AeroSafety WORLD

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BUSINESS AIRCRAFT FDM
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UNLATCHED OIL CAP
First link in accident causal chain

QF32 CABIN CREW SURPASSES EXPECTATIONS

BACK STORY

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

OCTOBER 2013

OCTOBER IS CONVENTION AND Summit Month

This is the time of year when Flight Safety Foundation holds its largest safety event — IASS. That acronym originally stood for International Air Safety Seminar, but beginning with this year's event, we are changing the name to International Air Safety *Summit*. We are making the change because we believe that the presentations at IASS are some of the best in the industry and more comprehensive than other aviation safety seminars held throughout the year.

IASS was first held in 1947. Since that time, it has been held every year, bringing quality safety presentations to many regions. Recent locations have included Milan, Italy; Singapore; and Santiago, Chile. This year (Oct. 29–31), we are going to bring IASS to Washington. It has been 10 years since IASS was here in our own backyard. Besides being the U.S. capital, it is an aviation intersection of private, business, commercial and industry entities.

Washington has many sights, including the Smithsonian National Air and Space Museum, which is a must-see for aviation enthusiasts. There are many other world-class museums to visit and sights to see, such as the Washington Monument, the National Mall and the White House.

Historically, IASS has included many presentations that have changed the course of aviation throughout the years. This year, IASS will continue that tradition, opening with a keynote speech by U.S. National Transportation Safety Board Member Earl Weener, a former Flight Safety Foundation Fellow.

We also have enhanced the agenda by adding more timely and relevant presentations, including interesting recaps of the Air France 447 accident and the American Airlines Cali, Colombia, accident. These presentations and others (an agenda is included in this issue) will contribute to knowledge that you can take away for your education and use.

Overall, our goal is to conduct "the safety summit of the year," so when you are putting together your travel and conference budget for the year, IASS is at the top of the list.

The week before IASS, many of us will be in Las Vegas for the NBAA 2013 Business Aviation Convention & Exhibition — the can't-miss business aviation event of the year and the sixth largest tradeshow in the United States. Operators and industry leaders will conduct business, make buying decisions and set the stage for business aviation activity for the year ahead. Attendees, the decision makers in the industry, will spend time on the exhibit floor, interacting with exhibitors and assessing aircraft and products. The NBAA Safety Town Hall Meeting, scheduled for Tuesday, Oct. 22, will address business aviation's top safety challenges and is part of the convention's education track. The NBAA Safety Committee has updated its Top 10 Safety Focus Areas. How can we best address these top concerns while keeping our eye on the mission at hand? This strategically focused session will bring together business aviation safety leaders from across the country for a collaborative discussion. The Foundation will participate in this session, and I look forward to seeing you at IASS and the NBAA 2013 Business Aviation Convention & Exhibition.

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

AeroSafety WORLD

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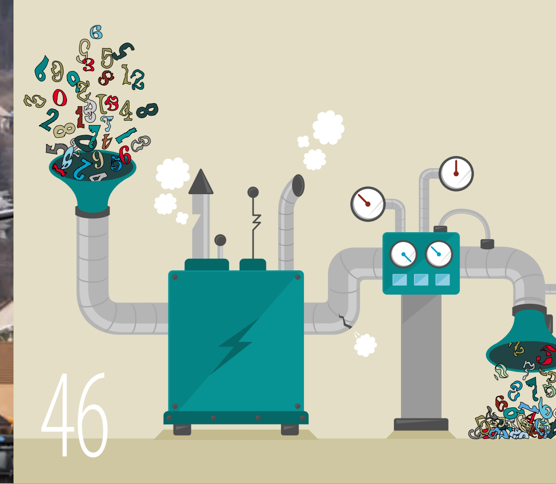

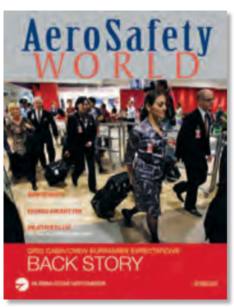

About the Cover
Photojournalists encounter the Qantas Flight 32 cabin crew leaving Singapore Changi Airport.

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Share Your Knowledge

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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AeroSafety WORLD

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OF TWO Minds

Foundation President and CEO Kevin Hiatt and I usually do not write about similar topics in our monthly columns. We address different subjects partially by design — who wants to read the same thing twice? — and partially because we approach things differently. Kevin is a career pilot and safety expert, and I'm an aviation journalist. We have different backgrounds, training and skill sets, and that often translates into different interests and column topics.

But the unifying factor this month is the Foundation's 66th annual International Air Safety Summit (IASS), which this year is scheduled for Oct. 29–31 in our backyard, Washington, D.C.

If you turn to p. 31 in this issue of *AeroSafety World*, you will find the IASS preliminary agenda as it stood in mid-September. Even a quick perusal of the agenda will show the breadth and depth of the issues to be addressed, from the integration of remotely piloted vehicles into controlled skies, to the analysis of data to uncover accident precursors, to effective monitoring in the cockpit.

Broad subjects to be discussed include key issues in aviation maintenance, air traffic management operational safety priorities and safety change management. In addition, we plan to take in-depth looks at the Air France Flight 447 investigation, at factors leading to runway excursions and at why go-around policies are ineffective. The list of notable speakers and panelists is long, and includes U.S. National Transportation Safety Board Members Earl Weener and Robert Sumwalt, JetBlue President and CEO Dave Barger and our own David McMillan, formerly director general of Eurocontrol and now chairman of the board here at the Foundation.

In addition to the speakers and presentations, there is much to be gained from regularly gathering with safety professionals from around the world to exchange ideas, dissect problems and develop solutions. Sometimes the conversations in the hallway or over lunch can be just as valuable as what is presented from the podium. IASS offers the best of both: thought-provoking panels and presentations, coupled with the opportunity to meet and, more importantly, talk with industry leaders — your peers — about the critical safety issues of today and tomorrow.

We hope you will join us.

And if you do and you see me wandering the hall, please take a moment to introduce yourself. I look forward to opportunities to meet our members, and I'd relish the chance to pick your brain on the safety issues of the day.

Frank Jackman
Editor-in-Chief
AeroSafety World

Serving Aviation Safety Interests for More Than 65 Years

Since 1947, Flight Safety Foundation has helped save lives around the world. The Foundation is an international non-profit organization whose sole purpose is to provide impartial, independent, expert safety guidance and resources for the aviation and aerospace industry. The Foundation is in a unique position to identify global safety issues, set priorities and serve as a catalyst to address the issues through data collection and information sharing, education, advocacy and communications. The Foundation's effectiveness in bridging cultural and political differences in the common cause of safety has earned worldwide respect. Today, membership includes more than 1,000 organizations and individuals in 150 countries.

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OCT. 9–10 ➤ Third International Winter Operations Conference. Air Canada Pilots Association. Vancouver, Canada. <winterops@acpa.ca>, <www.winterops.ca>, +1 905.678.9008.

OCT. 10 ➤ ACAS Monitoring Dissemination Workshop (SESAR Project 15.04.03). Eurocontrol. Langen (Hessen), Germany. Stanislaw Drozdowski <stanislaw.drozdowski@eurocontrol.int>, <bit.ly/10ok2HE>.

OCT. 14–16 ➤ SAFE Association Annual Symposium. SAFE Association. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3012.

OCT. 15–16 ➤ Icing Conditions: On-Ground and In-Flight. European Aviation Safety Agency. Cologne, Germany. Carmen Andres <asc@easa.europe.eu>, <webshop.easa.europa.eu/icing>, +49 221.89990.2205.

OCT. 15–17 ➤ Safeskies Australia 2013. Canberra, Australian Capital Territory. Doug Nancarrow, <office@safeskiesaustralia.org>, <www.safeskiesaustralia.org>, +61 (0) 2 9213 8267.

OCT. 18–19 ➤ Aviation Training Congress China. People's Government of Shaanxi Province, Civil Aviation Administration of China and China Council for the Promotion of International Trade. Xi'an, Shaanxi Province, China. Richard Ding, <pyxis@pyxisconsult.com>, <www.cdmc.org.cn/2013/atcc>, +86 21 5646 1707.

OCT. 18–19 ➤ China International General Aviation Convention 2013. People's Government of Shaanxi Province, Civil Aviation Administration of China and China Council for the Promotion of International Trade. Xi'an, Shaanxi Province, China. Li Bona, <15332462337@126.com>, <www.gashow.cn>, +86 029-85395014.

OCT. 22–24 ➤ SMS II. MITRE Aviation Institute. McLean, Virginia, U.S. Mary Beth Wigger, <maimail@mitre.org>, <bit.ly/YJofEA>, +1 703.983.5617.

OCT. 22–24 ➤ 2013 NBAA Business Aviation Convention & Exhibition. National Business Aviation Association. Las Vegas. <www.nbaa.org/events>.

OCT. 24–25 ➤ Training on Emergency Communications Involved in Major Aircraft Accidents and Incidents. U.S. National Transportation Safety Board. Ashburn, Virginia. Peter Knudson, <peter.knudson@ntsb.gov>, <www.ntsb.gov>, +1 202.314.6100.

OCT. 29–30 ➤ Emergency Response Planning Training Course. JAA Training Organisation. Abu Dhabi, United Arab Emirates. <jaato.com>, +31 (0)23 56 797 90.

OCT. 29–31 ➤ 66th International Air Safety Summit. Flight Safety Foundation. Washington, D.C. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/aviation-safety-seminars/international-air-safety-seminar>, +1 703.739.6700, ext. 101.

NOV. 3–8 ➤ CANSO Global ATM Safety Conference. Civil Air Navigation Services Organisation. Amman, Jordan. Anouk Achterhuis, <events@canso.org>, <www.canso.org/safetyconference2013>, +31 (0) 23 568 5390.

NOV. 12–13 ➤ Safety in Aviation North America 2013. Flightglobal. Montreal. Hannah Bonnett, <Hannah.bonnett@rbi.co.uk>, <flightglobal.com/events>, +44 (0)20 8652 4755.

NOV. 12–14 ➤ Safe-Runway Operations Training Course. JAA Training Organisation. Abu Dhabi, United Arab Emirates. <jaato.com>, +31 (0)23 56 797 90.

NOV. 13–15 ➤ 10th ALTA Airline Leaders Forum. Latin American and Caribbean Air Transport Association. Cancún, Mexico. <conferencesandmeetings@alta.aero>, <www.alta.aero>.

NOV. 19–21 ➤ Aviation Safety Management Systems Workshop. Embry-Riddle Aeronautical University. Daytona Beach, Florida, U.S. Sarah Ochs, <case@erau.edu>, <daytonabeach.erau.edu/coa/programs/professional-programs>, +1 386.226.6928.

NOV. 20 ➤ Flight Simulation Conference: Digital Media Convergence in Flight Simulation and Training — Design, Delivery and Acquisition. Royal Aeronautical Society. London. Matt Stubbs, conference@aerosociety.com, <bit.ly/1bmMBd0>, +44 (0)20 7670 4345.

NOV. 26 ➤ Air Transport Group Conference: Civil Aircraft Technology Enabled Services — Time to Collaborate; How? Royal Aeronautical Society. London. Matt Stubbs, conference@aerosociety.com, <bit.ly/150d6NU>, +44 (0)20 7670 4345.

DEC. 2–5 ➤ 7th Triennial International Aircraft Fire and Cabin Safety Research Conference. U.S. Federal Aviation Administration. Philadelphia, Pennsylvania, U.S. Cynthia Corbett, <cynthia.corbett@faa.gov>, <www.fire.tc.faa.gov/2013Conference/conference.asp>.

DEC. 21–22 ➤ European Business Aviation Safety Conference. Aviation Screening. Munich, Germany. Christian Beckert, <info@ebascon.eu>, <www.ebascon.eu>, +49 7158 913 44 20.

FEB. 11-16 ➤ Singapore Airshow 2014. Experia Events Pte. Ltd. Singapore. <enquiries@singaporeairshow.com, <+65 6542 8660>.

FEB. 19–20 ➤ European Business Aviation Safety Conference. Aviation Screening. Munich, Germany. Christian Beckert, <info@ebascon.eu> <www.ebascon.eu>, +49 7158 913 44 20.

FEB. 24–27 ➤ Heli-Expo 2014. Helicopter Association International. Anaheim, California, U.S. <heliexpo@rotor.org>, <rotor.org>, +1 703.683.4646.

MARCH 10-11 ➤ State Safety Program Solutions Seminar. The Aviation Consulting Group. Myrtle Beach, South Carolina, U.S. Bob Baron, <webinquiry@tacgworldwide.com, <tacgworldwide.com>.

APRIL 1–3 ➤ World Aviation Training Conference and Tradeshow (WATS 2014). Halldale Group. Orlando, Florida, U.S. Zenia Bharucha, <zenia@halldale.com>, <halldale.com/wats#.Ub4RyhYTZCY>, +1 407.322.5605.

APRIL 16–17 ➤ 59th annual Business Aviation Safety Summit (BASS 2014). Flight Safety Foundation and National Business Aviation Association. San Diego. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/bass>, +1 703.739.6700, ext. 101.

JUNE 30–JULY 2 ➤ Safe-Runway Operations Training Course. JAA Training Organisation. Abu Dhabi, United Arab Emirates. <jaato.com>, +31 (0)23 56 797 90.

JULY 14–20 ➤ 49th Farnborough International Airshow. Farnborough International. Farnborough, Hampshire, England. <enquiries@farnborough.com>, <farnborough.com>, +44 (0) 1252 532 800.

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 Frank Jackman at Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria, VA 22314-1774 USA, or <jackman@flightsafety.org>.

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

Safety News

© Eurocopter

Super Puma Flights Resume, Again

Eurocopter Super Puma flights around the North Sea — temporarily suspended after the fatal Aug. 23 crash of an AS332 L2 — have resumed, along with the U.K. Civil Aviation Authority's (CAA's) issuance of a statement that authorities "do not believe that the accident was caused by an airworthiness or technical problem."

The CAA added, "We would not allow a return to service unless we were satisfied that it was safe to do so."

The flight stoppage came just days after the North Sea fleet of Super Pumas had begun flying again after a 10-month grounding that followed two ditchings in 2012. When flights resumed in early August, authorities had said that a series of corrective actions had been performed to prevent cracking in the main gearbox bevel gear vertical shaft of affected EC225s and AS332s. Those actions restored "an acceptable level of safety" to offshore Super Puma operations, authorities said (*ASW*, 9/13, p. 26).

The Aug. 23 accident, which killed four of the 16 passengers, was not related to the earlier ditchings, the CAA said.

The U.K. Air Accidents Investigation Branch (AAIB) said in a preliminary report that the helicopter crashed into the sea about 1.5 nm (2.8 km) west of Sumburgh Airport in the Shetland Islands. It was on the third leg of a planned four-leg flight that began in Aberdeen, Scotland. The AAIB investigation was continuing.

The Helicopter Safety Steering Group (HSSG) of Step Change in Safety — a group representing North Sea helicopter operators, the energy industry, labor unions and regulators — had recommended both the temporary stoppage of Super Puma commercial passenger flights on Aug. 24 and their resumption several days later.

The HSSG said its recommendation to begin a phased-in resumption of flights — with the L2 Super Pumas initially being used only in non-passenger revenue operations — was based in part on the "confidence in the helicopters" that was expressed by regulators, the helicopter pilots' union and the Super Puma operators.

The three North Sea helicopter operators were working with their energy company customers to "ensure the correct level of information and confidence-building communication is available, sensitive to the individual needs of the offshore workforce, before returning to full commercial passenger service," said Les Linklater, Step Change in Safety's team leader.

He added that a "sympathetic approach will be taken to any worker who, during this period, feels unable to fly."

Bungled Landings

© pro6x7/istockphoto.com

Concerns about the increasing number of safety occurrences during the landing phase have prompted development of a safety video by the Australian Transport Safety Bureau (ATSB) to show "how easily unexpected events can dramatically increase confusion among flight crew," the agency says.

The ATSB said aviation safety experts have identified a trend in which pilots "mishandle or mismanage their aircraft and flight profile when unexpected events arise during the approach.

"When compared to other phases of flight, the approach and landing has a substantially increased workload. Pilots and crew must continuously monitor aircraft and approach parameters and the external environment to ensure they maintain a stable approach profile and make appropriate decisions for a safe landing."

The ATSB noted that it has investigated a number of occurrences in recent years involving problems during approach to landing, including a hard landing by a Boeing 717-200 in Darwin in 2008, a stickshaker activation during a 717-200's manually flown approach to Alice Springs in 2008, a Bombardier DHC-8's unstable approach in Sydney in 2011 and a go-around by an Airbus A321 in Melbourne in 2007.

