropolitan areas within three years."

BY RICK DARBY

That's FRAT

A study of flight risk assessment tools found strong support from their users.

Evolution of Business Flight Risk Assessment

Flight risk assessment tools (FRATs) have shown their value, and indications are that further refinement of the assessment process will provide even better results, according to a study conducted by the VanAllen Group and presented at the 2012 Corporate Aviation Safety Seminar.[1]

This was no academic exercise. "The goal of the study was to accelerate the evolution of FRATs," the author's paper says. It describes a second generation of FRATs that is available in the marketplace: "They are the software evolution of the first generation hard-copy models [paper forms] that were integral elements of the initial safety management systems protocols and resources."

Ten major non-commercial aviation departments participated, representing "high end" operations, most operating both domestically and internationally. Turbojets were the only type of business aircraft involved. Twenty percent of the FRATs were created by their own participants, and the rest used commercial FRATs from five different vendors.

The study collected data and participant responses for flights from August 2011 through January 2012. Because of the variety in FRAT metrics and scoring schemes among operators, it was decided to use the requirement for a "management review" — given a score of 100 percent — as the basic criterion (Table 1).[2]

FRAT Scores for 10 Operators

Phase	Score	Percent of Legs Reviewed by Management
Average scores for all legs		
Scheduling	36.0%	4.7%
Preflight	37.8%	2.5%
Post-flight	35.2%	3.3%
Average scores for domestic legs		
Scheduling	33.6%	4.6%
Preflight	36.5%	2.6%
Post-flight	32.7%	2.8%
Average scores for international legs		
Scheduling	48.7%	4.6%
Preflight	44.7%	2.0%
Post-flight	50.2%	5.4%
Range of individual participant scores		
Scheduling	19.5% –82.7%	0%–32.2%
Preflight	16.6%–70.8%	0%–12.9%
Post-flight	16.9%-72.5%	0%–13.7%

FRAT = flight risk assessment tool

Note: "Score" indicates the percentage of the score that would have triggered a management review. For example, a score of 36.0 percent would represent slightly more than one-third of the risk that would have led to a review.

Three participants (30 percent) did not incur any scores requiring management review, despite flying legs with substantial risks.

Source: The VanAllen Group

Table 1

"For the first three months, we gathered baseline FRAT and trip-leg data," the paper says. "This created an average FRAT score for each participant. … At the midpoint, we asked the participants to deliberately seek to lower [improve] their scores throughout the second half."

Average FRAT scores were collected at the end of the study. No overall lowering was found, however (Table 2).

The FRAT scores at times seemed counterintuitive. Some apparently higher-risk flight segments did not meet the "management review" hurdle:

- "Three training flights, among the highest-risk events in business aviation, averaged a score of 30 percent [less than one-third of the score that would have triggered a management review]."
- "Three hundred eighteen ferry flights, which have an accident rate four times greater than passenger-bearing legs, averaged a score of 44 percent, with only 7 percent of the flights reviewed."
- "A medium jet on its international factory delivery flight, [with] no mentor pilot [and] no translator, was flown on a 14.7-hour duty day. The crew was the owner and his chief pilot." The FRAT score was 65 percent.
- "The same medium jet, with the same crewmembers with less than 50 hours in type, conducted a night landing into a 4,000-ft [1,219-m] runway at sea level."

Again the FRAT score was 65 percent. "It is obvious that FRAT scoring is not an exact science," the paper says.

The numbers may have told one story — or no story — but the participants told another. "The majority of the participants reported strong positive benefits gained from the FRAT process," the paper says. "They also indicated the benefits continued to increase throughout the study."

After its conclusion, the researchers conducted a meeting and conference call with all the operators. When asked the most important benefit they had gained from using a FRAT, participants offered responses such as these (paraphrased and summarized):

- "It forces crews to talk about trip issues. It is a teaching and learning tool."
- "We found a number of FRAT conversations led to 'Aha!' insights."
- "We now have historic data, not just lore, to help us modify our training to make it much more meaningful."
- "Our crews shifted from 'checking the boxes' to truly understanding our operations, the risks incurred and how to most effectively manage or mitigate those risks."
- "We transitioned from using a FRAT for International Standard for Business Aircraft Operations (IS-BAO) compliance to it being a useful tool for measuring and managing safety."

The FRAT is valuable, the paper says, not only for the information it provides but also for the process itself, raising awareness and changing attitudes.

Participants were asked to reply to additional questions about their FRATs. For example, "How important is your FRAT to your SMS [safety management system], on a scale with 5 = critical to 0 = not at all?" The average response was 4.2. Another question was, "How effective is your FRAT as a risk management tool, on a scale with 5 = extremely to 0 = not at all?" The average response was 4.0.

Average FRAT Scores for 10 Operators, by Study Period

	Period 1	Period 2	Change
Scheduling score	33.6%	38.8%	15.4% increase
Preflight score	38.5%	37.1%	3.7% decrease
Post-flight score	32.2%	38.3%	18.9% increase
Average	34.8%	38.1%	10.2% net increase

FRAT = flight risk assessment tool

Note: Period 1 was prior to the beginning of the study; period 2 was during the study's second half, when participants were asked to make an effort to lower their scores.

"Score" indicates the percentage of the score that would have triggered a management review.

Source: The VanAllen Group

Table 2

The average number of data points assessed by users' FRATs was 51 (with 90 the largest number). The number of human factors data points tracked ranged from five to 18, with an average of 10.

"That translates to about 20 percent of data points focused on human factors," the author told *ASW*. "Yet, about 70 percent of accidents and incidents are human factors–sourced. This disparity underscores the need for more comprehensive development of FRAT data points."

The paper forecasts that FRATS in the not too distant future will be completely integrated with flight operational quality assurance programs, and with as many data points as possible automated.

"The crew would have current flight risk ratings as a cockpit readout, with risks and mitigations displayed upon request," the paper says. "When a significant change in the risk occurs, a message would be displayed with mitigation recommendations listed. A parallel message could be shared with management. … Variances would be recorded, reported and discussed. Procedural intentional noncompliance events, a major factor in accidents and incidents, would become much less frequent."

The next generation of FRATs will be much more effective, the paper says.

Canadian Accidents Up, Incidents Down in 2012

Aviation accidents reported to the Transportation Safety Board of Canada (TSB) totaled 290 in 2012, an increase of 13 percent from 2011 (Table 3).[3] However, the 2012 number was close to the average for the 2007–2011 period.