ATSB Chief Commissioner Martin Dolan said the agency's investigations found that "poor communication and lack of role clarification were worryingly common."

The ATSB added, "Good communication is vital. If there is any confusion or uncertainty, clarify the situation and take timely action to rectify any deviations before they become a problem. If there is any doubt about the safety of the aircraft, conducting a go-around is a perfectly legitimate option. Safety trumps scheduling or dignity."

U.S. Federal Aviation Administration

Weather Cameras

Citing a number of weather-related aircraft accidents in Hawaii and mountain passes in the continental United States, the U.S. National Transportation Safety Board (NTSB) is recommending installation of weather cameras in safety-critical areas.

The NTSB called on the U.S. Federal Aviation Administration (FAA) to install the cameras at selected locations, establish public access to their real-time images and train flight service station specialists in providing verbal preflight and en route briefings that incorporate the images.

The NTSB said it has investigated numerous accidents in Hawaii since 1997 that involved aircraft — primarily helicopters and small general aviation airplanes but also larger air taxi airplanes — that encountered instrument meteorological conditions or other adverse weather conditions. Accurate and current weather images could help pilots with weather-related flight planning issues, the agency said.

An existing program in Alaska has installed weather cameras in 185 locations, the NTSB said. That effort allows pilots and flight dispatchers to "review aviation weather camera images and cancel a flight based on information regarding possible poor weather conditions en route or at their destination, helping the pilot avoid a potentially hazardous situation or to avoid starting on a mission that the pilot will not be able to complete."

The NTSB cited FAA estimates that the Alaska Aviation Camera Program has "coincided with and contributed to a 53 percent decrease in the weather-related aviation accident rate in Alaska."

Considering the effectiveness of the program in Alaska, the NTSB added, a similar program would be expected to significantly improve aviation safety in Hawaii.

Workplace Safety

The U.S. Occupational Safety and Health Administration (OSHA) has begun enforcing certain workplace safety regulations for aircraft cabin crewmembers.

"While the FAA's [U.S. Federal Aviation Administration's] aviation safety regulations take precedence, OSHA will be able to enforce certain occupational safety and health standards not covered by FAA oversight," the FAA said in announcing the development, effective in late September.

Among the issues under OSHA jurisdiction are exposure to hazardous chemicals and blood-borne pathogens, hearing-conservation programs and rules on access to employee exposure and medical records.

The FAA and OSHA will work together to ensure that workplace safety regulation will not have an adverse effect on aviation safety, the agencies said.

"This policy … will enhance the safety of cabin crewmembers and passengers alike," said Labor Secretary Thomas Perez. "It is imperative that cabin crewmembers have the same level of safety assurances they provide the public."

Upgrading Air Ambulance Standards

Air ambulance flights should be held to higher standards, "given the passenger-carrying nature of their operations," the Civil Aviation Safety Authority of Australia (CASA) says.

A new CASA proposal calls for air ambulance flights to be covered by aviation safety regulations that govern passenger transport operations. The flights are now governed by aerial work regulations.

The change would result in enhanced training and checking for pilots of air ambulance flights, stricter aircraft equipment requirements, specific fatigue risk management standards for pilots and increased flexibility for some operations, CASA says.

The agency planned to accept public comments on the proposed change until late September.

YSSYguy at en.wikipedia

Crash Study

As part of their study of helicopter crash survivability, research engineers at the U.S. National Aeronautics and Space Administration (NASA) dropped the fuselage of an old U.S. Marine Corps Boeing Vertol CH-46E Sea Knight from 30 ft to observe the effects on improved seats and seatbelts.

The researchers used cables to lift the 45-ft-long (14-m-long) fuselage — with 15 crash-dummy occupants — into the air, then swing it forward. Pyrotechnic devices were used to separate the cables, allowing the fuselage a brief period of free flight before it hit a bed of soil while traveling about 30 mph (26 kt).

The test — a collaboration involving NASA, the U.S. Federal Aviation Administration, the U.S. Army and the U.S. Navy — was conducted at the NASA Langley Research Center's Landing and Impact Research Facility in Hampton, Virginia. It was designed to simulate a "severe but survivable crash," lead test engineer Martin Annett said.

"The fuselage hit hard," the facility said in describing the test. "Thirteen instrumented crash-test dummies and two uninstrumented manikins had a rough ride, as did some of the 40 cameras mounted inside and outside the fuselage."

The facility said preliminary indications were that the test produced good data, which will be analyzed over several months.

"High-speed cameras filming at 500 images per second tracked each black dot [on the helicopter's black-and-white speckled fuselage], so after everything is over, we can plot exactly how the fuselage reacted structurally to the test," test engineer Justin Littell said.

A similar helicopter — equipped with additional technology, including what the facility described as "high-performance, lightweight composite airframe retrofits" — will be used in another crash test in mid-2014.

Results from both crash tests will be used in efforts to improve helicopter performance and efficiency, as well as to improve helicopter safety features, the facility said.

"The ultimate goal of NASA's rotary wing research is to help make helicopters and other vertical takeoff and landing vehicles more serviceable — able to carry more passengers and cargo — quicker, quieter, safer and greener, and lead to more extensive use in the airspace system," the facility added.

U.S. Nationial Aeronautics and Space Administration

In Other News …

The U.S. Federal Aviation Administration has begun using its **en route automation modernization** system at least part-time at 16 sites, but as the system is expanded to busier facilities, software-related problems could result in extra costs and schedule delays, according to a report by the U.S. Department of Transportation's Office of Inspector General. … Tony Tyler, the director general and CEO of the International Air Transport Association, blames "lack of political will to push states to unify the European airspace" for delays in implementing the **Single European Sky**, which European authorities predict will enable a 10-fold increase in aviation safety.

Compiled and edited by Linda Werfelman.

For the global community of cabin safety specialists, the June 2013 final report[1] by the Australian Transport Safety Bureau (ATSB) on the Qantas Flight 32 (QF32) accident provides a missing piece — the official framework and conclusions — needed to interpret the many eyewitness accounts of injury-prevention factors. One such account is a November 2011 *AeroSafety World* video interview with the flight's cabin service manager (CSM), Michael von Reth.[2,3]

The cabin crew's alarm-saturated working conditions, imperfect/confusing information, resilient critical thinking and emergency

BY WAYNE ROSENKRANS

Presence of Mind

The Qantas Flight 32 accident fully engaged the cabin crew's skills and judgment.

responses had parallels to those of the flight crew, including overriding standard operating procedures (SOPs). Among crewmember attributes credited with influencing the outcome free of any reported injuries were: situational awareness beyond individual duties; attention to their own knowledge state and concern for passing on critical information; active monitoring and control of their own thoughts; and emotional intelligence and skills interacting with passengers. Some anticipated being overwhelmed at times by the complexity and volume of information inputs, and took proactive steps to shed non-essential workload.

Among examples of competent crew behavior, the ATSB report noted von Reth's assertion of single-point message control, which enabled rapid, thorough communication of necessary information between the flight deck and cabin. "The safe outcome of the accident flight was not only contingent on the primary and supporting flight crew but also on the efforts of the CSM and cabin crew," the report said. This article highlights some of von Reth's recollections in the context of a similar video interview with the QF32 captain, Richard de Crespigny, and the captain's 2012 book, titled *QF32,* and the ATSB report.

Cabin Perspectives

The takeoff was at 09:56:47 local time on Nov. 4, 2010, and the uncontained engine failure occurred at 10:01:07 (Table 1). Visual meteorological conditions prevailed, increasing passengers' ability to monitor developments. On duty in the cabin in addition to the CSM (functioning as purser) were a customer service supervisor and 22 flight attendants, taking care of 440 passengers.

At about 7,000 ft, during the Airbus A380's departure climb from Singapore Changi Airport, two explosive, boom-like sounds — the first indication of a problem — apparently were louder to some cabin occupants than to the five pilots on the flight deck, von Reth said. He was seated at the door nearest to the destroyed no. 2 engine.

Timing of Key QF32 Events (Local Time)

Time	Event	Notes
09:56:47	Takeoff	Cabin operations are in normal mode.
10:01:07	Uncontained engine failure	Heard, felt and observed by many passengers and cabin crew; cabin crew's calls get delayed response from flight crew.
10:18:05	Aircraft entered holding pattern	CSM initiates cabin emergency mode and PAs; flight crew takes 50 minutes to complete initial procedures associated with ECAM messages; SCC makes PA; captain makes his first PA around 11:00:00.
11:28:00	Aircraft left holding pattern	CSM briefed on potential runway overrun and evacuation.
11:36:39	Beginning point of retrieved CVR recording	Overwritten audio before this point would have enhanced human factors analysis.
11:48:00	Aircraft stopped on runway	Touchdown occurred at 11:46:47.
11:49:05–11:49:15	Engines no. 3 and no. 4 shut down; unsuccessful engine no. 1 shutdown attempts	Flight crew radio contact with AES commander delayed 2–3 minutes; captain's PA initiates alert mode; emergency egress options discussed.
11:57:46	CVR power interruptions of about 22 minutes from this point	Two-hour recording has gaps.
12:01:00	Flight crew requests airstairs and buses	Second officer briefs CSM, who briefs cabin crew for precautionary disembarkation; PA by captain briefs passengers.
12:23:00	Airstairs arrive	AES commander takes command of passenger egress; first bus arrives 10 minutes later.
12:39:00	Precautionary disembarkation of passengers begins	Flight attendants deplane one group of 20 passengers at a time per AES instructions.
13:41:05	Precautionary disembarkation of passengers ends	About two hours have elapsed since landing; cabin alert mode ends; cabin crew disembarks.
14:02:53	CVR recording ends	Total possible recording was two hours.
14:53:00	Engine no. 1 shutdown	Left-side damage is apparent to engine no. 2, wing, vertical fin and fuselage.

AES = airport emergency service; ; CSM = cabin service manager (purser); CVR = cockpit voice recorder; ECAM = electronic centralized aircraft monitoring system (display); PA = public address system announcement; QF32 = Qantas Flight 32; SCC = supervising check captain

Note: Time and event columns show ATSB data; notes indicate approximate periods based on other sources cited in this *ASW* article.

Source: Australian Transport Safety Bureau (ATSB)

Table 1

"When the first explosion occurred, I thought … 'Something is wrong in a cargo container,'" he said. "It was very audible in the cabin because the aircraft shook. … The second explosion came while I was looking out of the [left] window, and that was when the engine started disintegrating and the wing opened up." Von Reth felt the aircraft shudder during the second boom.

"Debris was flying with such a velocity out of that wing in all directions [that] you could not see the [individual pieces of] debris," he said. "I saw debris flying forwards [and] backwards, sparks and fumes." The disorienting scene was accompanied by a sound he compared to that of marbles rattling against corrugated iron plates. After the flight, he learned that the sound was shrapnel penetrating the wing and fuselage.

The ATSB report said that a large fragment of the engine's disintegrating turbine disc penetrated the left wing — leaving the hole that von Reth and many left-side passengers could see — and ignited a "short duration, low intensity flash fire inside the wing fuel tank" observed by one passenger-witness.

"There was silence in the cabin, absolute silence," von Reth said while describing his shift from normal-service operational mode into emergency-procedures mode. "Procedure says you wait until the flight deck has assessed the situation and stabilized everything [before] you get into action. … But then passengers … got out of that shock moment, and they started to get restless."

QF32 describes von Reth's first attempts to call the flight deck using the interphone and an additional emergency channel; there was no response. Other cabin crewmembers also received no response. The ATSB report said that the normal overhead panel light had illuminated and the corresponding horn had sounded, but the flight crew inadvertently canceled the horn "without recognising its association with the cabin interphone system emergency contact function" during an ongoing cascade of warning signals. The next event in the cabin was considered pivotal.

"A passenger got up in the cabin, stood up, and was just about to shout at me," von Reth said. "I thought, 'This is the moment. … I'll have to have this cabin under control.' So I took the PA [public-address handset of the] interphone … system and said, 'Ladies and gentlemen, obviously, we had some problem with the engine no. 2. Most of you on the left-hand side would've seen it out of the window and everybody else would've seen it on the in-flight video screen. I can assure [you] the pilots have this all under control. … As soon as they have stabilized everything, we will hear from them. If I get any further information, I'll pass it on to you." He emphasized the change to emergency operational mode and issued safety instructions.

The passenger quietly returned to a seat, sat down and followed crewmember instructions. "Then I did a quick run-around of the aircraft, and I sat down again," von Reth said. "We still hadn't heard then from the flight deck. … We were not in a situation where were just about to fall down, but we had structural damage. I saw the fuel leak, and obviously hydraulic [fluid leaking] as well." His next call to the flight crew was answered, and after his report, he was told that a pilot would go to the cabin for a first-hand look.

Mark Johnson, the second officer, examined the damage and leaks, walked through the remainder of the cabin, assessed other conditions, discussed the situation with von Reth on the main deck, and returned to the flight deck. After completing their initial response actions, the flight crew was cleared by Singapore air traffic control to fly a holding pattern east of Changi.

"[In] the cabin was dead silence," von Reth said. "It was like you could cut the air. It was strange, absolutely strange." Shortly after Johnson left the cabin, David Evans, a captain on the flight deck to supervise a third captain conducting de Crespigny's annual route check, made the first PA announcement by a pilot, a quick status report with reassurance that the situation was under control.

About an hour into the flight, de Crespigny made his first PA announcement "to explain what's happened, what we've done, that we are safe and how long it will take to configure the aircraft and land." After speaking about 10 minutes, he urged passengers to comply with instructions from "Klaus, the cabin supervisor." This last statement gave von Reth an idea.

"That PA was done [and there was] silence again, and I thought, 'No, I can't run the cabin like that,'" von Reth recalled. "'I'll have to break this [tension] somehow.' … So I took the PA [handset] and said, 'I want to extrapolate on what the pilot just said … but before I do that, I want to make a few things clear. First of all, my name is Michael and not Klaus, and, secondly, I'm not the supervisor, I am the manager.' Everybody broke out in laughter and applauded. … It broke the ice, the stifling fear in the cabin was gone, and passengers started to relax."

Von Reth resolved to keep information flowing to them that would be necessary for the safety of flight, but like the pilots, used discretion to avoid overloading passengers with a few of the facts and plans known to crewmembers. For example, based on his knowledge of normal turnback procedures for jettisoning fuel to reduce the landing weight, he told passengers this was being done. In reality, the flight

Qantas Flight 32 Flight Path, Nov. 4, 2010

Note: Three hours and 40 minutes elapsed from the QF32 uncontained engine failure to the end of precautionary disembarkation.

Source: Australian Transport Safety Bureau

Figure 1

crew was unable to jettison fuel, and the fuel quantity was being depleted by the consumption by three engines while holding, and by the fuel tank leaks.

Qantas SOPs specify that normally flight attendants be seated with their seat belts fastened when the flight crew illuminates the seat belt signs. Von Reth judged that intentional non-compliance with that SOP was warranted as the holding pattern was entered (Figure 1). "I got the crew on the right-hand side [and] left-hand side out of their seats," he said. Meeting with small groups in the galleys, he instructed right-side flight attendants to check all the cabin conditions first, then check all passengers, especially looking for any individual passengers in distress. This meant special attention to mothers with children, elderly people, those who speak a language not being used by crewmembers and people who indicate they do not understand the situation.

"The crew on the left-hand side [took their] primary positions," von Reth said. "I told them, 'You stay where you are, you are not moving. You watch the outside. [If you see] any changes on the outside, you report that immediately.'"

A cascade of cabin equipment malfunctions made these tasks difficult. The in-flight entertainment system operated intermittently, and the cabin emergency lighting repeatedly illuminated, then turned off. Half the cabin had no normal interior lighting but had daylight through windows.

Observing their oblong circuits within gliding range of the airport, in an approximately 20-nm (37-km) long racetrack holding pattern at 7,400 ft, the passengers showed signs of better understanding the risks and reasons for the actions of the flight crew and cabin crew.

"The ambient noise in our work environment — with all these whistles, bells, lights and whatever — was just incredible," von Reth said. He decided to implement a decision-making rule for everyone: If the cabin crew could not see that an anomaly indicated was real, still present and significant, the assumption would be, "It's not happening to us," he said.

The CSM began walking throughout the main deck and upper deck in a figure-8 pattern. But the number of people seeking his attention, warning systems, and other sights and sounds started to become overwhelming. "Maybe for a half an hour, I was in overdrive, [but] you can't handle it. … It's too much," he said. He considered options that could very quickly make him more situationally aware, able to keep focusing and concentrating.

The best option came to mind when the cabin supervisor from the upper deck accosted him and began to deliver a lengthy report. "I stopped him in his place and said, 'Listen very carefully now,'" von Reth said. "'You are 2IC [second-in-command]. The crew will report through you to me.'" Von Reth then told himself, "[Flight crew now] are the only people I have to talk to. … The rest are not relevant for the time being." He deliberately "tuned into" PA announcements, signals of incoming interphone calls, engine sounds and

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Australian Transport Safety Bureau

Top, cabin crew and passengers of QF32 had a view of left-wing damage and fluid leaks; second photo, damage to engine no. 2, vertical fin and fuselage was not visible to passengers.

voices of flight attendants and successfully ignored non-safety-critical signals and passenger voices, he said.

As plans were finalized on the flight deck to exit the holding pattern and to conduct checks of manual control of the aircraft during a 20-nm approach, von Reth received an in-person briefing from Johnson about the state of the aircraft, the expectation of stopping near the end of the runway, and the best/worst possibilities of a runway overrun and/or an evacuation.

To brief the entire cabin crew with these details, "I went from galley to galley because the interphone system was useless," he said. "I told them, 'Guys, this is it. We've been trained for this.'" Von Reth directed them to secure the cabin for landing, stow loose objects, secure themselves into their jump seats, mentally rehearse the ABC (able-bodied passengers, brace position, and commands to passengers during an evacuation) impact drill and perform their silent review of memorized emergency checklist items.

Von Reth described this landing phase as a very tense time for passengers, yet they complied with crewmember instructions as the aircraft stopped. "It was quiet," von Reth said. "None got out of their seats. … They were all relieved. … But then I looked out of the window, and I really got tense … the most intense moment for me throughout this entire episode. When I … looked at the fuel leak and realized it was a fuel leak — how it was gushing down onto the tarmac and then flowing off — I thought … this can't be true. There was not one firefighter in sight, no rescue personnel, nothing." He said he felt "desperate" to get everyone off the aircraft as the cabin became hot and cabin alarms continued.

The captain's next PA announcement, however, only began the alert phase: "Attention! All passengers remain seated and await further instructions." The ATSB report said, "During the alert phase, all cabin crew were to remain at their assigned stations, with all doors armed. This allows the crew to immediately activate the escape slides should they be needed."

Emergency Continues

The threats presented by the fuel leak prompted von Reth to immediately try again to call the captain but each call attempt failed, so he considered going to the flight deck. "But then, again, my inner voice said to me, 'No, you can't go to the flight deck because they are in overload … so it's a waste of time [a distraction, and] would take too long to [gain entry]," he recalled. "What finally stopped me was that if anything happens I have to be in the cabin."

At about the same time, de Crespigny called him and said that airport emergency service (AES) firefighters already were positioned out of sight behind the aircraft, assessing the situation while applying aqueous film-forming foam and washing away the leaked fuel from the runway underneath the aircraft. This reduced the CSM's stress level.

Von Reth repeated the essence of this information to passengers. "Some of them had started to take their cameras and mobile phones and everything else out," von Reth recalled. "So I made a very terse statement: 'We are in a very difficult situation right now, and it's not over, as you can see out there. No electronics. Switch it all off immediately. Put it away.' They did."

Precautionary Disembarkation

The flight crew was acutely aware of risks of deploying the high, steep slides, but they also considered evacuation — only from the right side — an acceptable Plan B from knowledge of the 78-second evacuation time of 873 occupants from half the exits, according to required conditions of the A380's certification demonstration (*ASW,* 1/07, p. 46). Moreover, evacuating 440 QF32 passengers with the aircraft crew remaining inside, given the threats outside the aircraft, was not an ideal situation.

The ATSB report said, "The flight crew elected to use a single door for the [precautionary] disembarkation so that the passengers could be accounted for as they left the aircraft and to keep the remainder of the right side of the aircraft clear in case of the need to deploy the escape slides. They also decided to leave the remaining doors armed, with cabin crewmembers at those doors ready to activate the respective escape slides until all of the passengers were off the aircraft."

Contrary to Qantas procedures for selection of the precautionary evacuation door, the AES commander selected the main-deck, two-right (2R) door, von Reth said. The ATSB report said, "There were hurried communications between the cabin and flight crew to ensure that there was no accidental deployment of a door slide when main deck 2R door was opened. The flight crew also instructed the cabin crew to prevent any subsequent evacuation from the left side of the aircraft while the no. 1 engine continued to run."

However, von Reth realized that the flight attendant stationed at this door would not be able to operate the door as usual. He asked the captain to inform the AES commander to open this door from the outside, and firefighters did this.

The AES commander then took command and instructed von Reth to assist in the precautionary disembarkation by keeping all passengers seated except for one group of 20 passengers, one busload, to be deplaned at a time. Von Reth made the associated PA announcement and added that only airline tickets, passports and vital medication could be removed from the airplane.

During the hour-long disembarkation, von Reth reminded the cabin crew, "Stay on your doors. Be ready." At one point, a false electronic command to evacuate was displayed. A more experienced colleague had to counsel one flight attendant to disregard this indication, von Reth said.

The ATSB's analysis concluded, "Given that there was no indication of an immediate threat to the safety of those on board, and that the option of an immediate evacuation remained throughout, the crew's decision to evacuate via the stairs likely provided the safest option."

Industry awareness of potentially hazardous distractions while using portable electronic devices (PEDs) — for passengers, flight attendants and pilots — has increased in recent years. The ATSB report thus cited QF32 as a new case study of the importance of complying with crewmember instructions on PED use. This reason is in addition to the long-assumed risk of interference with aircraft systems, many of which were in a degraded state during QF32. Von Reth and de Crespigny also noted the potential generation of sparks by PEDs in the presence of spilled fuel.

The ATSB report said, "Video and still images showed that some of the passengers did not comply with the crew's instructions, such as moving about the cabin when they had been instructed to remain seated [and] using PEDs during flight, and in particular during the approach, landing and post-landing phases, when instructed to switch them off.

"[Emergency] instructions will be significantly different to the normal announcements made during a flight and contain specific information and instructions not normally provided to passengers. … Actions need to be carried out quickly, and there can be insufficient time for crew to be repeating information to passengers distracted by their PEDs."

The ATSB report also noted that although no unsafe situation resulted from this event, "the lack of conspicuity of the cabin emergency call function delayed the transfer of potentially important information to the flight crew."

Notes

1. ATSB. "In-flight uncontained engine failure overhead Batam Island, Indonesia, 4 November 2010, VH-OQA, Airbus A380-842." ATSB Transport Safety Report. Aviation Occurrence Investigation AO-2010-089. June 27, 2013.
2. A 28-year Qantas employee at the time, assigned to the Airbus A380 fleet, von Reth has since shared the cabin safety aspects of the QF32 event in several industry forums. Excerpts from the *ASW* interview have been available for viewing only on the FSF website <flightsafety.org/media-center/news>, which has a companion interview with de Crespigny.
3. The flight crew's response has been summarized in two *ASW* articles, one based on the account of events in a 2011 video interview with the QF32 captain (*ASW,* 12/11–1/12, p. 32) and the other based on the ATSB's final report (*ASW,* 9/13, p. 10).

Airman7474/Wikimedia Commons

FARs Part 23 assumed simpler aircraft, but the push is on to rewrite the rules for current designs and safety equipment.

Updating The Rules

BY HEATHER BALDWIN

The gulf between aviation technology and airworthiness regulations widens almost daily as new capabilities are developed with ever-increasing speed, while key regulations remain static.

This situation has been a particular source of frustration for those operating under U.S. Federal Aviation Regulations (FARs) Part 23, which prescribes airworthiness standards for the issuance of type certificates for airplanes under 12,500 lb (5,670 kg; the normal, utility and acrobatic categories) and under 19,000 lb (8,618 kg; the commuter category). The standards, based on weight, do not account for modern, potentially life-saving technologies such as angle-of-attack (AOA) indicators, leaving many products inaccessible or unaffordable for the vast majority of pilots flying Part 23–certified aircraft. So pilots do without the latest equipment, or they bring aboard uncertified, handheld devices that can add workload and distraction to the job of flying the airplane.

This safety gap may close soon. In May 2013, the Part 23 Aviation Rulemaking Committee (ARC) submitted its recommendations to the U.S. Federal Aviation Administration (FAA) for changes. The ARC report contains two major recommendations:

- Reorganize Part 23 based on airplane performance and complexity rather than existing weight- and propulsion-derived categories.
- Rewrite certification requirements for Part 23 airplanes as a top-level regulation with more detailed implementation methods defined by reference to industry and government standards.

The recommendations would make it far simpler for new technologies to be installed on Part 23 aircraft, which in turn would help achieve the new rule's goal of doubling real world safety while cutting in half the cost of certification. The ARC report is currently being reviewed by the FAA. Michael Huerta, the FAA administrator, said his goal is to issue a final rule based on the committee's report and that the process could take as long as three years.

Rep. Mike Pompeo is pushing the FAA to move faster. On May 7, he introduced the Small Aircraft Revitalization Act, which would require implementation of the Part 23 ARC recommendations by Dec. 31, 2015. In introducing the bill, Pompeo noted, "The existing outdated certification process needlessly increases the cost of safety and technology upgrades by up to 10 times. With this bill, we can ensure that the general aviation industry has what it needs to thrive."

Performance, Not Weight

Back in 1965, when the Civil Aviation Regulations migrated to the FARs, certification of aircraft based on weight made sense, as there was a direct correlation between the performance of the aircraft and the weight of the aircraft: Small airplanes were simple and slow; bigger airplanes were faster and more complex. Even in the 1980s, when Part 23 was last reviewed, today's technologies were largely inconceivable, making weight still the best determinant of performance.

Since then, advances such as small turbine engines, composite airframes and lightweight digital electronics have raised the operational capability and performance of these small airplanes. "With today's modern technologies, performance is not limited to heavier aircraft," said Ric Peri, vice president, government and industry affairs, Aircraft Electronics Association (AEA). "Also, because of the broad utility base of aircraft, heavier aircraft are not always high-performance." Weight, he added, has therefore become less relevant to the original intent of the regulation, when weight and performance were correlated.

Today's technologies colliding with yesterday's weight-based Part 23 regulations create a long, expensive certification process. "When the regs don't adequately address the technology, the only tool the FAA has to use is 'special conditions' and this hampers efficient certification processes," said Peri. Certification through "special conditions" can take years. By the time it is complete, the technology has often been surpassed while the resulting costs make it too expensive for most small aircraft owners to install.

Here is an example. Greg Bowles, director, engineering and manufacturing at the General Aviation Manufacturers Association (GAMA) and chairman of the Part 23 ARC, said there is currently on the market an AOA indicator that provides early warning of a stall that could lead to loss of control in flight (LOC-I). For experimental aircraft, which are not bound by Part 23 rules, the equipment costs around $500 to $600. "In a certified airplane, the same part is a $5,000 to $6,000 installation, which changes the story about who can afford to put it in. That's purely a bureaucratic cost," Bowles said.

Made more affordable, this kind of equipment could save lives. Bowles said the no. 1 accident category the ARC is trying to resolve is LOC-I, which usually involves a pilot error resulting in unintended departure from the airplane's normal aerodynamic envelope — an issue that the AOA indicator addresses. "The way we can double safety, or cut in half accidents, is by bringing to market technology that can save lives at a price people can afford to put in their aircraft," he explained. The proposed changes to the regulations would "put in people's hands technology that can make meaningful change."

The global, large commercial jet industry segment has witnessed this kind of "meaningful change" in the area of reducing controlled flight into terrain (CFIT) with the wide use of mandatory terrain awareness and warning systems. Until about six years ago, CFIT consistently ranked around no. 2 as a cause of general aviation fatal accidents each year. Then in the late 2000s, it began a slow slide down the list of fatal accident causes until last year when it did not even make the top 10. What happened? Handheld global positioning systems happened, said Bowles. "Because you didn't have to certify them, pilots brought on board technology that saved their lives. They didn't install it because it was too difficult to certify."

The technology has certainly saved lives, but it often requires some elaborate adjustments. Peer into a cockpit with these kinds of handheld devices and you are likely to see wires strung across the cockpit, plugs going into the 12-volt accessory socket and suction cups on the window. There is no evidence pointing to accidents caused by extraneous wires snaking through the cockpit, but the extra equipment can be a safety risk because of distraction.

"I know folks who have failed their instrument [rating] check rides because they were playing with their lap-mounted equipment trying to make it do what it was supposed to do," said Max Trescott, author of *G1000 Glass Cockpit Handbook* and the National Association of Flight Instructors' 2008 National Certificated Flight Instructor of the Year. "When your head is in your lap rather than on the instrument panel or looking outside," the conditions for an accident exist, he said.

Trescott said installing the instrumentation that is available to operators of experimental and light sport aircraft "would be a bonanza" for aircraft owners and the safe operation of their aircraft. In particular, he points to the AOA indicator mentioned by Bowles. "The angle-of-attack indicator is the best-kept secret in general aviation and has the greatest potential for reducing stall/spin accidents," he said.

"Currently, our biggest accident cause is loss of control, usually on the downwind to base leg turn," said Robert Hackman, vice president of regulatory affairs for the Aircraft Owners and Pilots Association (AOPA). "Pilots make the turn and get the aircraft in a configuration where it enters a stall close to the ground and

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FARs Part 23 revisions are expected to make the addition of safety equipment such as this angle-of-attack indicator, with its potential to avoid stalls, more practicable.

Crafting New Industry Standards

While the U.S. Federal Aviation Administration reviews the Part 23 aviation rulemaking committee report, roughly 100 global aviation stakeholders are addressing a key piece of the proposed changes: international standards for general aviation (GA) equipment.

To ensure harmonization of the safety requirements under a revised Part 23, the industry created a new global standards committee under ASTM International,[1] which develops and delivers international voluntary consensus standards. The official scope of ASTM F44, *General Aviation Aircraft*, is "the development and maintenance of internationally accepted standards and guidance materials for general aviation aircraft."

F44 standards will address the complexity and performance of the full spectrum of general aviation aircraft, including design and construction, systems and performance, quality acceptance tests and safety monitoring. The standards will better align certification requirements with the type of operation an aircraft will experience. The ASTM F44 committee will not duplicate existing standards but will reference them. F44 standards will be published in the *Annual Book of ASTM Standards*, Volume 15.11. F44 has six technical subcommittees that maintain jurisdiction over these standards.

Formed in December 2012, the ASTM F44 committee meets twice a year. Meetings are scheduled in conjunction with ASTM committees F37 on light sport aircraft and F39 on aircraft systems along with industry trade shows and airshows. Membership stands at roughly 100 and is open to all stakeholders with an interest in the standardization process. Visit <www.astm.org/committee/f44> for more information.

— HB

Note

1. The organization was formerly known as the American Society for Testing and Materials.

goes into a spin. With the ability to provide a warning to the pilot or keep the plane from getting into the attitude in the first place, we should see a reduction in loss of control accidents."

Hackman said the Part 23 changes are "one of the most significant efforts" AOPA is involved with today because of the new rule's goal to increase safety by a factor of two. "If the process goes forward, you'll see an increase in folks upgrading their avionics," he said. "You'll see upgrades to newer models of autopilot or first-time installation. We'll see technology come forward in the area of envelope protection."

Hackman's comments point to a potential revitalization of general aviation — one of the aims of the ARC. "We knew we needed to improve the health of aviation, not just safety," explained GAMA's Bowles, noting that the industry has been losing about 10,000 active pilots a year for the last 15 years and last year dipped below 250,000 active pilots for the first time since 1965. "If you have an industry that is thriving, you have more people coming in, there's innovation, people are excited, they are learning and safety improves." Until now, he added, "we have been going the wrong way."

Helicopters Likely to Follow

So far, the aviation community has been hailing Part 23 reform as a success due to the cooperation between industry and international regulators and the change proposals, which promise to improve safety, cut certification costs and accommodate future technological developments.

Noting this success, AEA leaders and others wondered whether a similar process could be applied for helicopters. "We said, let's look at [FARs Parts] 27 and 29 because those are just as outdated," said Paula Derks, AEA president. AEA co-hosted a forum with GAMA and Helicopter Association International (HAI) that brought together representatives of the rotorcraft community, the FAA and international regulatory agencies to share perspectives on how to approach a review of Parts 27 and 29, which govern rotorcraft airworthiness standards. "We asked: Do we model it after the Part 23 rewrite? The consensus was, yes," Derks said.