Fatal accidents numbered 42 in 2012, 17 percent more than the 2007–2011 average (Table 4). Six of those 42 involved commercial aviation airplanes, and five involved commercial aviation helicopters. Sixty-three fatalities resulted from the 2012 accidents, a decrease from 67 in 2011 and an average 66 in 2007–2011. There were 50 serious injuries in 2012 accidents, compared with 44 in 2011 and an average 48 in 2007–2011.

"In 2012, a total of 636 incidents were reported," the TSB said. "This is a 6 percent decrease from the 2011 total of 677 and a 21 percent decrease from the five-year average of 808."

Canadian Aviation Accidents, 2007–2012

	2012	2011	2007-2011 Average
Total	**290**	**257**	**292**
Accidents in Canada involving Canadian-registered aircraft	267	240	272
Accidents outside Canada involving Canadian-registered aircraft	8	7	8
Accidents in Canada involving non-Canadian–registered aircraft	16	10	13

Source: Transportation Safety Board of Canada

Table 3

Canadian Fatal Accidents, by Aircraft Type, 2007–2012

	2012	2011	2007–2011 Average
Total	**42**	**35**	**36**
Airplane	25	23	23
Helicopter	7	8	7
Ultralight	8	3	5
Other aircraft types	2	1	1

Note: "Other aircraft types" includes balloons, gyroplanes, gliders, dirigibles, hang gliders and similar aircraft types.

Source: Transportation Safety Board of Canada

Table 4

Notes

1. Agur, Peter v. Jr. "Second Generation FRATs: Strengths, Weaknesses and Next Generation Opportunities." Flight Safety Foundation, Proceedings of the 57th annual Corporate Aviation Safety Seminar.

2. For example, at one operator a score of 26 would prompt management to review the trip leg, while a score of 19 might have the same result at another operator. For the sake of apt comparison, both would be scored equally by the researchers as 100 percent.

3. TSB. "2012 Statistical Highlights: Aviation Occurrences." <bit.ly/YAORFs>.

Error Tolerance, Error Containment

Human factors includes the non-technical skills needed for an SMS.

BY RICK DARBY

SCHELL Game

SMS for Aviation — A Practical Guide. 6: Human Factors

Civil Aviation Safety Authority of Australia (CASA), 2012. 28 pp. <bit.ly/Z3zC5R>.

This is one of six modules published by CASA as a resource kit to acquaint its personnel and other aviation professionals with the components of a safety management system (SMS).[1]

Human factors (HF) "is an umbrella term for the study of people's performance in their work and non-work environments," the module says. "Perhaps because the term is often used following human error of some type, it is easy to think of it negatively. However, human factors also includes all the positive aspects of human performance: the unique things human beings do well."

Although SMS is perhaps most often associated with technical and procedural metrics such as flight data monitoring and trend analysis, risk calculation and incident reporting, HF also plays an integral role. "It is unlikely that your SMS will achieve its full potential for improving safety performance without a full understanding and application of HF principles by all your staff to support a positive safety culture," the module says. "Regulations and safety management systems are merely mechanical unless organisations understand and value safety behaviour."

The Theory

The module begins with a widely accepted theoretical framework, the SHEL model, now often expanded into SCHELL. The latter term's components include S (software — the procedures and other aspects of work design); C (culture — the organizational and national cultures influencing interactions); H (hardware — the equipment, tools and technology used in work); E (environment — the environmental conditions in which work occurs); L (liveware — the human aspects of the system of work; and L (liveware — the interrelationships between humans at work).

"The SCHELL model emphasises that the whole system shapes how individuals behave. Any breakdown or mismatch between two or more components can lead to human performance problems," the module says.

"For example, an accident where communication breaks down between pilots in the cockpit, or engineers at shift handover, would be characterised by the SCHELL model as a liveware-liveware problem. Situations where pilots or engineers disregarded a rule would be characterised as liveware-software."

The Skills

Another way of looking at human factors is that "human factors training should focus squarely on providing aviation safety-critical personnel with the *non-technical skills* to manage the prevention/consequences of human error. This implies that making errors is normal and expected. The consequences of error are just as important as the causes.

"Non-technical skills are the decision making and social skills that complement technical skills. For example, inspecting an aircraft engine using a borescope is a technical skill performed by a licensed maintenance engineer. However, maintaining situational awareness (attention to the surrounding environment) during the inspection of a wing, to avoid tripping over hazards, is a non-technical skill."

Error tolerance can be built into the organization and operator procedures.

The module lists as the main categories and elements of non-technical skills managing fatigue; managing stress; alcohol and other drugs; team-based cooperation and coordination; decision making; situational awareness; communication; and leadership.

One key to developing non-technical HF skills is threat and error management (TEM), the module says. TEM begins with recognition — of human errors, of threats to safety and of undesired aircraft states.

A second key is professionalism, which encompasses these abilities and qualities:

- Maintain discipline — follow approved procedures to perform a given task.
- Assess situations — know what's going on around you.
- Make decisions — take decisive actions.
- Set priorities and manage tasks — prioritize safety above personal concerns.
- Maintain effective communication and interpersonal relationships.
- Maintain currency.

The System

"If you want to find actual solutions for the problems human errors cause, you often need large systemic changes," the module says. "For example, you might have to modify maintenance rostering to combat fatigue, or revise your flight manuals to make them easier to interpret."

Beyond systemic changes, error tolerance can be built into the organization and operator procedures. This is something like a human-centered version of the redundancy that engineers include in aircraft systems design, so that a single-point failure is extremely unlikely to be catastrophic.

"Error tolerance refers to the ability of a system to function even after an error has occurred," the module says. "In other words, an error-tolerant system is one in which the results of making errors are relatively harmless. An example of building error tolerance is a scheduled aircraft maintenance program. Regular inspections will allow multiple opportunities for catching a fatigue crack in a wing before it reaches a critical length.

"As individuals we are amazingly error tolerant, even when physically damaged. We are extremely flexible, robust, creative and skilled at finding explanations, meanings and solutions, even in the most ambiguous situations. However, there is a downside: The same properties that give human beings such robustness and creativity can also produce errors."

How can creativity and flexibility produce, as well as reduce, errors? Part of the problem is that we extrapolate from the known to the unknown — for instance, we fill in missing information. We surmise, especially in task-saturated or time-pressured situations. Usually, this creative response is rational, based on experience. Sometimes, though, the reality differs from the norm and the conventional assumption is mistaken.

"Our natural tendency to interpret partial/missing information can cause us to misjudge situations in such a believable way that the misinterpretation can be difficult for us to discover," the module says. "Therefore, designing systems that predict and capture error — in other words installing multiple layers of defences — is more likely to prevent accidents that result from human error."

Supplementing error tolerance is error containment. Error containment strategies include policies that "formalise acknowledgement that errors are 'normal'; [include] regular systemic analysis to identify common errors and build stronger defences; identify risk of potential errors through normal operations behavioural observation programs; identify potential single-point failures (high risk) and build stronger defences; [and] include the concept of shared mental models in team-based training initiatives."

The Fit

CASA recommends blending HF principles into at least these SMS elements:

- Hazard identification and reduction to as low as reasonably practical;
- Change management;
- Design of systems and equipment;
- Training of operational staff;
- Task and job design;
- Safety reporting and data analysis; and,
- Incident investigation.

Each of these subjects is discussed with an explanation of its HF content, an example scenario and a checklist. To illustrate the methodology, here is how the module examines the first element, integrating HF into hazard identification and reduction.

"Your hazard identification program can reveal potential or actual errors and their underlying causes," is the summary statement. An example follows:

"A pilot notices the mobile aircraft stairs being left unsecured and the potential for the stairs to hit the aircraft, particularly in strong wind. The pilot reports this concern via the company hazard reporting process. The company safety manager considers the human factors issues involved, and, in talking with ramp staff, finds out that sometimes people forget … to secure the wheel brake properly.

"On inspecting the stairs, the safety manager finds that there are no signs on them to remind operators to activate the wheel brake. Simple human factors solutions would be to install a sign prompting operators to secure the wheel brake, and to ensure that all airport staff are regularly reminded of the danger of unsecured stairs."

The module's SMS checklist for hazard identification and reduction includes items such as these:

- "Do you consider HF issues in general risk assessments where hazards are identified?"
- "Are the HF issues involved with hazards understood?"
- "Are different error types with hazards recognised? Are the workplace factors that increase error potential for hazards, such as high workload, or inadequate equipment availability or design, considered?"
- "Do you consider human performance issues in regular staff workshops identifying potential safety hazards?"
- "Is your hazard-reporting process user-friendly and does it prompt users to consider HF issues? What errors might result if the hazard is not managed well?"

Change Management

The module describes how HF fits in with the other identified SMS elements, noting, "Any major change within your organization has the potential to introduce or increase human factors issues. For example, changes in machinery, equipment, technology, procedures, work organisation or work processes are all likely to affect performance and cause distractions.

"Carefully consider the magnitude of change: how safety-critical is it? What is its

'Any major change within your organization has the potential to introduce or increase human factors issues.'

potential impact on human performance? Consider human factors issues especially during the transition period of the change."

Design of Systems and Equipment

"Poorly thought-out equipment design can have a major impact on the performance of your staff, and you should ensure that there is a good fit between the equipment and those using it," CASA says. "The design of equipment such as displays and control systems, alarm systems, signals and warnings, as well as automated systems, may involve significant human factors risks."

Training of Operational Staff

"Before training operational staff in non-technical skills, do a training needs analysis, so that you know which error management measures to target to which groups — individuals and/or teams."

> **'The same decision-making, communication breakdown and distraction problems you see in a serious accident you will also tend to see in minor occurrences.'**

Task and Job Design

"Tasks involving excessive time pressure, a complex sequence of operations, relying overly on memory, or that are physically or mentally fatiguing, are likely to negatively affect performance. Task design is essentially about task matching — make sure that tasks and activities are appropriate and suited to a person's capabilities, limitations and personal needs."

Safety Reporting Systems and Data Analysis

"Generally, the same decision-making, communication breakdown and distraction problems you see in a serious accident you will also tend to see in minor occurrences. Your safety reporting system should not only collect information about notifiable occurrences and incidents, but also hazards, near-misses and errors that otherwise might have gone unnoticed."

Incident Investigation

"Make sure your investigation procedures detail clearly how human factors considerations are included. … Your investigators need to be trained in basic human factors concepts and design procedures to be able to establish which human performance factors might have contributed to the event."

The Preconditions

As in other aspects of SMS, human factors goes hand-in-hand with a paradox: solutions cannot always be applied at the location or time when errors are made. Mitigation often resides at a different level, the conditions that predispose fallible humans to error. Those conditions can be far in time or distance from the "sharp end."

For instance, take the issue of unsecured mobile stairs discussed earlier on the subject of hazard identification and reduction. The suggested solution is to install a sign reminding operators to be sure the wheel brake is locked.

But incident analysis might discover that a dozen kinds of errors have been made in connection with airstairs. Should management post signs warning of them all? How many signs can gate area personnel read while attending to their duties? If they forget to set the brake as they have been emphatically trained to do, will they remember the reminders?

These questions are not carping — they go to a fundamental issue in human factors. Telling people not to make mistakes probably does not help much. Personnel typically are trying to perform their work correctly. If distractions or time pressure cause them to forget to secure the stairs, they're even less likely to remember a warning sign, let alone numerous signs.

If any conclusion can be drawn from this, it may be that HF — like the SMS itself — is an interrelated whole. Individual steps are useful, but should not lead to a "check-off" mentality that says, "We've done this, that and the other so we're good to go." SMS is above all a habit of mind.

Note

1. The other modules concern SMS basics; safety policy and objectives; safety risk management; safety assurance; and safety promotion. A DVD is included with the kit. All modules are available online at <bit.ly/XdvzWQ>.


FLIGHT
SAFETY
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‘Mission Pressure’ Cited in Overrun

Emergency medical services flight encountered fog at destination.

BY MARK LACAGNINA

The following information provides an awareness of problems that might be avoided in the future. The information is based on final reports by official investigative authorities on aircraft accidents and incidents.

JETS

Pilots Flared High, Landed Long

Learjet 25D. Substantial damage. No injuries.

“Mission pressure to land” was cited by the U.S. National Transportation Safety Board (NTSB) as a contributing factor in a runway-overrun accident that substantially damaged a Learjet 25D of Mexican registry that was completing an emergency medical services flight in low instrument meteorological conditions (IMC) at Houston. None of the six occupants of the airplane was injured in the March 4, 2011, accident.

The Learjet had departed from Tuxtla Gutiérrez in southern Mexico at 0140 local time with two passengers, two medical crewmembers and two flight crewmembers. As the airplane neared the destination — Houston’s William P. Hobby Airport — about four hours later, the automated weather observing system was reporting 3/4 mi (1,200 m) visibility in mist, an indefinite ceiling at 200 ft and surface winds from 200 degrees at 3 kt.