The issues are similar, with the FAA frequently having to resort to special conditions or exemptions to approve new technologies, resulting in lengthy delays and soaring costs. Another problem for rotorcraft: "You get so close to the weight category [limit] just building the aircraft to do what it needs to do that some of the things that would enhance safety are left out because of the weight limit," said J. Heffernan, HAI's director of safety.

"The aircraft of today are heavier [than those that existed when the regulations were written] because manufacturers have been able to put in bigger transmissions, more robust rotor heads, enhanced landing gear, and the ability to carry more fuel," Heffernan said. "Add to that five or six passengers instead of one or two and that's a big weight difference, so you can't add equipment that will improve [risk reduction] performance."

Recognizing these problems, on Feb. 22, 2013, the FAA opened a request for public comments on restructuring the rotorcraft airworthiness standards for normal and transport category rotorcraft. Introducing this request, the FAA said, "We have recognized that the evolution of the Part 27 and 29 rules has not kept pace with technology and the capability of newer rotorcraft. Therefore, the FAA is interested in investigating new approaches to make the rotorcraft airworthiness regulations more efficient and adaptable to future technology. Additionally, the FAA has found that without a rulemaking effort to extensively revise the rotorcraft standards, we are left with the option of issuing multiple special conditions for the same technologies (fly-by-wire flight control systems, search-and-rescue approach, etc.)."

The comment period closed May 23, and an FAA spokesperson said the agency is currently reviewing the comments but has not yet decided on a way forward. Still, there is every indication the path will follow that of Part 23. In its request for comments, the FAA noted: "If we find adequate interest from the rotorcraft community, we would consider initiating a rulemaking effort, similar in scope to the proposed revisions of the small-airplane Part 23 standards."

Heather Baldwin is a Phoenix-based freelance writer. A pilot and former U.S. Army officer, she writes regularly about aviation, military issues and topics related to management and workplace performance.

Save the Data

Business aviation seeks to replicate the safety benefits of data sharing and analysis introduced in commercial air transport.

BY MARIO PIEROBON

Virtually all aviation safety data sharing initiatives that have been in place for some time, such as the International Air Transport Association Global Safety Information Center, focus on commercial air transport operations. They do not collect, analyze or publish safety data for business aviation. The same is true of the International Civil Aviation Organization (ICAO), which every year prepares and analyzes safety data related only to commercial operations involving transport category, turbine-powered airplanes engaged in scheduled and non-scheduled passenger and cargo operations.

Business aircraft typically fly into and out of more operationally demanding airports, and take off from and land on shorter runways, including many that lack instrument landing system or other precision approaches. The operational hazards are thus different from those of scheduled commercial aviation. The nature and frequency of operations are different. Crew composition in business aircraft operations also is unlike that of commercial airline operations, with crewmembers operating more like a "small family" and rostering and rotation of crewmembers considerably less structured.

The particular need for data collection and analysis in business aviation is recognized by the International Business Aviation Council (IBAC) and is one of the pillars of IBAC's *Business Aviation Safety* Strategy, released in 2007.

"Mechanisms are needed to measure the level of safety achievement and to monitor trends," says IBAC. "Concurrently, there is a need to determine weaknesses and deficiencies so that attention can be focused on achieving safety improvement. There is an ongoing need to collect and analyze data on aircraft incidents, accidents, safety issues, accident rates and causal factors."[1]

IBAC also stresses a need to "partner with aircraft manufacturers and aviation authorities to share accident, incident and safety-related

Aircraft: © Ivan Cholakov/Dreamstime
Map: © User: saicle/Vectorstock.com
Photo illustration: Jennifer Moore

data and information and improve/validate exposure data (hours/sectors operated).”[2]

One possible reason safety-data sharing initiatives have so far been of limited scope in business aviation is the fragmentation of the business aviation sector. Europe, as an example, has more than 300 commercial operators of business aircraft, with 87 percent operating fewer than five aircraft. Only a few of these operators have more than 20 aircraft under management or in operation.

Despite the difficulties of data sharing, business aviation operators have a generally positive attitude. “Safety culture is automatically an inherent part of the business,” said Graham Williamson, president, Aircraft Management and Charter Services at TAG Aviation Europe, with a managed fleet of 140 aircraft worldwide.

Initiative From the Industry

While larger business aircraft operators can invest substantial amounts in safety, customer service and quality, and promote common values and ethics, smaller operators often have limited resources and need to identify economically feasible ways to share experiences and resources. In Williamson’s view, there is a good potential for cooperation on safety-data sharing in business aviation among players of all sizes. TAG Aviation Europe has been involved in the launch and the ongoing work of the Corporate Aviation Safety Executive (CASE), a regional, collaborative business aviation safety initiative.[3]

“Five years ago,” recalled Williamson, “we were implementing our own safety management system (SMS) within TAG Aviation Europe, and representatives of some business aircraft operators that approached us expressed a need for support to implement their SMSs after SMS Phase I gaps were identified.[4] CASE arose from a group of like-minded safety professionals, whose aim was to collate and share data.”

Since its inception, CASE has grown to become an important collaborative working group for a number of U.K. business aircraft operators to share experiences related to flight safety. CASE now has 40 members, representing around two-thirds of U.K. business aviation operations.

“The group meets quarterly to share flight safety data and experiences,” said Malcolm Rusby, European safety director, TAG Aviation (U.K.) and CASE manager. “Our meeting in early June 2013 was well attended, with excellent feedback from members.

“The second phase of growth for CASE is about to start, extending the membership to more European operators; some U.S.-based operators have also expressed an interest in participating and sharing data and best practices,” said Williamson. CASE also aims to involve more engineering companies, and helicopter and general aviation operators.

Business Aviation Safety Database

Email reports highlighting the latest safety concerns are regularly sent out and shared on Air Safety Central, an electronic reporting tool that enables CASE members to upload data and reports into the system in an organized way so the wider industry can benefit from each member’s findings.

Air Safety Central was conceived as a social media–like network that allows safety managers to post completed but anonymous safety investigations. Members can review data, comment on any aspect of an incident, and share best practices through the network. There also is an opportunity to join groups of similar operators to share safety data and draw trend analysis from a far larger pool than might otherwise be possible. Air Safety Central has been developed by aviation information technology provider Vistair and has operated for about nine months, with more than 250 reports stored.

Harmonization of SOPs

One of CASE’s biggest projects is the harmonization of standard operating procedures (SOPs) among business aircraft. “Reports filed in Air Safety Central are particularly useful because they can form the basis of proposed changes to operating procedures,” Williamson said. CASE is working closely with training providers to put CASE data into their courses so that training is more in line with what is happening in the industry.

TAG Aviation Europe's headquarters at London Farnborough Airport. TAG Aviation hosts the day-to-day activities of CASE.

"The fact that CASE is run as a collaborative industry working group makes it possible for operators that are particularly experienced in the operation of a certain aircraft type to exchange information with less-experienced operators or those introducing the type," Williamson said. "For example, TAG Aviation Europe operates a Dassault Falcon 7X fleet of 11. With this aircraft type, our SOPs are of proven reliability, and we can share them with smaller or less-experienced operators. SOPs can be harmonized across the industry by the strengthening of forums like CASE."

Flight Data Monitoring

CASE also intends to build a flight-data monitoring (FDM) database to offer additional data-driven safety insights. CASE initially is working with the U.K. Civil Aviation Authority (CAA) on a project to equip three business aircraft with a maximum takeoff weight of less than 27,000 kg (27 metric tons; 59,525 lb) with quick access recorders (QARs) so that flight data from routine operations can be downloaded. The three types used for the QAR test are the Bombardier Challenger, Learjet 45 and Hawker 800. "We want to collect data on these aircraft, which often operate into smaller airports, to build more robust models of safe precision approaches," said Rusby. "We will also harmonize this project with our SOPs to ensure the trend data is correct."

"The funding received from the U.K. government for equipping three business aircraft below 27,000 kg with QARs is important; this is an area of business aircraft operations where data is insufficient," said Williamson.

European regulations require operators to establish and maintain an FDM system, to be integrated into their management system, only for airplanes with a maximum certificated takeoff weight of more than 27 metric tons. This means no flight data are collected for the majority of the European business aircraft fleet. Thus, flight crew performance cannot be thoroughly monitored, and trends cannot be identified with confidence. Operators of smaller airplanes do not perform any FDM.

U.S. Focus

On the other side of the Atlantic, the U.S. Federal Aviation Administration (FAA) is focusing on reducing general aviation (GA) accidents by using primarily a voluntary non-prescriptive, proactive and data-driven strategy to get results.

At the top of the FAA's priorities list for action in GA safety is loss of control–in flight (LOC–I) and — in second place — controlled flight into terrain, on the basis that these are the most frequently occurring fatal accident categories.[5]

The FAA is working with GA associations to use data to identify risk, pinpoint trends through root cause analysis, and thus develop safety strategies. "The GA Joint Steering Committee (GAJSC) is moving toward using deidentified GA operations data in the Aviation Safety Information Analysis and Sharing program to help identify risks before they become accidents," the FAA says. "Data from these programs can also be used for GAJSC initiatives and research conducted by the GA Centers for Excellence. The agency also reviews airworthiness directives to identify causal factors and trends."[6]

The GAJSC is a government and industry group that uses the same approach as the Commercial Aviation Safety Team (CAST). "The group recently proposed 23 safety interventions to address [LOC-I] during approach and landing," the FAA says. "Other achievements include several web-based resource guides, including the *General Aviation Pilot's Guide to Pre-Flight Weather Planning, Weather Self-Briefings* and *Weather Decision Making*, which provide advice to pilots on how to safely make flying decisions involving weather. The GAJSC combines the expertise of many key decision makers across different parts of the FAA, various government agencies and several GA associations."[7]

Data Relevance

Business aviation safety-database development initiatives should not be set up to provide measures such as fatality rates, which are already collected elsewhere and provide a limited picture of safety performance. Industry databases should provide an insight into causal factors.

Historically, Embry-Riddle Aeronautical University says, safety has been assessed in terms of accident, incident or fatality rates.[8] To improve safety metrics, Embry-Riddle is running a research program for designing and testing a GA pilot survey to obtain data on unsafe acts and to question pilots on their safety attitudes and beliefs.[9]

Data Integrity

Confidence in statistical analysis results and in the decisions derived from them depends largely on the quality of the data supplied in the first place, especially if the database is meant for contributions from several operators across the business aviation industry.

Data quality primarily depends on a carefully defined taxonomy. "Raw safety data (e.g., pilot reports and flight data events) need to be put into a standardized, recognizable format so that everyone can interrogate and analyze it," says Eddie Rogan of the Superstructure Group.[10]

While full standardization in individual-source reporting may never be achieved, attempts should at least be made for the non-narrative categories of reported information, with all database contributors using the same reporting form with as few free-text (open-ended) data entries as possible.

To generate consistent and repeatable results, the taxonomies used must be understood and applied by those making and reporting the observations. Criteria to be observed include the following, according to Alan J. Stolzer, Carl D. Halford and John J. Goglia:

- The taxonomy's framework has to be actively used by operational people.
- Its terms need to be derived from operational language.
- The taxonomy needs to support the human factors model of human error.
- The taxonomy needs to provide data that can support a risk management system.[11]

Rogan says, however, that certain technical hurdles must be overcome so all information suppliers use a standard format:

- **Standard Occurrence Classification**. There is no currently recognized industry standard for classifying occurrence events within business aviation, let alone classifying the root causes discovered during investigations.[12]
- **Flight Data**. Many operators monitor similar events, but the parameters are selectable, differing in definition and purpose.
- **Funding**. Who pays and how much is such a service worth?
- **Occurrence reporting**. Not all potential information providers have a software tool that can export data/information.[13]

For ensuring data quality and reducing the work of each reporting organization and the central management of the database, a software tool is important. As noted by one study, "The aggregate analysis of measures of a system such as ours in aviation, in which we can have thousands of employee self-reports per year, or millions of observations from which events are detected, absolutely requires automation to support the analysis. Especially for larger service providers and data-sharing programs, the size of our datasets is much too big for manual analysis."[14]

Safety Benchmarking

The use of a standardized and well-defined taxonomy also allows establishing a baseline safety performance for the business aviation industry against which contributing operators can benchmark safety performance and assess risks. Database contributors may even be able to benchmark themselves against their own past performance and other operators in their region.

However, says Rogan, "Benchmarking safety information needs to be done cautiously and thoughtfully; for example, if you have an information provider with a very good and open reporting culture, then this could mistakenly be seen as a negative performance comparison which would undermine the ultimate reason for sharing information."[15]

Additional Barriers

Despite all best efforts on behalf of a safety database — including, certainly, the deidentification of reported information — additional barriers remain that inhibit contributors from consistently reporting and sharing everything requested of them. Rogan lists some barriers to participation which might prevent successful sharing of business aviation safety information:

- **Legal**: Fear of information being used against them in court or by the regulator.
- **Internal politics**: Information is power, and sharing might expose weaknesses in employees or work groups.
- **Economic**: The cost of collecting and distributing information.
- **Unions**: Staff fears of sharing information involving them.
- **Media**: Fear of information being published or broadcast.
- **Competition**: Revealing operational secrets that affect presumed competitive advantages.
- **Warranty**: Giving information manufacturers could use against a warranty claim — for example, when an aircraft has been operated outside the normal range of its aerodynamic envelope.
- **Workload**: The perception that it is too much hassle to share.
- **Incentive**: "What's in it for me?" Getting direct feedback and benefit from sharing.[16]

Unless these barriers are tackled and overcome, "We would be forced to accept the lowest common denominator approach ... and, ultimately, this would mean a less effective safety information scheme," Rogan said.[17]

Management Commitment

For a safety-data sharing initiative to succeed, responsibility rests partly with each operator's top management as well as with regulatory authorities.

An accountable manager creates a cultural environment where safety is an inherent part of the business. Such an environment increases the likelihood that lessons are learned from both good and bad experiences.

"I sit on the U.K. Safety Improvement Advisory Board, which has been doing a great deal of work to improve safety culture in the U.K.," said Williamson. Looking at further improvements in safety culture across the various domains of aviation, Williamson has suggested that the CAA host a meeting of all the U.K.'s accountable managers, possibly later in 2013.

In the overall picture, initiatives in several world regions are taking shape at last to collect and analyze safety information that is especially relevant to business aviation. For safety-data sharing initiatives to succeed, the derived information needs to support safety risk assessment with relevant and reliable measures; report forms need to be standardized among contributors; and addressing some operators' lingering concerns about sharing — such as the fear of repercussions from reporting their information — are key factors.

Mario Pierobon works in business development and project support at Great Circle Services in Lucerne, Switzerland.

Notes

1. IBAC. *Business Aviation Safety Strategy — A Blueprint for Making a Safe System Safer*. September 2007.
2. Ibid.
3. For a more detailed description of CASE, see <www.fly-corporate.com/article/4-things-you-need-know-about-case-0?utm_source=weekly_feed_20130904&utm_medium=email&utm_campaign=fly_corporate_weekly_feed&utm_content=feed_ad>.
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5. Learmount, David. "Business Aviation Safety Performance Over 20 Years." *Flight International*, May 8, 2012. <www.flightglobal.com/news/articles/in-focus-business-aviation-safety-performance-over-20-years-371577>.
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11. Elaborated from Stolzer, Alan J; Halford, Carl D.; and Goglia, John J. *Safety Management Systems in Aviation*. Ashgate, 2008, pp. 169–176.
12. Author's note: Even if there could be some standardization of the wording, there is considerable divergence among operators in the structure of an air safety report. Considerable room is left to free text, making it difficult to map database information and perform statistical analysis.
13. Rogan.
14. Stolzer, Halford and Goglia.
15. Rogan.
16. Ibid.
17. Ibid.

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IASS 2013

OCTOBER 29–31, 2013

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FSF plans to launch its first-ever mobile event app in time for IASS 2013. The app, for tablets and mobile phones, is scheduled to be available in early October and will provide all the details about IASS for attendees, including real-time updates and news.