The flight crew apparently conducted the instrument landing system (ILS) approach to Runway 12R, which is 7,602 ft (2,317 m) long and 150 ft (46 m) wide. The report said that the runway was dry.

“The pilot and the copilot both reported that, due to the fog and low visibility, they could not see the far end of the runway, and the pilot flared the airplane too high,” the report said. “After landing long on the runway, the pilot said he applied maximum braking and reverse thrust but could not stop the airplane before exiting the runway.”

The Learjet struck ILS localizer antennas and came to a stop in a flat, grassy area about 1,000 ft (305 m) from the departure end of the runway. The operator of the airplane told investigators that there was no pre-existing mechanical malfunction or failure that would have precluded normal operation of the airplane.

“The operator [also] stated that the decision not to delay the flight and to land in marginal conditions was influenced by medical considerations for the passenger, who needed immediate specialized medical treatment,” the report said.

Crew Forgot About Shortened Runway

Airbus A319-111. No damage. No injuries.

While preparing for a four-sector trip beginning at Stansted Airport, London, the morning of July 4, 2012, the flight crew reviewed a notice to airmen (NOTAM) about runway construction in progress at the third stop of the trip: Prague Airport in the Czech Republic. The NOTAM said that, due to the construction on Runway 24, the runway length temporarily would be reduced from 3,715 m (12,188 ft) to 2,500 m (8,203 ft).

Late that afternoon, "the aircraft landed at Prague on Runway 30 after the third sector of the duty, and the flight crew started preparation for their final flight to Stansted" with 149 passengers and six crewmembers, said the report by the U.K. Air Accidents Investigation Branch. "The runway in use for takeoff was Runway 24. The pilots listened to the ATIS [automatic terminal information service] broadcast, but it was reportedly in heavily accented English. They did not glean from it that the runway length was reduced and had forgotten the content of the associated NOTAM seen at the preflight stage."

As a result, the pilots used the normal length of the runway when they calculated the A319's takeoff performance. The report noted that the pilots had not seen the construction activity on Runway 24 when they landed on Runway 30. Moreover, "the work in progress on Runway 24 was at the departure end, not easily visible to the crew at the start of the takeoff roll," the report said. "The commander noted later that there were no warnings from ATC [air traffic control] or ground signage indicating that the runway length was reduced."

The takeoff initially appeared normal to the flight crew, but then they saw that the A319 was rapidly nearing the runway-construction area. "The aircraft rotated and became airborne at the planned speeds but approached much closer to the works than would have been intended," the report said. "The event posed a considerable distraction for the crew which, combined with a frequency change immediately after takeoff, led to [their failure] to select the landing gear up or check that it was retracted prior to reaching the landing gear limit speed." The flight proceeded to London without further incident.

The commander told investigators that the oversight regarding the shortened runway could be attributed to "reduced crew awareness at the end of a lengthy duty period." He also said that a contributing factor was the presence in their route manuals of charts showing both the normal (full) length of Runway 24 and the reduced length of the runway. "As the crew were not aware during planning that the available length was reduced, they referred only to the normal charts," the report said.

"[The commander] also noted that the crew's preflight activities had been interrupted by a visit to the flight deck by an acquaintance and thought that this distraction may also have been a factor."

Engine Separates on Takeoff

Boeing 707-300. Destroyed. Three minor injuries.

The failure of a midspar engine-mount fitting that was known to be susceptible to fatigue cracking and that should have been replaced with a more fatigue-resistant version was the probable cause of an accident during an attempted takeoff at Point Mugu Naval Air Station near Los Angeles the afternoon of May 18, 2011, the NTSB report said.

The report also said that an erroneous maintenance entry made when the 707 was in the hands of a previous owner, incorrectly indicating that the engine-mount fitting had been replaced in accordance with an existing airworthiness bulletin, was a contributing factor in the accident, which destroyed the airplane and resulted in minor injuries to the three flight crewmembers.

The airplane was operated by a company that provided aerial-refueling services on contract to the U.S. Navy. Manufactured in 1969 and converted to a tanker in 1996, the airplane had accumulated 47,856 flight hours and 15,186 cycles.

The 707 was within weight-and-balance limits when it departed from Runway 21 at Point Mugu to refuel McDonnell Douglas F/A-18s offshore. Surface winds were from 280 degrees at 24 kt, gusting to 34 kt, creating a crosswind for the takeoff on the 11,102-ft (3,384-m) runway.

"According to the crew, the takeoff roll was normal," the report said. "At rotation speed [152 kt], the captain rotated the airplane to an initial target pitch attitude of 11 degrees airplane nose-up."

Shortly after the airplane lifted off about 7,000 ft (2,134 m) down the runway, the crew heard a loud noise as the left inboard engine separated and propelled itself above and over

An erroneous maintenance entry made when the 707 was in the hands of a previous owner … was a contributing factor in the accident.

the left wing. The nacelle and pylon also separated and then struck and broke off the inlet cowling on the left outboard engine.

The captain applied full right rudder and nearly full right aileron in an attempt to maintain directional control, but the airplane continued to drift left. Both of the right engines were producing maximum power, but the power produced by the damaged left outboard engine was negated by the drag created by the absence of the inlet cowling, the report said. The airplane descended, and the captain leveled the wings just as it touched down on the runway. The 707 then veered off the left side of the runway and came to a stop in a marsh near the departure end.

"All three crewmembers successfully evacuated through the left forward entrance via the escape slide" before the airplane's fuselage was nearly consumed by fire, the report said.

The midspar fitting that had failed was among several that attached the engine to the wing and had a history of fatigue cracking that had caused at least three previous accidents. "To address the midspar cracking issue, a series of Boeing service bulletins (SBs) and FAA [U.S. Federal Aviation Administration] airworthiness directives (ADs) were published between 1975 and 1993," the report said. Among them was an AD requiring compliance with SBs recommending repetitive inspections of the original fittings until they were replaced by a redesigned, stronger fitting.

The aerial-refueling company had acquired the 707 in 1994 and had inspected the midspar fittings after converting the airplane to a tanker. However, the company deleted the inspection requirement from its maintenance program after finding a maintenance record indicating (erroneously) that redesigned fittings had been installed in 1983. The report noted that U.S. "federal regulations do not require an owner/operator acquiring an aircraft to physically verify the compliance of every AD for which compliance has been recorded."

Bleed Air Overheat

Airbus A320-214. No damage. No injuries.

Before departing from Helsinki, Finland, for a scheduled flight to London with 140 passengers and six crewmembers the morning of March 5, 2011, the flight crew found that the no. 1 (left engine) bleed air system was inoperative and that repair had been deferred per provisions of the minimum equipment list (MEL).

"According to [the MEL], it was permissible to fly the aircraft for 10 days with one engine bleed air system out of service," said the report by the Safety Investigation Authority of Finland. "The aircraft had already flown for seven days with this technical limitation. The previous flights had been uneventful."

The flight to London was initiated with the cross-bleed valve open to supply bleed air from the no. 2 engine to both air-conditioning packs. However, about 10 minutes after reaching cruise altitude, Flight Level (FL) 360 (approximately 36,000 ft), the pilots noticed fluctuations in the no. 2 bleed air pressure and the cabin altitude indications. The A320 was over the Baltic Sea, north of Öland Island, Sweden, at the time.

A few minutes later, the electronic centralized aircraft monitor (ECAM) generated a fault warning for the no. 2 bleed air system. "The bleed air temperature of the right engine had exceeded its maximum permissible value (247 degrees C [477 degrees F])," the report said. "As a result of this, the system shut down and the cabin pressure altitude slowly began to climb. The bleed air needed for cabin pressurisation was no longer available, and therefore the flight crew had to immediately initiate a descent to a safe altitude."

The crew requested and received clearance from ATC to descend to FL 100, "the maximum recommended altitude for unpressurised cabins," the report said. During the descent, the ECAM generated a warning about the cabin altitude, which had reached 9,450 ft. The pilots donned oxygen masks, and the captain, the pilot flying, extended the speed brakes to increase the descent rate. At no time did the crew declare an emergency.

"The aircraft momentarily, and slightly, exceeded its maximum airspeed during the descent," the report said. "There was no high terrain or, in this case, any other flight activity below the planned route. … At no stage of the occurrence were the passengers at risk, nor did the automatic pressure control deploy the passenger oxygen masks in the cabin."

The report noted that the crew did not start the auxiliary power unit, which can supply sufficient bleed air for pressurized flight below 20,000 ft. However, during the descent, the crew was able to reset the no. 2 bleed air system. Investigators later determined that the system had overheated due to a malfunction of the fan air valve or the thermostat. "The pre-cooled air was too hot; therefore, the temperature sensor of the system worked as per its design and shut off the overheated system," the report said.

The no. 2 bleed air system had cooled sufficiently during the descent to resume normal operation, and the crew leveled the aircraft at FL 140. "Seeing that the engine bleed air system continued to function normally and there was sufficient fuel to take them all the way to London, the flight crew decided to continue the flight to their destination at a lower flight level [than originally planned], FL 250," the report said.

Although bleed air temperature neared the limit during the last 20 minutes of cruise flight, the A320 was landed without further incident in London.

Elevator Trim Cable Snaps

Cessna Citation 560XL. Minor damage. No injuries.

The flight crew was conducting a positioning flight from New Orleans to Houston the afternoon of April 8, 2011. The flight was uneventful until the Citation reached about 22,000 ft during the climb to cruise altitude. "The captain noticed an abnormal feel in the flight controls, followed by the pitch trim annunciator light coming on," said the NTSB report.

He disengaged the autopilot, and the airplane abruptly pitched nose up. He moved the control column forward to correct the pitch attitude and attempted unsuccessfully to relieve the control forces with the electric and the manual pitch trim systems. "The pitch trim wheel spun without effect or friction," the report said. "The captain slowed the airplane to the speed at which it was trimmed and ran the checklist for jammed elevator trim." Completion of the checklist actions did not rectify the problem.

The crew declared an emergency and diverted the flight to San Antonio, Texas. "The captain did a controllability check to [ensure] no other control issues existed," the report said. "He then flew a long final approach to an uneventful landing at San Antonio."

Examination of the airplane revealed that the elevator trim cable had failed due to fatigue. "The fracture occurred 11 inches [28 cm] from the roller chain that tracked through the elevator trim actuator," the report said. The cable had been installed during manufacture of the Citation, which had accumulated 5,445 hours before the incident occurred.

In April 2012, a year after the incident, Cessna Aircraft issued a service bulletin recommending replacement of the elevator trim cables in 560XLs with cables made of "improved rope wire material," the report said.

TURBOPROPS

Dual Engine Failure

CASA 212. Destroyed. One fatality, one serious injury, one minor injury.

About three hours after departing from Saskatoon, Saskatchewan, Canada, to conduct a local geophysical survey flight the afternoon of April 1, 2011, the right engine lost power. "No annunciators or warning lights were illuminated, and there were no abnormal engine instrument indications," said the report by the Transportation Safety Board of Canada.

The flight crew had felt the right engine shudder before it smoothly spooled down, the report said. The aircraft was at 400 ft above ground level (AGL) at the time. The crew applied full power to the left engine, feathered the right propeller and secured the right engine. They declared an emergency and turned back to the airport.

"The crew did not attempt to restart the right engine," the report said. "Their priorities were aircraft controllability, climbing to a higher altitude, recovering the birds [two externally deployed sensors] and returning to Saskatoon."

Neither pilot noticed that the master caution light had re-illuminated after it was reset following completion of the checklists for the right-engine failure. In addition, the left fuel quantity and fuel pressure lights had illuminated.

The C-212 was at about 1,300 ft AGL and 3.5 nm (6.5 km) out on final approach to Runway 27 when the left engine "smoothly lost power with no surging," the report said. "The captain [the pilot monitoring] was looking at the engine instruments at the time, and all indications had been normal."

Realizing that they could not reach the runway, the crew turned toward a road. However, they saw traffic on the road and decided to land the aircraft on a grassy area next to the road. Nearing the grassy area, the pilots saw a concrete noise-abatement wall too late to avoid it. "The aircraft landed astride the wall at 90 kt," the report said.

The C-212 was destroyed by the impact. The survey equipment operator was killed, the first officer was seriously injured, and the captain sustained minor injuries.

Investigators determined that the shudder felt by the pilots before the right engine spooled down was caused by failure of a gear on the torque sensor shaft, which in turn caused loss of drive to the engine-driven fuel pump. "The immediate result would have been fuel starvation of the engine, flameout and the loss of power," the report said.

'The immediate result would have been fuel starvation of the engine, flameout and the loss of power.'