Preliminary Agenda

(as of September 13, 2013)

Monday, 28 October 2013

0900–1200 International Advisory Committee Meeting

1700–1800 Day 1 Chairmen's and Speakers' Meeting

Tuesday, 29 October 2013

Opening Ceremonies

0830–1000 Kevin Hiatt — President and CEO, Flight Safety Foundation

David McMillan — Chairman, Flight Safety Foundation Board of Governors

Keynote Address — Honorable Earl Weener, Member, U.S. National Transportation Board

Danny Ho, Chairman, Flight Safety Foundation International Advisory Committee

Awards

1000–1030 **Refreshments**

Session I

Session Chairman: David Mawdsley, Aviation Safety Advisor, Superstructure Group

1030–1110 "FSF Year in Review" — Jim Burin, Foundation Fellow, Flight Safety Foundation

1110–1150 "Key Safety Issues in Aviation Maintenance" — Joseph Barclay, President, Inflight Warning Systems and Vice Chairman, Flight Safety Foundation Maintenance Advisory Committee; and Edward MacAskill, Senior Manager, Compliance, American Airlines

1150–1230 "Shared Skies — Safe Integration of Remotely Piloted Aircraft" — Sean Cassidy, First Vice President and National Safety Coordinator, Air Line Pilots Association, International

Tuesday, 29 October 2013 continued

1230–1400 **Lunch**

Panel I: Safety Change Management — Merging Tactical Safety with Strategy

Moderator: Mary McMillan, Tetra Tech

Panelist: Stephen Angus — Executive General Manager of Safety Assurance, Air Services Australia

Panelist: Hank Krakowski — Former FAA COO and United Airlines Vice President of Operations

Panelist: David McMillan — Chairman of the Board, Flight Safety Foundation

1400–1500 Panel discussion: "What Are the Challenges for Today and the Future?"

1500–1530 "Smoke and Fire in Transport Aircraft 2013 — an Update" — John M. Cox, FRAeS, CEO, Safety Operating Systems

1530–1600 **Refreshments**

1600–1700 "LOSA and TEM: Insights Gained from 100 LOSA Projects and 20,000 Observations" — James Klinect, Ph.D., CEO, The LOSA Collaborative

1730 Day 2 Chairmen's and Speakers' Meeting

Wednesday, 30 October 2013

Session II

Session Chairman: Chris Baum, Manager, Engineering and Operations, Air Line Pilots Association, International

0830–0910 "An Examination of Factors Leading to Runway Excursions" — Scott Winter, President, Flight Safety Foundation Student Chapter, Purdue University

0910–0950 "Why Are Unstable Approaches Continued?" — Ewout Hiltermann, Safety Manager, KLM Cityhopper

0950–1030 "Why Are Go-Around Policies Ineffective? — The Psychology" — Martin Smith, CEO and Founder, The Presage Group

1030–1100 **Refreshments**

1100–1140 "The Research of One Engine Inoperative for RNP" — Wang Zhong, China Academy of Civil Aviation Science and Technology

1140–1220 "Top 5 ATM Operational Safety Priorities" — Tzvetomir Blajev, Operational Safety Coordinator, Eurocontrol, and Captain Ed Pooley, Principal Consultant, The Air Safety Consultancy

1220–1400 **Lunch**

Session III

Session Chairman: Jonathan Tree, Director of Industry Relations, Jeppesen

1400–1440 "Human Performance Based Training and Flight Operations" — Christof Kemény, Head of Training, Lufthansa CityLine

1440–1520 "Training Interventions for Managing Startle During Unexpected Critical Events" — Wayne Martin, Ph.D. candidate, Griffith University

1520–1550 **Refreshments**

1550–1700 "The Air France 447 Investigation" — BEA, France
"Lessons Learned" — Jean-Paul Troadec, Director; "Human Factors Issues" — Sebastien David, Senior Safety Investigator; "Communications Issues — Media and Victims' Families" — Martine Del Bono, Head of Public Affairs

1730 Day 3 Chairmen's and Speakers' Meeting

Thursday, 31 October 2013

Session IV

Session Chairman: Kevin Hiatt, President and CEO, Flight Safety Foundation

0830–0910 "Airline Safety Perspective" — Dave Barger, President and CEO, JetBlue

Panel II: Expanding Information Sharing

Moderator: Kevin Hiatt, President and CEO, Flight Safety Foundation

Panelist: Dr. Hassan Shahidi, MITRE Corporation

Panelist: TBA

Thursday, 31 October 2013 continued

Panelist: TBA

0910–1000 Panel Discussion — "Expanding Information Sharing"

1000–1015 FSF–MITRE Announcement of the Center for Safety Excellence

1015–1045 Refreshments

1045–1145 "Lessons Learned: Accident Investigation and Crisis Management in a Remote Area — the American Airlines Cali, Colombia, Accident" — Christa Meyer Hinckley, Counsel, Dentons US LLP; and Curt Lewis, President, Curt Lewis & Associates LLC

1145–1300 **Lunch**

Session V

Session Chairman: Michel Piers, Institute Director, National Aerospace Laboratory Transport Safety Institute, Netherlands

1300–1340 "For a Better Use of Incident Analysis and Safety Databases" — Bertrand de Courville, Corporate Safety Manager, Air France

1340–1420 "Fatigue Risk Management — The Pilot's Perspective" — Donald Wykoff, Chairman, Flight Time and Duty Time Committee, Air Line Pilots Association, International

1420–1450 **Refreshments**

1450–1530 "Safety Culture and the Corporate Beast" — David Deveau, Vice President, Safety Quality & Environment, Jazz Aviation

1530–1610 "A Practical Look at the Road to Safety Culture" — Honorable Robert Sumwalt, Board Member, U.S. National Transportation Safety Board

1610–1630 "A Practical Guide to Effective Monitoring " — Helena Reidemar, Director of Human Factors, Air Line Pilots Association, International; and Honorable Robert Sumwalt, Board Member, U.S. National Transportation Safety Board

1630–1645 Closing — Kevin Hiatt, President and CEO, Flight Safety Foundation

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Unlatched

BY LINDA WERFELMAN

The loose cap on an engine oil tank went unnoticed before the fatal crash of a King Air 100.

An unlatched oil reservoir cap touched off a series of events that led to the 2011 crash of a Northern Thunderbird Air (NT Air) King Air 100 as its pilots turned back to Vancouver International Airport (CYVR) because of an oil leak, the Transportation Safety Board of Canada (TSB) says.

The two pilots were killed in the Oct. 27 crash, and all seven passengers were seriously injured. The airplane was destroyed.

The TSB said in its final report on the accident that, although considerable oil had leaked because of the unlatched cap, "enough remained to allow the engine and propeller to operate normally."

Oil leaked through the unlatched cap.

© Transportation Safety Board of Canada

The accident flight began around 1541 local time with takeoff from CYVR, where the airplane had been kept in a hangar overnight. It

© Jesse Adams

was inspected in the hangar by NT Air maintenance personnel, who added 1 L (1 qt) of oil to the left engine and signed off the overnight inspection as complete.

"It is likely that the oil cap was not secured or verified during completion of the overnight inspection," the report said.

The captain arrived at the hangar at 1420 local time, and, about two minutes later, pulled the airplane from the hangar. The first officer arrived while the airplane was being fueled outside the hangar. Neither pilot conducted a complete preflight inspection, the report said.

After the engines were started, the airplane, being operated as a sub-charter for another carrier based at another location at the airport, was taxied to the other location to pick up the passengers.

"Before the flight, an oil puddle was discovered under the left engine after the aircraft was taxied to pick up the passengers," the report said. "The crew was aware of this oil, but no further action was taken to determine the source. Overfilling the oil reservoir will cause oil to vent, but it could not be determined whether the captain thought that this was the cause."

After a passenger briefing, the airplane took off on an instrument flight rules flight plan to Kelowna, British Columbia, about 175 nm (324 km) east. The captain was the pilot flying as the airplane climbed to 16,000 ft above sea level, and the first 15 minutes of the flight were described as uneventful. Then the crew determined that oil was leaking from the left engine. They requested and received clearance to return to CYVR, and then turned toward the airport and began the descent (Figure 1).

About five minutes later, they conducted the "Abnormal" checklist for low oil pressure, agreeing that they would fly the airplane normally "unless the oil pressure dropped below 40 pounds per square inch (psi), at which time they would follow the emergency checklist and single-engine procedures."

The crew received clearance to intercept the localizer for a visual approach to Runway 26L, and later, 3.8 nm (7.0 km) from the runway, they received clearance to land. The initial approach proceeded without incident, the report said, but the last 45 seconds of the flight were marked by an increase in crew activity.

"The flaps were lowered to 60 percent," the report added. "The ground proximity warning system (GPWS) announced the altitude above ground level in feet as '500.' The speed was announced as '105 kt,' then 'V_{REF}'[1] (99 kt) and finally 'V_{REF} minus 5.' There was a change in the propeller noise and an immediate aircraft upset. The aircraft yawed left, rolled about 80 degrees left and pitched nose-down about 50 degrees."

The airplane crashed into a roadway outside the airport perimeter fence during a gap in traffic and fire broke out. Motorists who had been stopped at traffic lights helped several passengers out of the wreckage. Aircraft rescue and firefighting personnel from a fire station 700 m (2,300 ft) away arrived at the accident site within three minutes to rescue the seventh passenger. Air traffic control notified Vancouver Airport

Flight Path

asl = Above sea level

Source: Vancouver Airport Authority, Transportation Safety Board of Canada

Figure 1

Authority firefighters, who arrived one minute later and worked with the local firefighters to extinguish the flames and pull the pilots from the wreckage.

Everyone in the airplane was taken by ambulance to a hospital; three people on the ground — two people in a car that was struck by the airplane and one cyclist who was almost hit — were examined by medical personnel at the scene and released.

13,876 Flight Hours

The captain of the accident airplane had an airline transport pilot license and 13,876 flight hours, including 7,200 hours in twin-engine turboprops similar to the accident airplane and 978 hours in type. In the 90 days before the accident, he had flown 184 hours, including 46 hours in type. Before reporting for duty, two hours before the accident, he had been off duty for 38 hours.

The first officer, with a commercial pilot license and 1,316 flight hours, had 85 hours in type; in the 90 days before the accident, he had flown 192 hours, including 65 hours in type. He also reported for duty two hours before the accident, after 20 hours off duty.

The accident airplane was manufactured in 1970 and had accumulated 26,993 hours of total airframe time. It was equipped with two Pratt & Whitney Canada (P&WC) PT6A-28 engines and had been certified, equipped and maintained as specified by relevant regulations and procedures.

However, the airplane had never been modified according to P&WC Service Bulletin (SB) 1506R2 — issued in 1995 and re-issued in 2010 — which recommended action to limit oil loss "in the event that the oil-filler cap is not properly installed in the locked position." Compliance with the SB was not required by regulations.

The SB called for replacing the oil-filler tube with an oil-filler-tube valve assembly that had a ball-type check valve and replacing the oil quantity gauge with a "new or modified shortened oil-quantity gauge," the report said.

Although Transport Canada (TC) did not elevate the SB's recommendations to the mandatory force of an airworthiness directive, the agency issued Service Difficulty Advisory AV-2006-08 in 2006, to recommend that operators comply with P&WC service information letters and SBs, "and following engine oil servicing, always double check to ensure that oil caps are properly fastened."

NT Air had experienced no known problems involving unsecured oil-reservoir caps and did not implement the modification outlined in the SB or take alternative actions, the report said.

© Ben Nelms/Reuters

Emergency personnel gather near the wreckage of a Northern Thunderbird Air King Air 100 that crashed as the pilots attempted to return to Vancouver International Airport.

Engine Oil System

Each of the accident airplane's engines had an oil reservoir with a capacity of 8.7 L (9.2 qt). Normally, there is a negligible amount of oil venting; if the oil reservoir has been overfilled, however, surplus oil leaks from the vent when the engine is operating.

Engine-oil pressure is maintained as long as there is oil in the system, but engine-oil temperature may increase, especially if the amount of engine oil decreases while the engine load is high, the report said, adding that temperature indications are not reliable if the oil has been depleted.

A post-accident examination of the wreckage found that the cap on the left engine oil reservoir was unlatched. Accident investigators found 0.8 L (0.8 qt) of oil in the left oil reservoir and about 7 L (7 qt) of oil in the right reservoir.

Founded in 1971

NT Air has operated since 1971 in British Columbia and the Yukon. At the time of the accident, the company had a fleet of Beechcraft 1900s, King Airs and Cessna Caravans that were used for scheduled flights, charter service, medical evacuations and corporate and cargo flights.

NT Air is an approved aircraft maintenance organization and performs maintenance on its own aircraft. Under maintenance-control procedures approved by TC, NT Air's director of maintenance and quality manager review all SBs to determine their applicability to company aircraft. (As noted, implementation of applicable ADs is mandatory.)

"The overnight maintenance inspection checklists include 'check engine oil level' as one of their tasks," the report said. "This task implies removing the oil reservoir cap and replacing it; however, there is no check for verifying the security of the cap. The cap is difficult to see when closing the engine cowling.

"The overnight inspection of the occurrence aircraft was performed by an apprentice aircraft maintenance engineer (AAME) … [who] had been working at NT Air for about six months and had carried out several hundred similar overnight inspections before without issue. The AAME was authorized to carry out this inspection without supervision; however, a licensed aircraft maintenance engineer (AME) was required to sign — and did sign — that the inspection was completed."

Although it was not required, NT Air had implemented a safety management system (SMS); it had not been approved by TC.

"A fully functioning safety management process would be expected to rigorously challenge and validate any underlying assumptions and safety risks," the report said. "The company's SMS had not identified company occurrences of oil reservoir caps being left unlatched. The SB had not been assessed by the company's SMS, nor had the company's SMS identified any other mitigation of the risks associated with unlatched oil-reservoir caps."

The company's standard operating procedures (SOPs) suggest that the captain delegate the preflight inspection of the airplane. Nevertheless, the captain typically completed the preflight inspection, the report said, adding that in this case, the preflight inspection was incomplete.

The SOPs include no additional discussion of the inspection, but the pilot's operating manual, issued by the manufacturer, includes this item among its preflight procedures: "Engine Oil — CHECK QUANTITY, CAP SECURE."

The NT Air *Quick Reference Handbook* did not discuss engine oil leaks but its "Abnormal" checklist and "Emergency" checklist both referred to low oil pressure. In both cases, the checklists "suggest reducing power," but neither "cautions the pilot about the effect on the minimum speed to be maintained when the engine power is reduced, the propeller is not feathered and asymmetrical thrust is applied," the report said. The "Emergency" checklist, however, includes a statement that, during single-engine operations, all V_{REF} speeds should be increased by 10 kt.

The company's SOPs discuss the need for a stabilized approach after the airplane passes the final approach fix, as well as the criteria for a missed approach. However, the SOPs described limits that "would not trigger a missed approach until the aircraft has already exceeded the instrument approach standards set out in the preceding paragraphs of the SOPs," the report said. In addition, the SOPs "lacked clear direction on how the aircraft was to be configured for the last 500 ft, or what to do if an approach is still unstable when 500 ft is reached, specifically in an abnormal situation."

The report also noted that all training scenarios for single-engine operations make clear that "pilots have to feather the propeller. … All actions and data then assume that the failed engine propeller is feathered."

During the accident flight, however, with the left engine at idle and the propeller not feathered, airspeed dropped below V_{REF} and the pilots were unable to maintain control.

After the accident, NT Air issued an "online training center" communication warning pilots that specific low-power settings "may produce undesirable or uncontrollable yaw as airspeed decreases" and an SOP bulletin prescribing an airspeed of 130 kt until a King Air 100 is in final landing configuration, on final approach slope, the pilots have the airport in sight and the pilot flying says "target V_{REF}," the report said.

In addition, the report said that TC is working with the engine manufacturer "to improve implementation of … P&WC SB no. 1506R2 to mitigate the consequences of an unsecured oil filler cap. The implementation may include mandating the subject design change for this and other engines."

This article is based on TSB Aviation Investigation Report A11P0149, "Loss of Control and Collision With Ground; Northern Thunderbird Air Inc.; Beechcraft King Air 100, C-GXRX; Vancouver International Airport, Richmond, British Columbia; 27 October 2011." The report is available at <tsb.gc.ca>.

Note

1. The report defined V_{REF} as "a landing reference speed based on the aircraft's weight and configuration … found on the approach checklist."

Flying Blind

BY WAYNE ROSENKRANS

© Sebastian Fernandez Bielkiewicz/AirTeamImages.com

Deviating from the consensus in upset prevention and recovery training risks negative outcomes.

A few times this year, amid news reports of air carrier accidents, inquiries poured into the Royal Aeronautical Society's International Committee for Aviation Training in Extended Envelopes (ICATEE). Among those inquiries were a number indicating that some training organizations might be on the verge of implementing upset prevention and recovery (UPRT) programs without full benefit of current expertise. Moreover, some operators sounded uncertain about how to recognize commercial programs that unjustifiably deviate from leading experts' consensus on how to conduct UPRT, Sunjoo Advani, chairman of ICATEE and president of International Development of Technology, told *AeroSafety World* (*ASW*) in August.