Fuel starvation also was the likely cause of the loss of power from the left engine. The first officer had placed the aircraft in a slight left bank, per procedure, following the failure of the right engine. This caused fuel to flow from the center collector tank into the wing tanks and one of the two ejector pumps, which pump fuel from the wing tanks into the collector tank, to unport. The nozzle in the other ejector pump was found to be partially blocked by unidentified debris; the pump therefore was unable to deliver a sufficient quantity of fuel to the collector tank.

Smoke Prompts Emergency Descent

Beech King Air B200GT. Minor damage. No injuries.

The airplane was cruising at FL 230 during a ferry flight from Melun, France, to Toulouse the night of April 15, 2010, when the flight crew noticed that the cabin heating system was not providing sufficient heat. They reset the system from the automatic mode to the manual mode.

"A few moments later, acrid smoke penetrated the cabin," said the report by the French Bureau d'Enquêtes et d'Analyses. "The captain and copilot put on their oxygen masks, switched off the heating, declared an emergency … and began an emergency descent to Flight Level 100."

While conducting the corresponding checklist, the crew noticed that the smoke abated soon after they closed the left bleed air valve. They continued the flight without further incident to Toulouse.

Investigators determined that a fault in the automatic temperature controller had caused the heating system to shut down. Moreover, they found that a warm air duct previously had been split by a sharp instrument during a maintenance inspection of the air conditioning system and then repaired improperly with a sheet of aluminum and gray adhesive tape. Heat transferred to the adhesive subsequently had caused it to deteriorate, and the rapid increase in heat when the crew selected the manual mode caused it to melt.

Gear Extension Falls Short

Bombardier Q300. Minor damage. No injuries.

A faulty "inhibit switch" caused the nosewheel steering system to malfunction as the flight crew prepared to depart from Hamilton, New Zealand, for a scheduled flight with 41 passengers and a flight attendant to Wellington on Feb. 9, 2011.

"The faulty switch caused a loss of hydraulic pressure to the nosewheel steering," said the report by the New Zealand Transport Accident Investigation Commission. "The nosewheel steering system was considered nonessential, so, in accordance with the approved minimum equipment list, the aeroplane departed Hamilton with the system inoperative."

The faulty switch also prevented normal extension of the landing gear on final approach to Hamilton. The crew conducted a go-around and completed the "Alternate Gear Extension" checklist, which resulted in extension of the main landing gear but not the nose gear. The crew diverted the flight to Woodbourne Aerodrome and landed the Q300 with the nose gear retracted.

"There was nothing mechanically wrong with the alternate landing gear extension system," the report said. "The nose landing gear did not extend because the pilots did not pull hard enough on the handle that should have released the uplock. If the uplock had released, the nose landing gear would have lowered under gravity and locked down."

The report noted that the force required to release the uplock during flight simulator training was much less than the force required in the aircraft itself.

PISTON AIRPLANES

'Minimal Experience in IMC'

Beech 58C Baron. Destroyed. Four fatalities.

The Baron was en route under instrument flight rules from Scott City to Topeka, both in Kansas, U.S., the afternoon of April 22, 2011, when the pilot found that the back-course localizer approach to Runway 31 was in use at the destination, and the airport was reporting a 500-ft overcast and 10 mi (16 km) visibility.

The NTSB report noted that the private pilot had 438 flight hours, including 29 hours in multiengine airplanes, 50 hours of simulated instrument time and 11 hours in actual instrument conditions. He had earned a multiengine rating two months earlier and had logged 0.7 flight hours in IMC since earning an instrument rating five months earlier.

Nearing the airport from the south, the pilot received vectors from ATC to establish the airplane on the localizer back course. After the Baron flew through the inbound course, the controller issued a heading to re-intercept it, terminated radar service and told the pilot to contact Topeka Tower.

The airplane again flew through the inbound course. The pilot declared a missed approach but then asked the tower controller if he could circle to land. The controller told him to conduct the published missed approach procedure, climb to 4,000 ft and re-establish radio communication with the center controller. During the climb, the pilot requested clearance to conduct the global positioning system (GPS) approach to Runway 36.

"The pilot was maneuvering in IMC to set up for the GPS approach when the airplane departed controlled flight and impacted terrain," the report said. "The airplane struck the ground in a left descending turn at high speed."

NTSB concluded that the pilot's failure to maintain control of the airplane was the probable cause of the accident and that his "minimal experience flying in actual instrument conditions" was a contributing factor.

Caught in a Crosswind

Piper Aerostar 602P. Substantial damage. No injuries.

Inbound from Lock Haven, Pennsylvania, U.S., the pilot was cleared to land on Runway 26 at Philadelphia International Airport, which was reporting surface winds from 330 to 340 degrees at 14 to 18 kt, gusting to 25 kt, the afternoon of April 2, 2012. The runway was 5,000 ft (1,524 m) long and 150 ft (46 m) wide.

"The pilot said that he landed on the left main gear, with the right main intermittently touching the ground, and tried to lower the right wing to improve wheel-to-runway contact but was unsuccessful because of a wind gust," the NTSB report said. "He felt the left main gear become 'mushy' as he was braking to avoid an overrun."

The Aerostar then veered off the left side of the runway onto a soft, grassy area. The main landing gear collapsed, and both wings were substantially damaged before the airplane came to a stop.

Set Up for a Stall

Beech 76 Duchess. Substantial damage.
One serious injury, one minor injury.

The pilot said that he thought the Duchess was near its maximum gross weight for the departure from Perris Valley (California, U.S.) Airport the morning of July 30, 2011. Nevertheless, he began the takeoff from the midpoint of the 5,100-ft (1,554-m) runway, applying full power before releasing the wheel brakes, the NTSB report said.

"The pilot [had] selected Runway 15, which had a 6-kt tailwind component at the time of the attempted takeoff," the report said. Before reaching the normal airspeed for rotation, the Duchess pitched nose-up and became airborne. Shortly thereafter, the left cockpit door opened. The pilot was closing the door when the airplane stalled, struck an embankment and crashed in an open field about 1,000 ft (305 m) off the end of the runway.

The pilot was seriously injured, one passenger sustained minor injuries and two passengers escaped injury.

Investigators calculated that the airplane was more than 273 lb (124 kg) above maximum gross weight and that the center of gravity was 0.4 in (1.0 cm) aft of the limit. In addition, "the elevator trim tab was found in the full nose-up position," the report said.

HELICOPTERS

Thin Air, Overweight Takeoff

Bell 206B. Substantial damage. Two serious injuries.

The pilot did not perform weight-and-balance calculations before attempting to take off from Midrand, South Africa, with a full load of fuel and two passengers and their baggage the afternoon of May 27, 2012, according to the report by the South African Civil Aviation Authority.

Aural and visual low rpm warnings were generated soon after the pilot lifted the helicopter into a hover. He set the helicopter back on the ground, offloaded one passenger and some baggage, and attempted another takeoff. Investigators determined that the JetRanger was 140 lb (64 kg) over maximum gross weight for the conditions, which included a density altitude of 7,000 ft.

"The pilot was able to become airborne due to the fact that he was able to gain airspeed by remaining within ground effect for a considerable distance," the report said. "Once he started to climb, conditions changed and power required to sustain flight exceeded the power available, and the rpm started to decay."

The pilot told the airport traffic controller that he was having an engine problem and was going to fly one circuit of the pattern to evaluate the problem. The helicopter was on a left downwind leg when he reported that the engine was losing power and that he was going to land. Shortly thereafter, the JetRanger struck a tree and a concrete fence next to a road. Both occupants sustained serious back injuries.

Pilot Loses Consciousness

Robinson R44. Substantial damage.
One fatality, one serious injury.

The pilot and a crewman were conducting a geophysical survey that required landings at waypoints about 2.5 km (1.4 nm) apart. After completing about 80 takeoffs and landings south of Newman, Western Australia, the morning of Sept. 3, 2011, the crewman saw that the pilot, who was seated in front of him, had slumped forward.

"The crewman attempted to rouse the pilot, but all attempts failed, and the helicopter's descent rate was not arrested," said the report by the Australian Transport Safety Bureau. The crewman was seriously injured when the R44 struck terrain. The pilot regained consciousness momentarily but succumbed to chest injuries sustained during the impact.

Investigators found that the pilot had sought help from medical practitioners several times after losing consciousness, once because of a "vasovagal episode" involving lowered heart rate and blood pressure, and once because of a blow to the head. None of the prior episodes of loss of consciousness occurred during flight. "The information contained in the pilot's aviation medical records did not accurately reflect the pilot's medical history, elements of which may have, if known, led to further medical testing and influenced the subsequent renewal of the pilot's Class 1 aviation medical certificate," the report said.

Preliminary Reports, February 2013

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Feb. 2	Rome, Italy	ATR 72-212A	substantial	2 serious, 2 minor, 46 none
Surface winds were from 250 degrees at 28 kt, gusting to 41 kt, and wind shear had been reported before the ATR 72 landed hard, bounced several times and veered off Runway 16L. Fiumicino Airport's Runway 25 was closed for construction.				
Feb. 3	Assis, Brazil	Beech King Air C90A	destroyed	5 fatal
The King Air was on a night flight from São Paulo to Maringá when it crashed in an open field.				
Feb. 6	Tunis, Tunisia	Airbus A320-211	substantial	83 NA
No fatalities were reported when the A320 veered off Runway 19 while landing in a rain squall with surface winds from 250 degrees at 16 kt, gusting to 38 kt.				
Feb. 6	Casa Grande, Arizona, U.S.	Beech King Air E90	substantial	2 fatal
The King Air was on a go-around following a bounced landing during an instructional flight when witnesses saw it enter an "extreme" left bank and nose-down pitch attitude, and descend to the runway.				
Feb. 9	Blue River, British Columbia, Canada	Beech 1900C	substantial	NA
No injuries were reported when the 1900 veered off the runway and struck a snow bank while landing during a scheduled passenger flight.				
Feb. 10	Acton, California, U.S.	Bell 206B	substantial	3 fatal
Dark night visual meteorological conditions (VMC) prevailed when the JetRanger struck terrain while maneuvering in a valley for filming by a movie crew.				
Feb. 11	Charlesville, Liberia	CASA/IPTN CN-235-220	destroyed	11 fatal
The Guinean military transport struck sloping terrain during an approach to Monrovia in instrument meteorological conditions (IMC).				
Feb. 11	Muscat, Oman	Boeing 737-33A	substantial	108 none
The airplane veered off the runway after the left main landing gear collapsed on landing.				
Feb. 11	Ponderosa, New Mexico, U.S.	Bell 206B-3	substantial	3 none
The helicopter was on a wildlife-survey flight at 200 ft when the engine lost power. The main rotor blades partially severed the tail boom, and the helicopter rolled over during the forced landing.				
Feb. 13	Donetsk, Ukraine	Antonov 24RV	destroyed	5 fatal, 47 NA
Visibility was 250 m (0.2 mi) in fog when the An-24 touched down hard, bounced twice and came to a stop inverted while landing during a night charter flight.				
Feb. 13	New Smyrna Beach, Florida, U.S.	Cessna T337C	destroyed	1 fatal
The pilot declared an emergency shortly before the Skymaster struck terrain while departing in day VMC.				
Feb. 14	Yeehaw Junction, Florida, U.S.	Cessna 310H	substantial	3 fatal
Air traffic control radar showed that the 310 entered a rapid descent shortly after the pilot, who was not instrument-rated, requested assistance after encountering IMC during cruise flight.				
Feb. 20	Thomson, Georgia, U.S.	Beech 390 Premier 1A	destroyed	5 fatal, 2 serious
All five passengers were killed when the airplane struck an unlighted utility pole and terrain during a go-around in night VMC.				
Feb. 21	Santa Lucia, Mexico	Pilatus PC-6 Turbo Porter	destroyed	2 fatal
The single-turboprop airplane crashed out of control during a military training flight.				
Feb. 24	Homestead, Florida, U.S.	Cessna T337G	substantial	4 minor
The rear engine lost power while the Skymaster was cruising along the coast at 900 ft. The front engine did not respond when the pilot attempted to increase power. The airplane then flipped over while being ditched in Biscayne Bay, but all the occupants were able to exit the airplane before it sank and were rescued by boaters.				

NA = not available

This information, gathered from various government and media sources, is subject to change as the investigations of the accidents and incidents are completed.