The overall interest indicates that awareness of this committee's work since May 2009 in UPRT apparently has permeated the aviation industry. Updates on imminent global adoption of recommendations to mitigate loss of control–in flight (LOC-I) were due to be presented Sept. 25–26 in London by 40 international specialists at the society's international flight crew training conference.

Six *ASW* articles in this period of time also have cited related concerns among ICATEE members who contributed to a hard-won consensus, and the following synopsis of frequently asked questions highlights their concerns. (The paraphrased/condensed answers lack detailed source attribution, which can be found in the *ASW* articles cited, in the interest of simplification.)

Concerning just the human-factors dimension of provider selection, one ICATEE expert said, "UPRT instructors must cautiously build from the familiar to the unfamiliar to effectively bridge knowledge and experience gaps. Extensive experience shows that early focus on awareness of angle-of-attack, load, lift vector, coordination and energy management, combined with real-time feedback on the negative consequences of their mismanagement of those elements, helps trainees to gain trust and confidence in the training platform, the instructor pilot and the building-block design of the course of UPRT training.

"Teaching the fundamental concepts and core skills in a progressive, non-threatening manner enhances the trainee's situational awareness at a rate that allows knowledge, skills and abilities to be internalized — enhancing long-term retention. When effectively delivered, this initial UPRT indoctrination comprehensively prepares the pilot for type-specific UPRT differences training ideally provided by the airline in the simulator [*ASW,* 10/11, p. 36]."

How significant is the risk of negative training in UPRT?

ICATEE members from airlines, civil aviation authorities, aircraft manufacturers, academia and the International Civil Aviation Organization (ICAO) for four years have warned consistently that negative training could have devastating consequences for any operator. Two often-voiced concerns have focused on risks from inconsistent UPRT adoption among civil aviation authorities and from failure of operators to strictly adhere to detailed practices derived from the consensus of international specialists.

How have some UPRT programs deviated from model practices?

One critical concern has been evidence of providers promoting training in a flight simulation training device (FSTD) unsuitable for the task. On-aircraft training, too, can lead to negative training if the difference in behavior and control capabilities of a light aircraft and a transport heavy jet aircraft is not recognized. Another concern is failure to change FSTD modeling to match additional training maneuvers, or to detect that new maneuvers will take the pilot outside the FSTD's normal training envelope.

What are ICATEE's concerns about the potential for flawed UPRT?

During its formation, the committee concluded that training mitigations for LOC–I were not as effective as providers had assumed, and were ineffective or incorrect in some cases despite the best intentions (*ASW,* 6/11, p. 24). Training then had been focusing on unusual attitudes rather than the full range of upsets, and limitations in capabilities of FSTDs were not being considered adequately.

Now, one often-expressed concern is resistance among operators to changing their practices, and an equal concern is willingness of some to adopt UPRT but with a misguided or an inadequately informed grasp of the broad concepts, the FSTD/aerodynamics aspects or the effects of outdated training techniques on pilots. ICATEE has stated that safety is enhanced when training is integrated through proper academics, aircraft-based training and simulator-based training — and that the key element to that process is the qualified instructor.

© Boeing

What are key characteristics of the best UPRT programs?

A few examples are detailed specification of the training objective of each proposed Level D (full-motion) FSTD maneuver, the appropriate method to provide corresponding training and a quality-controlled delivery process. Other attributes are scenario-based, crew-oriented training — adding unexpected conditions, a realistic startle factor — rather than exclusively maneuver-based training. Training providers also will have rectified errors of the past, especially the discredited stall recovery technique that begins with selecting full power and prioritizes minimum loss of altitude rather than immediately reducing angle-of-attack.

The g-awareness (of aircraft state in relation to standard acceleration of gravity) and accurate recovery techniques of mainstream UPRT will not cause in-flight structural breakup of a large commercial jet. G-cueing, motion-cueing, aerodynamic model limits, comprehensive feedback to FSTD instructors and pilot debriefing elements also are factored into such programs. Instructor/operator stations (IOSs) increasingly include displays of g-loading, angle-of-attack and the validated aerodynamic envelope for the airplane type.

Some airlines that voluntarily have implemented UPRT patterned after the ICATEE consensus (such as Alaska Airlines, United Airlines and UPS Air Cargo) also have openly shared their lessons learned. They are familiar, for example, with organizations operating an FSTD outside the validated envelope, false confidence about the actual level of FSTD realism during UPRT because of lack of feedback about the simulation fidelity, high-risk improvisations by pilots or instructors of so-called "alternative control strategies" and the false assumption that demonstration (demo) modes are part of the validated envelope and suitable for training.

Early-adopter airlines have focused intently on standardization of UPRT training in FSTDs, partly because of the challenge of avoiding negative training. They can provide examples of trial scenarios they have abandoned as unsafe or unsuccessful. All have discarded the old assumption that manual-handling skills alone automatically translate to UPRT skills, knowing that, in reality, many upset-recovery skills are counterintuitive.

What if a provider's proposed UPRT focuses exclusively on upset recovery?

During research in 2009, ICATEE encountered many training providers treating the upset-recovery phase as the primary, or even exclusive, focus of their version of UPRT. Therefore, ICATEE calls this clearly an important component but notes that the core element of UPRT must be upset *prevention,* a broad area involving skills such as automation monitoring and crew resource management.

Experience with upset recovery training — the predecessor of UPRT — around 2000–2009 revealed pilots' inadequate knowledge about relevant aerodynamic principles and how to apply them. Therefore, the academic portion of the program alone produced a large positive effect that some interpreted as sufficient for LOC–I mitigation.

Among early-adopter airlines, some now conduct UPRT in FSTDs that represent a flight-protected airplane in a full-stall situation (*ASW,* 8/13, p. 34). Publicly described experiences have been positive, and additional experiences are scheduled to be shared at the September conference in London.

What difference do FSTD requirements make?

Imminent changes will cover aerodynamic modeling for UPRT that enables introduction of additional pilot tasks, new functions and tools for IOSs, and specification of which maneuvers should *not* be trained in an FSTD to avoid negative training. The guidance material explains FSTD UPRT for a pilot's type rating. If there is no FSTD for the airplane type, however, other LOC-I mitigations should be adopted, but operators never should allow UPRT on a transport-category airplane because of unacceptable risks.

Where does UPRT fit into the big picture of addressing LOC-I accidents?

ICAO regards pilot training as the first, and one of the most mature, mitigations among several long-term solutions (*ASW,* 7/13, p. 27). Proposed amendments to ICAO Annex 1 on pilot licensing and Annex 6 on UPRT training requirements; *Procedures for Air Navigation Services: Training (PANS-TRG);* and Doc 9625, *Manual of Criteria for the Qualification of Flight Simulation Training Devices, Volume I — Aeroplanes* have been undergoing an adoption and approval process aligning them with new UPRT standards. Operators and providers already should be taking steps to be ready as these pieces fall into place.

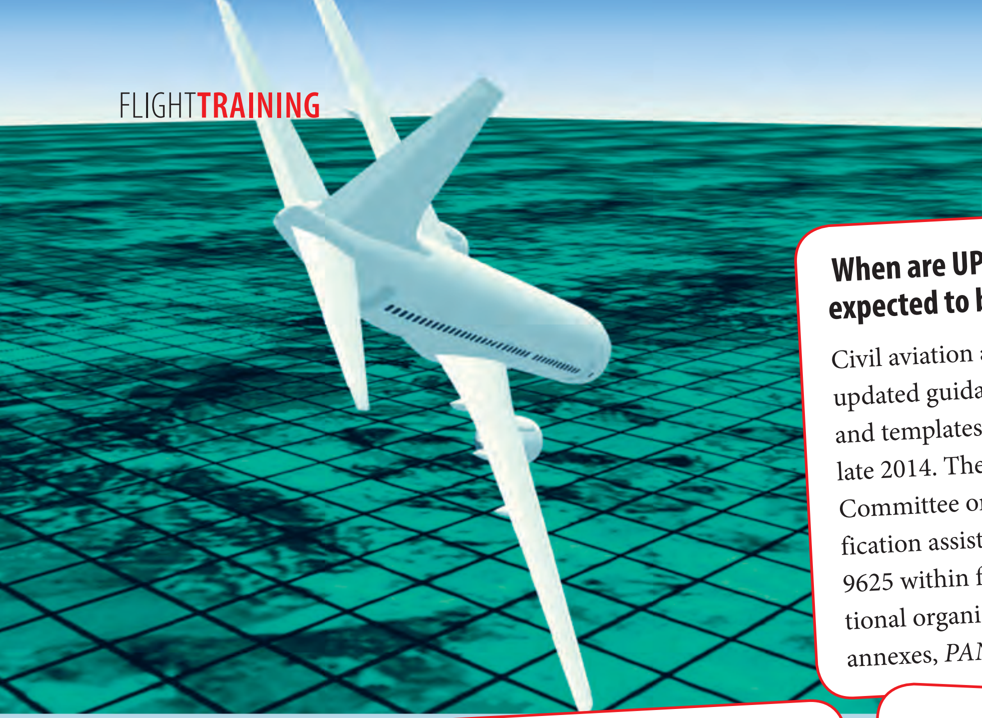
What if a consultant emphasizes only the academic component?

ICATEE and other experts consider industry-approved, Web-based and tablet-based training tools welcome advances in academic resources. From the outset of LOC-I intervention development, however, they have emphasized that academic preparation of pilots and instructors offers only limited LOC-I mitigation if used as a standalone intervention. Academics combined with practical, hands-on experience under a quality-assured program can have significant and lasting UPRT skill–development benefits.

How can I get up to speed today on the mainstream framework of UPRT?

ICAO's official philosophy of UPRT, influenced by the ICATEE work, will appear in the revised *PANS-TRG.* For example, the competency-based approach and the scope of expected pilot knowledge are spelled out in detail in the draft. A set of upset recovery techniques, FSTD training scenarios endorsed by relevant aircraft manufacturers, and the meaning and role of "approved training organization" overseen by the civil aviation authority also are included.

Other changes cover the regulatory templates for states and expected state regulatory oversight, single-pilot UPRT on an airplane, multi-crew pilot license UPRT in a generic FSTD and type-specific UPRT in a type-specific FSTD. Also covered are instructor qualification for on-airplane UPRT and FSTD UPRT.



When are UPRT requirements and guidance expected to be adopted?

Civil aviation authorities likely will reap the benefits of updated guidance on best practices by the end of 2013 and templates for changing regulatory requirements by late 2014. The Royal Aeronautical Society's International Committee on Flight Simulation Training Device Qualification assisted ICAO to complete the update to Doc 9625 within first quarter of 2014. States and international organizations were to finalize their inputs to the annexes, *PANS-TRG* and Doc 9625 by November 2013.

How can an operator judge an FSTD that a training provider proposes?

Training providers on the leading edge of UPRT often are experts, or, at a minimum, are well conversant with the imminent changes in ICAO Doc 9625 and other critical factors. Some of the ground to cover in this conversation would be displaying color-coded aerodynamic diagrams in IOS alongside replays of the pilot's control inputs with animation software. These advanced instructional tools have been designed to allow instructors to provide more accurate situational awareness and UPRT feedback to pilots while avoiding negative training.

What if we disagree that on-aircraft training is appropriate for pilots at some career levels?

ICATEE issued detailed advice based on extensive deliberation and consultation with the airline industry. Exposure of pilots to the actual threat environment helps to develop habitual responses to incipient conditions and confidence in their ability to respond correctly to upset situations (*ASW*, 6/12, p. 16). Every UPRT event recommended for initial and recurrent pilot training has a dedicated instructor manual linked to comprehensive instructor pilot standardization and qualification.

All-attitude, all-envelope airplanes have proven to be an ideal platform for an approved UPRT instructor to provide the psychological component, the physiological component, g-awareness and an accurate recovery environment. However, about 90 percent of the skills can be learned in correctly equipped Level D FSTDs.

What else does ICATEE recommend for UPRT background?

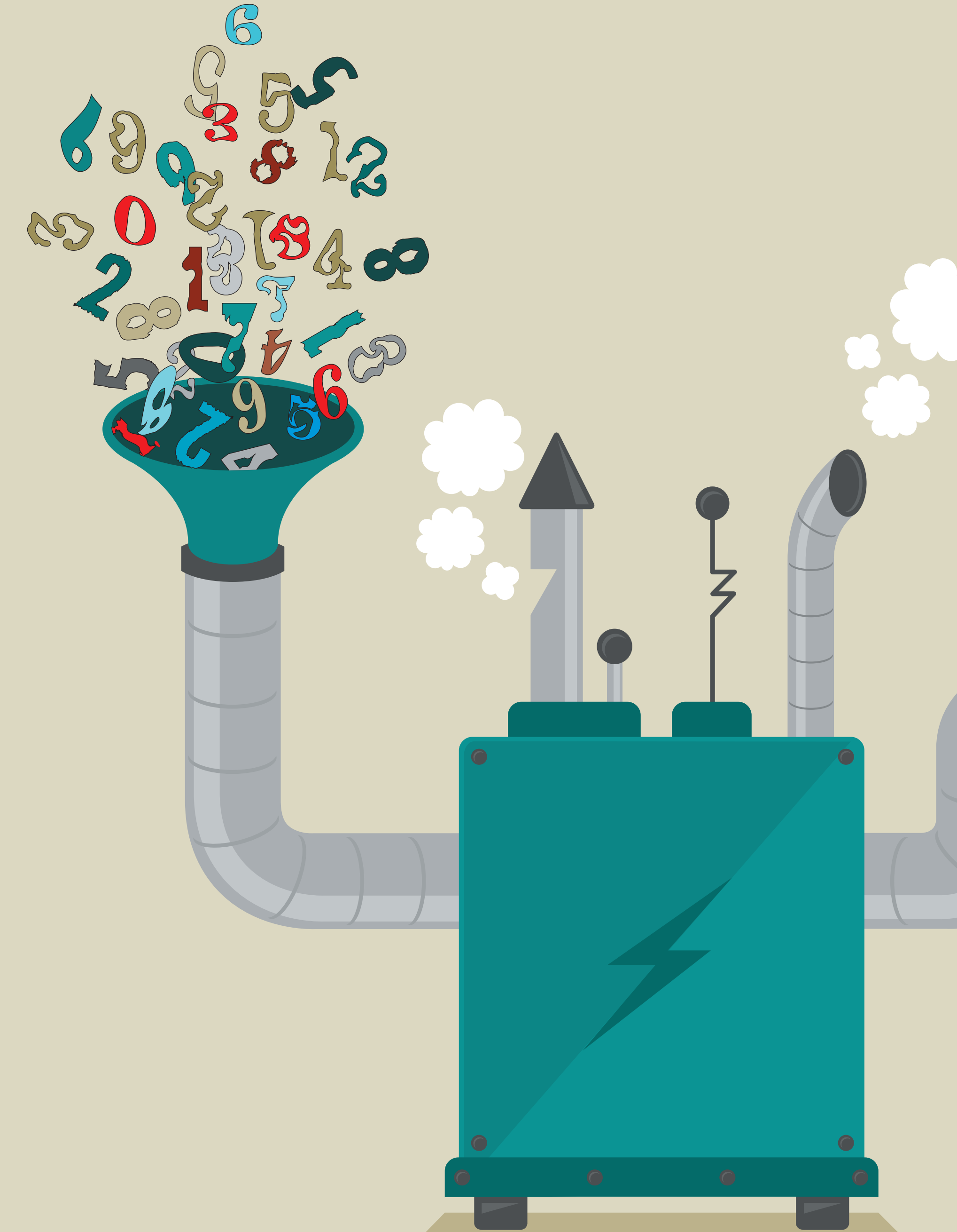
ICAO's review process for adopting the ICATEE-drafted *Manual on Aeroplane Upset Prevention and Recovery* was completed in mid-2013 and is on a fast track toward adoption by year-end. Meanwhile, among must-have resources for airlines contemplating or updating upset recovery training is the November 2008 release of Revision 2 of the *Airplane Upset Recovery Training Aid* — including a "High Altitude Operations" supplement (*ASW*, 2/09, p. 34).

The supplement focuses on known safety issues in the high altitude environment — above Flight Level 250 (approximately 25,000 ft) — and particularly on knowledge gaps identified among pilots who routinely operate there. Although this product primarily focuses on large aircraft, many of the same aerodynamic principles apply to smaller swept-wing turbine aircraft. It remains available at no cost at <flightsafety.org/archives-and-resources/airplane-upset-recovery-training-aid>.