<table>
<tr><th colspan="7">Selected Smoke, Fire and Fumes Events, October–December 2012</th></tr>
<tr><th>Date</th><th>Flight Phase</th><th>Airport</th><th>Classification</th><th>Subclassification</th><th>Aircraft</th><th>Operator</th></tr>
<tr><td>Oct. 2</td><td>Cruise</td><td>Shannon, Ireland (SNN)</td><td>Entertainment system</td><td>Smoke</td><td>Boeing 777</td><td>American Airlines</td></tr>
<tr><td colspan="7">The crew reported an acrid odor and smoke in the area of the right no. 2 door. They declared an emergency and diverted the flight to SNN, where it was landed without incident. Maintenance personnel found an inflight entertainment system cooling fan that had overheated. The inflight entertainment station was removed from service and the circuit breaker pulled. Maintenance inspection for the fan was deferred according to the minimum equipment list (MEL). The flight was continued to its destination, London Heathrow, without incident. Maintenance replaced the inflight entertainment system cooling fan, and a system ground check showed normal operation.</td></tr>
<tr><td>Oct. 2</td><td>Cruise</td><td>Cleveland (CLE)</td><td>Independent instruments</td><td>Smoke</td><td>Embraer 135KL</td><td>Chautauqua Airlines</td></tr>
<tr><td colspan="7">The crew reported that during flight, an electrical odor was present in the cockpit. The crew diverted to CLE and landed the airplane without incident. Maintenance isolated the issue to the first officer's chrono button in the yoke. The item was deactivated and then deferred. The deferral was cleared two days later when the first officer's chrono switch on the yoke was replaced. Operational checks revealed no further defects.</td></tr>
<tr><td>Oct. 8</td><td>Climb</td><td>Chicago (ORD)</td><td>Air distribution system</td><td>Smoke</td><td>Bombardier Challenger CL-600</td><td>American Eagle Airlines</td></tr>
<tr><td colspan="7">Approximately 10 minutes into the flight, the no. 1 and no. 2 flight attendants reported a burning odor coming from the rear of the aircraft. They reported that it resembled burning wood, but no smoke was visible. The crew declared an emergency and returned to ORD. Emergency services were dispatched. The aircraft was landed without incident and taxied to the gate with aircraft rescue and firefighting (ARFF) units following. The ARFF crew inspected the aircraft inside and out and could not locate the source of the odor. The aircraft was removed from service. Maintenance performed visual check of the lavatory, behind the mirror and trash bin and under the sink. They performed an operational test of the recirculation fans in accordance with the maintenance manual. No malfunction was discovered.</td></tr>
<tr><td>Oct. 8</td><td>Cruise</td><td>Toyko (NRT)</td><td>Air distribution system</td><td>Overtemperature, smoke</td><td>Boeing 777</td><td>American Airlines</td></tr>
<tr><td colspan="7">The cabin crew reported that a strong electrical odor was detected in business class around rows 11, 12 and 13. Power ports and the inflight entertainment system were turned off, and the smell dissipated. The flight was landed at NRT without incident. Maintenance found that the aft upper recirculation fan had overheated. They deferred the fan replacement according to the MEL. A system ground check showed normal operation.</td></tr>
<tr><td>Oct. 10</td><td>Cruise</td><td>Philadelphia (PHL)</td><td>Engine</td><td>Smoke</td><td>Airbus A330</td><td>US Airways</td></tr>
<tr><td colspan="7">The crew reported a strong odor throughout the cabin and cockpit, especially in the aft cabin section. The crew and some passengers experienced throat and lung irritation. The flight was returned to PHL and landed without incident. Maintenance troubleshot the cabin air quality, analyzed the bleed air and checked for engine odor on the left and right engines. The right engine was removed and replaced along with the right engine check valve.</td></tr>
<tr><td>Oct. 28</td><td>Cruise</td><td>—</td><td>Humidity control system</td><td>Smoke</td><td>Bombardier Challenger CL-600</td><td>Express Airlines</td></tr>
<tr><td colspan="7">The smoke detector in the lavatory sent a warning indication at 1,500 ft above ground level, although no smoke was visible. The crew consulted the quick reference handbook (QRH) and declared an emergency. An overweight landing was conducted without incident. Technicians complied with the work scope for smoke in the cabin and found the coalescer soiled. They removed and replaced the coalescer socks. The auxiliary power unit (APU) checked out with no problems and no further defects were noted. Technicians performed a high-power engine run with the environmental control system selected to engine bleeds and APU bleeds. No smoke was noted and the aircraft was returned to service.</td></tr>
<tr><td>Nov. 3</td><td>Climb</td><td>Chicago (ORD)</td><td>Turbine engine compressor section</td><td>Smoke</td><td>Boeing 737</td><td>American Airlines</td></tr>
<tr><td colspan="7">When climbing through about 5,000 ft, a very strong odor was present in the cockpit and cabin. The QRH procedure for smoke, fire or fumes was followed. The odor started to dissipate but returned a couple of times. The crew returned the flight to ORD. Maintenance found excessive lubricant on fan blades from the previous night's blade lubrication. No other discrepancies were noted. The technicians performed a high-power run with no odors noted. Following a system ground check, the aircraft was returned to service.</td></tr>
<tr><td>Nov. 25</td><td>Cruise</td><td>Detroit (DTW)</td><td>Humidity control system</td><td>Smoke, warning indication</td><td>Bombardier Challenger CL-600</td><td>Express Airlines</td></tr>
<tr><td colspan="7">The flight departed DTW and performed an air return due to reported smoke in the cabin. The lavatory smoke detector indicated a caution on climbout, and a flight attendant reported smoke coming from the back of the cabin. A passenger reported an odor of electrical fire. Maintenance found dirty coalescers and deicing fluid in the engine inlets. They removed and replaced the left and right pack coalescers in accordance with the aircraft maintenance manual. Operations checks showed no problems and technicians performed high-power engine runs and left and right pack burn. All checks were good and no smoke was noted.</td></tr>
<tr><td>Nov. 30</td><td>Climb</td><td>Washington Dulles (IAD)</td><td>Air distribution fan</td><td>Smoke, warning indication</td><td>Airbus A320</td><td>JetBlue Airways</td></tr>
<tr><td colspan="7">The crew declared an emergency and diverted to IAD because of an aft avionics rack smoke indication. Maintenance found that the aft rack cooling fan assembly had seized and a wire terminal lug had overheated. They removed and replaced the cooling fan assembly and re-terminated the wire 9842. Operations checks revealed no further problems.</td></tr>
<tr><td>Dec. 9</td><td>Descent</td><td>—</td><td>Air distribution fan</td><td>Smoke</td><td>Boeing 737</td><td>Delta Air Lines</td></tr>
<tr><td colspan="7">During descent, an acrid odor issued from the air conditioning system but dissipated after landing. During maintenance testing, with the right pack off, the odor returned. Maintenance replaced the right recirculating fan in accordance with the maintenance manual. Following an operations test, the aircraft was returned to service.</td></tr>
</table>

Source: Safety Operating Systems and Inflight Warning Systems