As an operator, how can I find a recognized UPRT expert?

Now that ICATEE has submitted its products to ICAO, some of its individual members or members' organizations remain available to advise on UPRT implementation by other organizations.

Airplane Upset Recovery Training Aid



Data

Data are important to safety, but their quality and quantity must be managed with care.

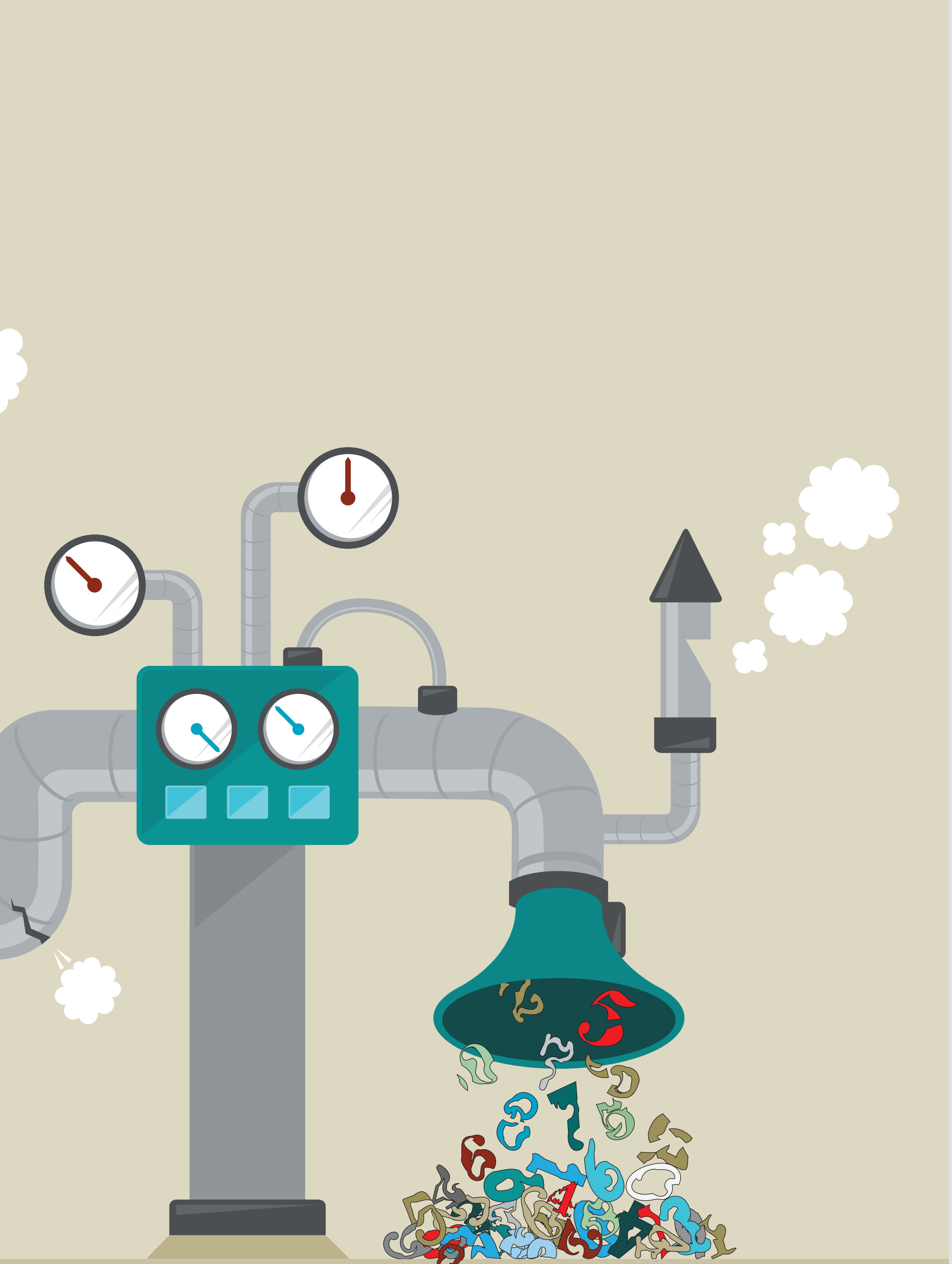
Recommendations on safety management systems (SMS) typically address the requirements of implementation but less often the challenges associated with data collection. Inadequate quality of data — "garbage in, garbage out" (GIGO) — can be a problem, as well as too many — or too few — data — which can yield the same net effect, the inability to adequately analyze, understand and act on the organization's safety deficiencies and objectives.

An organization's SMS can be thought of as a data hub, with programs that feed into the SMS as data spokes. Hub-and-spoke data can be derived from a multitude of sources such as flight operational quality assurance, a fatigue risk management system, an aviation safety action program, a line operations safety audit (LOSA), and the analytical results generated by an SMS.

Sometimes all these data become so difficult to manage that their intended benefit is never fully realized. A number of problems may manifest during data collection. The first, GIGO, later can make data interpretation problematic because of a low or undetermined level of confidence. Second, an overabundance of data in relation to the time and tools available can place a severe burden on a safety manager trying to sort through it all and have it make any sense. Effectively, there is so much information that the safety manager may suffer from what I call "data delirium." Conversely, the third problem — a scarcity of data — may not allow management to make actionable decisions because it is unclear whether the data represent reality. This article will address each of these potential problems and offer practical solutions.

Data Basics

Data can be obtained quantitatively (by focusing on raw numbers), qualitatively (by interpreting text in narrative reports) or a combination of both. Quantitative data are relatively easy to analyze using descriptive and inferential statistics. An example of descriptive analysis of quantitative data is dividing total accidents by a number representing risk exposure (such as total departures) to determine, for example, the accident rate per 100,000 departures in a particular geographic region. This type of data provides useful metrics for



Delirium

BY ROBERT I. BARON

comparisons but does not tell us much about the actual accidents.

Qualitative analysis of texts, though more unwieldy, time-consuming and potentially subjective, can provide a much more robust understanding of a construct within the accidents under study. An example of qualitative data use is a brainstorming session directed at identifying airside hazards (e.g., producing a preliminary hazard list). A combination of both methods will offer a much more complete picture of the construct(s) under study.

One data collection instrument that incorporates both methods is the survey. Surveys often use short statements that collect data quantitatively through the use of a Likert scale (a scale typically ranging from 1 to 5, each number representing the strength of the respondent's opinion or attitude toward the corresponding statement). For each statement, there also may be a text area where qualitative data can be collected. This allows the respondent not only to provide the numerical score for an opinion or attitude about each statement, but also to expound on each numerical response with a short explanation.

Regardless of how data are collected, the GIGO principle must be considered for quality control. One of the biggest challenges of collecting data is assuring that the data are valid (measuring what they purport to be measuring) and reliable (consistent when measuring the same thing). Scientific research methodology applied to aviation safety shares theories, statistical concepts and specialized terminology with other fields. Plenty of courses, websites and college textbooks offer further explanations.

Here are a few examples of how GIGO might affect your data. In the first example, let us say an airline conducts a LOSA (a spoke in the SMS hub). LOSA data collection consists of trained observers, riding in the cockpit jumpseat, who fill out quantitative and qualitative checklists related to observed crew performance. Although an observation of every single flight would be highly beneficial, it would obviously not be very practical. Thus, LOSA observations require a series of flights as a sample of the entire flight operation.

A sample should, in theory, very closely resemble the overall flight operation including the flights not

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machine: © sammyc/iStockphoto

observed. But what if the sample has been designed incorrectly and therefore does not truly represent the entire flight operation, for example, if the sample is too small? What if the observers are not properly trained or calibrated — *calibration* meaning they have standardized criteria so that there is inter-rater reliability among observers when recording threats, errors and undesired aircraft states. What if the observations are heavily skewed toward one particular fleet or route? Once the LOSA is completed, does the airline have a valid and reliable picture of the entire operation? Probably not.

LOSA data, like any kind of data with safety implications, may require a significant allocation of financial and human resources. If management does not believe your data, it is unlikely that you will be approved for those resources.

For the second example, let us use a survey to understand the GIGO principle. The safety manager at a major airport wants to measure employee morale. Morale can have a very significant impact on safety, because employees with low morale may not be motivated to work as safely as possible. So the safety manager creates a survey using statements that she feels would adequately measure employee attitudes about morale. The survey presents five statements and incorporates a Likert scale (1 — strongly agree, 2 — agree, 3 — neutral, 4 — disagree, 5 — strongly disagree). The statements are worded as follows:

1. Management is never on the same sheet of paper.
2. Low morale seems to be the norm around here.
3. I think low morale is correlated with low self-esteem.
4. Everyone I work with is unhappy most of the time.
5. They don't pay me enough to motivate me.

The safety manager emails a survey link to all airport employees, including contractors (approximately 1,200 total people) and makes the survey available online for 14 days. Upon completion of the data collection period, there are 100 responses and the safety manager emphatically declares that the results are conclusive: Employees are suffering from low morale. But could the results have been affected by the GIGO principle? Yes, and here are a few reasons why:

Although short surveys are well received, these five statements do not adequately address the full dimensions of a construct such as morale. The statements are not based on an accepted definition of the construct being studied, but are based on the safety manager's own definition of morale. A review of the extant research literature should be conducted to operationally define the research constructs (or variables).

The statements include a *neutral* point. There are mixed opinions about the use of a neutral point. The problem is that respondents use the neutral point as a "safe zone" if they are uncomfortable expressing their genuine feelings, even anonymously. Too many of these neutral answers can work against the purpose of the survey, which is to measure attitudes and opinions about the construct being studied. Some argue that everyone really has an opinion, even if he or she would prefer not to reveal it to the researcher.

All of the statements are negatively worded. When all statements have a positive or negative value, it can influence respondents to choose the same response for each. This is called the "straight-line effect."

The actual wording of some of the statements is problematic:

- **Management is never on the same sheet of paper.** Ambiguous. Does this mean lack of agreement or coordination among management personnel, or between management and line employees? Do all respondents understand the expression "on the same sheet of paper"?
- **I think low morale is correlated with low self-esteem.** Confusing. The respondent may not know how to define *low morale* and *low self-esteem*. Additionally, some respondents may not understand the definition of *correlated.* This can become more problematic when English is not the respondent's first language.
- **Everyone I work with is unhappy most of the time.** Double-barrel statement involving *two* criteria. One could be true, the other not. The two problematic words are *everyone* and *most.*
- **They don't pay me enough to motivate me.** A leading question that could suggest a particular answer. Also, this statement has a strong bias, and the word *they* can be ambiguous.

There are problems with the methodology, including:

- **The inclusion of contractors.** Contractors may not be airport employees and thus may come from a very different culture at their own organizations. Contractor responses can skew the results of the resident airport's own personnel.

- **The time allocated for data collection.** Two weeks is insufficient to collect a large number of responses. A better collection period would have been four weeks. After two weeks, a reminder email should have been sent out.
- **Low response rate.** Although response rates for surveys are typically low (in the 20–30 percent range), 8 percent was exceptionally low. This response rate can have implications for the sample, as was discussed earlier. Does this sample adequately represent the other 92 percent of the airport population? Was there something different about the employees who participated in the survey compared with those who did not? Are the results statistically significant (i.e., capable of being extrapolated to the larger population)? Would the results have been different if all 1,200 people had answered the survey?

This was not a very well developed survey and its distribution was problematic (garbage in). Thus, the safety manager may have come to a false conclusion based on the results (garbage out). It would be hard to sell to management on allocating resources to the problem.

Data Excess

An overabundance of data can become so burdensome that the safety manager may suffer from data delirium. Some safety managers have complained that, while their SMS is a welcome hub for their company's safety processes, paradoxically, sometimes they do not know what to do with all their data. The problem may not be poor data management, but rather a shortage of human resources. Or perhaps the staffing is adequate, but there is so much irrelevant data that it is tying up those limited resources. Whatever the case, I offer the following recommendations.

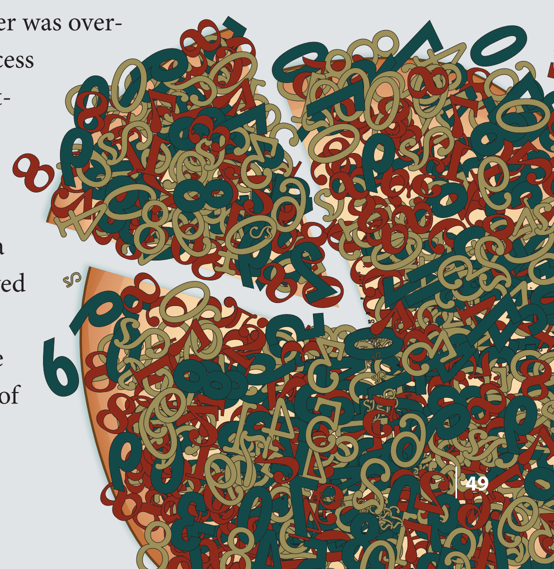
If the problem is a shortage of human resources, the obvious solution would be to hire more people to assist with data analysis. That may not be feasible these days, where lean is the corporate *modus operandi*. If there is a legitimate need for additional help, consider a temporary service or a college student intern. Interns are invaluable resources, especially if their study has included research methods and data analysis.

If the staffing is sufficient, but an overabundance of irrelevant data is the issue, then it would be worth taking a look at all the data sources and considering the use of data filters. Which incoming data are relevant and which are not? Prioritize the most-need-to-know data. This does not mean that the other data are irrelevant or useless, just that they will be lower priority.

Was there something different about the employees who participated in the survey compared with those who did not?

Are you simply collecting too much data? As a qualitative example, there was a safety manager at an airline who insisted on posting on a bulletin board U.S. National Transportation Safety Board (NTSB) accident reports for operationally similar airlines and environments. That seemed a great idea. However, what he posted was the entire accident report (sometimes hundreds of pages). Pilots are busy. You cannot expect them to read through a complete accident report. This is a case of too much data. A better approach would be to post the NTSB accident summary, a "Causal Factors" story from *AeroSafety World* or, if those are not available, only the most important points, especially causal factors.

Data overload also can be quantitative *or* qualitative. For example, as part of its new SMS, an airline began collecting narrative hazard reports from its large workforce. Before the SMS existed, there were few, if any, reports submitted. For the first year of the SMS, the airline received only 26 hazard reports. Due to the low reporting, the airline, in the second year, decided to put much more emphasis on hazard reporting. In the second year, there was a precipitous spike in reports (267). The safety manger was overwhelmed and was not able to process all the reports, and a large percentage of those reports contained "sneak peek" information — an inside look at the hazards. In this example, the quantitative data were the number of reports received (measurable and comparable), while the qualitative data were the sneak peeks (textual descriptions of



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hazards). Because of this data overload, reporters quickly lost trust in the system because their reports were not acknowledged. Hence, managing hazard reports should be given high priority.

Data Shortage

Many times, safety managers and upper management do not see eye to eye about safety expenditures. It is frustrating when upper management disapproves requests to spend financial resources for a safety improvement that you know is needed. This may be due, in part, to the safety manager not having cost-benefit justification for requests. It happens all the time, and because of this, safety may have to be thought of as a "case" or "argument," to persuade management to approve the allocation. You are misled if you think you will be able to walk into the CEO's office and get a quick sign-off on your new safety equipment request simply because you are a good salesperson. The question, then, is why might an astute safety manager lack the necessary data to present a logical case to management?

First, it may be the result of simply not knowing how to mine data. Choosing the right methodology to collect and analyze data (while avoiding GIGO) is imperative. To start, you must ask yourself what type of data you need to collect. Will they be numbers (quantitative), words (qualitative), or both? Will you be collecting data from the entire workforce or a sample? What types of data collection instrument will be used (questionnaires, surveys, test scores, interviews, focus groups, etc.)?

Once the data are collected, how will they be analyzed? Will your quantitative analysis use basic descriptive statistics (which represent a specific study group only) or inferential statistics (which can be generalized to the broader population)? What type of software will you use for the analysis? A standard spreadsheet program will work fine in most cases, but for more complex statistical analyses, you may need a program with more specialized functions.

For qualitative data, how will you sort through the hundreds or thousands of pages of text? Some software programs simplify this process by categorizing responses with keywords. Data collection is a structured process that requires good planning, a proven methodology and effective time management to yield valid results.

Second, the safety manager may not think that data need to be mined. Quite often, people use unstructured, personal observations as data sources. They develop a hunch about something and then try to sell it to management as a verified issue. While this method makes data collection simple, it has little value.

For example, the other day, a ramp worker at a major airport passed by a large paper cup on the apron. He noticed it but did not pick it up. Is that conclusive evidence that lack of foreign object debris awareness or a prevention problem prevails among all or many ramp personnel? Certainly not. But it does lend itself to a hypothesis, which can be tested, and for which the results can be presented to management as a basis for any interventions that might be required.

Third, good data may exist, but the safety manager chooses to ignore them. For example, an airport safety manager is collecting bird strike data as part of a new wildlife risk mitigation program. The manager is comparing bird strike data from before the implementation of the mitigation program (pre-measure) with data from after the implementation (post-measure). However, the data are not incorporated with study results (or data) from other, similar airports that have implemented a similar program. External data are very important not only for reference and comparison but also for benchmarking purposes. Think of it in two ways, "How are we doing?" and "How are we doing compared with other airports?" Use safety metrics to set objectives, goals and targets. Do not ignore relevant, easily obtainable data.

Data delirium can be treated, and the treatment is usually successful!

Robert I. Baron, Ph.D., is president and chief consultant of The Aviation Consulting Group. He has more than 25 years of experience in the aviation industry. His specializations include human factors, SMS, crew resource management and LOSA training/program development for aviation organizations worldwide.

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BY LINDA WERFELMAN

Mixed Results

Fewer commercial jets crashed in 2012, but associated fatalities soared.

Accidents involving Western-built commercial jets worldwide decreased 17 percent in 2012 — 30 crashes (Table 1) compared with 36 recorded in 2011 — but the 281 on-board fatalities recorded in 2012 represented a 61 percent increase, according to data from Boeing Commercial Airplanes.[1,2]

In its annual *Statistical Summary of Commercial Jet Airplane Accidents*, published in August, Boeing's data showed that five of the 30 accidents involved fatalities. Of these, two crashes resulted in on-board and external fatalities and one crash killed everyone in the airplane and no one on the ground. In two other crashes, everyone in the airplane survived, but fatalities were recorded on the ground.

Four of the five fatal crashes were classified as *major* accidents, which Boeing defines as an accident that meets any one of three conditions: "The airplane was destroyed, or there were multiple fatalities, or there was one fatality and the airplane was substantially damaged."

In a broader time frame, the data showed that there were 407 accidents, including 75 fatal accidents, from 2003 through 2012 (Table 2, p. 54). In comparison, the report released by Boeing in 2012 showed that 404 accidents, including 79 fatal accidents, had occurred from 2002 through 2011. On-board fatalities numbered 4,269 during the 2003–2012 period and 4,547 from 2002 through 2011.

The data also showed 173 *hull loss* accidents from 2003 through 2012, compared with 181 in the 2002–2011 period. Boeing defines a hull loss as an airplane that is "totally destroyed or damaged and not repaired."[3]

Since Boeing began compiling data in 1959, it has recorded 1,828 accidents, including 608 fatal accidents (33 percent of the total) and 935 hull loss accidents (Figure 1, p. 54). Of these, 717 accidents, including 26 fatal accidents, have resulted in substantial damage to airplanes.[4]

Using the standardized taxonomy developed by the U.S. Commercial Aviation Safety Team/International Civil Aviation Organization (CAST/ICAO),[5] Boeing data showed that loss of control–in flight (LOC-I) was the most frequent cause of accidents and fatalities in 2003–2012 (Figure 2, p. 55).

Eighteen of the 75 accidents recorded in 2003–2012 (24 percent) were classified as

2012 Airplane Accidents, Worldwide Commercial Jet Fleet

Event Date	Airline	Model	Type of Operation	Accident Location	Phase of Flight	Event Description	Damage Category	On-board Fatalities/ Occupants (External Fatalities)
Jan. 24	Swiftair	MD-83	1	Kandahar, Afghanistan	Landing	Right wing damaged; no injuries	Substantial	
Feb. 5	All Nippon Airways	A320	1	Sendai, Japan	Go-around	Tail strike; no injuries	Substantial	
Feb. 14	easyJet	A319	1	Luton, United Kingdom	Landing	Hard landing; no injuries	Substantial	
Feb. 27	Shuttle America	EMB 170	1	Newark, U.S.	Landing	Nose landing gear not fully extended; no injuries.	Substantial	
Feb. 28	Hi Fly	A340	3	Darwin, Australia	Landing	Hard landing; no injuries	Substantial	
March 12	Air India	A319	1	Mumbai, India	Go-around	Tail strike; no injuries	Substantial	
March 31	Japan Airlines	777-200	1	Tokyo	Go-around	Tail strike; no injuries	Substantial	
April 22	Bhoja Air	737-200	1	Islamabad, Pakistan	Final approach	Crashed short of runway	Destroyed*	127/127(0)
April 22	Shaheen Air International	737-400	1	Karachi, Pakistan	Landing	Landing gear collapsed; no injuries	Substantial	
May 1	Saudi Arabian Airlines	A300-600	4	Jeddah, Saudi Arabia	Landing	Nose landing gear retracted; no injuries	Substantial	
May 6	Niki	A321	1	Vienna, Austria	Load/ Unload	Jetway became entangled with the airplane passenger door; one serious injury		
June 1	Sriwijaya Air	737-400	1	Pontianak, Indonesia	Landing	Runway veer-off; no injuries	Substantial	
June 2	Allied Air Limited	727-200	2	Accra, Ghana	Landing	Runway overrun	Destroyed*	0/4(12)
June 3	Dana Airlines	MD-83	1	(near) Lagos, Nigeria	Final approach	No engine response to crew input, airplane crashed in populated area	Destroyed*	153/153(10)
June 6	EgyptAir	A320	1	Nairobi, Kenya	Landing	Runway veer-off; no injuries	Substantial	
June 20	All Nippon Airways	767-300	1	Tokyo	Landing	Hard landing; no injuries	Substantial	
July 18	Sky Airline	737-200	1	La Serena, Chile	Landing	Wing tip strike and rejected landing, normal landing at alternate airport; no injuries	Substantial	
Aug. 17	Mandarin Airlines	EMB 190	1	Makung, Taiwan	Landing	Runway overrun; no injuries	Substantial	
Aug. 24	Aserca Airlines	MD-82	1	Santo Domingo, Venezuela	Landing	Burst tires, runway veer-off; no injuries	Substantial	
Aug. 29	Vueling Airlines	A320	1	Berlin	Landing	Tail strike; hard landing; no injuries	Substantial	
Sept. 20	SyrianAir	A320	1	(near) Duma, Syria	Climb	Collision with military helicopter	Substantial	0/156(2)
Sept. 25	Air Astana	A320	1	Istanbul, Turkey	Landing	Tail strike; no injuries	Substantial	
Oct. 13	Centurion Air Cargo	MD-11-F	2	São Paulo, Brazil	Landing	Left main landing gear collapse; no injuries.	Substantial	
Oct. 14	Corendon Airlines	737-800	1	Antalya, Turkey	Taxi	Evacuation because of fire during pushback; serious and minor injuries	Substantial	
Oct. 16	Brit Air	CRJ 700	1	Lorient, France	Landing	Runway overrun, wind shear; no injuries	Substantial	
Oct. 19	Network Aviation	F-100	3	Nifty, Australia	Landing	Hard landing; no injuries	Substantial	
Nov. 1	Lion Air	737-400	1	Pontianak, Indonesia	Landing	Runway overrun; no injuries	Substantial	
Nov. 13	Global Aviation Leasing	MD-82	1	Johannesburg, South Africa	Takeoff	Rejected takeoff, burst tire; no injuries	Substantial	
Nov. 16	European Air Transport	A300	2	Bratislava, Slovakia	Landing	Nose landing gear collapse; no injuries	Substantial	
Dec. 25	Air Bagan	F-100	1	(near) Heho, Myanmar	Final approach	Crashed short of runway	Destroyed*	1/71(1)
	Total accidents: 30							**281 (25)**

Type of operation 1 = scheduled passenger   2 = scheduled cargo   3 = charter passenger   4 = positioning

* major accident

Source: Boeing Commercial Airplanes

Table 1

Accidents, Worldwide Commercial Jet Fleet, by Type of Operation

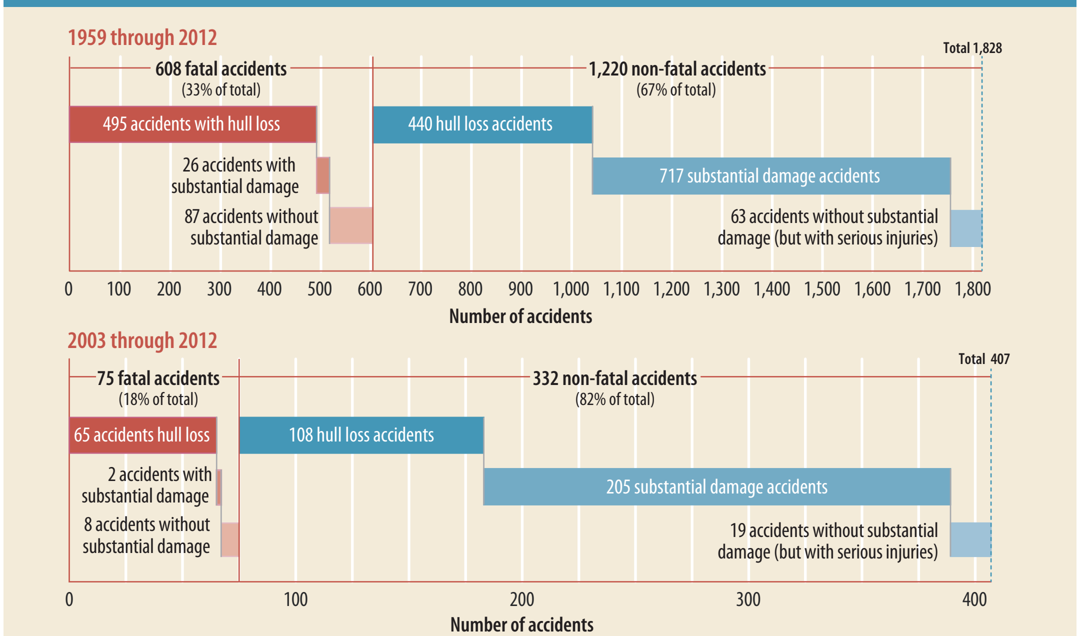
Type of operation	All Accidents 1959–2012	All Accidents 2003–2012	Fatal Accidents 1959–2012	Fatal Accidents 2003–2012	On-board Fatalities (External Fatalities)* 1959–2012	On-board Fatalities (External Fatalities)* 2003–2012	Hull Loss Accidents 1959–2012	Hull Loss Accidents 2003–2012
Passenger	1,450	323	487	59	28,834 (790)	4,210 (124)	688	123
Scheduled	1,331	298	441	56	24,708	4,194	619	116
Charter	119	25	46	3	4,126	16	69	7
Cargo	255	71	77	13	264 (342)	42 (15)	172	42
Maintenance test, ferry, positioning, training and demonstration	123	13	44	3	208 (66)	17 (0)	75	8
Totals	**1,828**	**407**	**608**	**75**	**29,306 (1,198)**	**4,269 (139)**	**935**	**173**
U.S. and Canadian operators	557	74	180	11	6,193 (381)	17 (8)	223	23
Rest of the world	1,271	333	428	64	23,113 (817)	4,252 (131)	712	150
Totals	**1,828**	**407**	**608**	**75**	**29,306 (1,198)**	**4,269 (139)**	**935**	**173**

*External fatalities include ground fatalities and fatalities on other aircraft involved, such as helicopters or small general aviation airplanes, that are excluded.

Source: Boeing Commercial Airplanes

Table 2

Accidents, by Injury and Damage, Worldwide Commercial Jet Fleet



Source: Boeing Commercial Airplanes

Figure 1

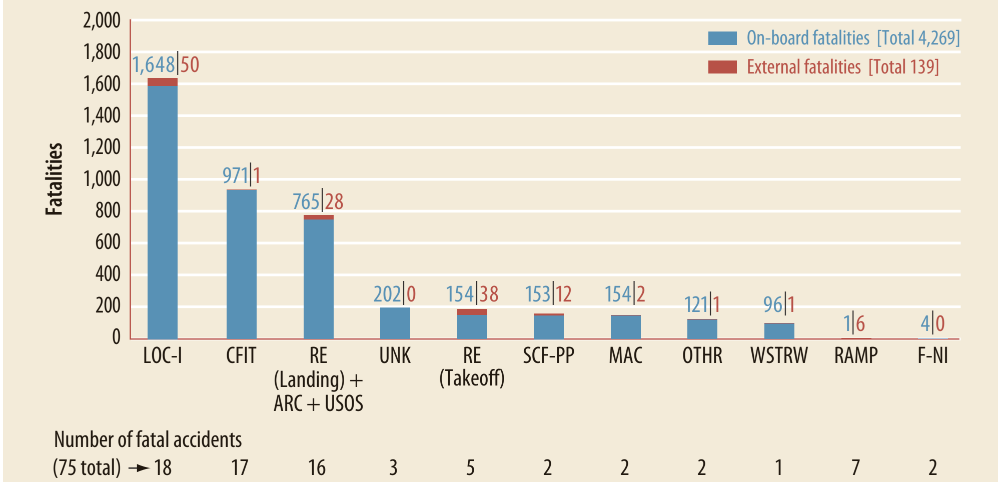
LOC-I accidents; these 18 accidents killed 1,648 people inside the airplanes — 39 percent of the total 4,269 on-board fatalities — and 50 people on the ground — 36 percent of the total 139 external fatalities. In comparison, the 18 LOC-I accidents recorded in 2002–2011 accounted for 23 percent of the 79 total accidents, 33 percent of the 4,547 total on-board fatalities and 37 percent of the 214 total external fatalities.

Controlled flight into terrain (CFIT) accounted for 17 accidents during the 10-year period from 2003–2012, along with 971 on-board fatalities (23 percent) and one external fatality (0.7 percent). During the previous 10-year period, there were 18 CFIT accidents, with 1,078 on-board fatalities (24 percent).

Runway excursions (landing) — a category that includes abnormal runway contact and undershoot/overshoot — accounted for 16 accidents (21 percent) in 2003–2012, one more than during the previous 10-year period. These accidents accounted for 765 on-board fatalities in each 10-year stretch.

Other segments of the report calculate that Western-built commercial jets worldwide have flown 635 million departures, and 1.148 million flight hours since 1959, including 24.4 million departures and 52.8 million flight hours in 2012. The accident rate, for 212 million departures during 2003–2012, was 0.82 per million departures; the fatal accident rate for the same period was 0.35 per million departures.[6]

Fatalities by CAST/ICAO Taxonomy Accident Category, Worldwide Commercial Jet Fleet, 2003–2012



CAST = U.S. Commercial Aviation Safety Team; ICAO = International Civil Aviation Organization; ARC = abnormal runway contact; CFIT = controlled flight into terrain; F-NI = fire/smoke (non-impact); LOC-I = loss of control – in flight; MAC = midair/near midair collision; OTHR = other; RAMP = ground handling; RE = runway excursion; SCF-PP = system/component failure or malfunction (powerplant); UNK = unknown or undetermined; USOS = undershoot/overshoot; WSTRW = wind shear or thunderstorm.

No accidents were noted in the following principal categories: aerodrome; abrupt maneuver; air traffic management/communications, navigation, surveillance; bird strikes; cabin safety events; evacuation; external load-related occurrences; fire/smoke (post-impact); fuel related; ground collision; icing; low altitude operations; loss of control – ground; runway incursion – animal; runway incursion – vehicle, aircraft or person; security related; system/component failure or malfunction (non-powerplant); turbulence encounter; wildlife.

Note: Principal categories are as assigned by CAST. Airplanes manufactured in the Russian Federation or the Soviet Union are excluded because of lack of operational data. Commercial airplanes used in military service are also excluded.

Source: Boeing Commercial Airplanes

Figure 2

Notes

1. Boeing Commercial Airplanes. *Statistical Summary of Commercial Jet Airplane Accidents: Worldwide Operations 1959–2012*. August 2013. <www.boeing.com/news/techissues/pdf/statsum.pdf>.

2. The data include commercial jet airplanes heavier than 60,000 lb (27,217 kg) maximum gross weight. Airplanes manufactured in the Soviet Union or the Commonwealth of Independent States are excluded because of insufficient operational data. Commercial airplanes operated in military service also are excluded.

   For purposes of this report, Boeing defines an accident as "an occurrence associated with the operation of an airplane that takes place between the time any person boards the airplane with the intention of flight and such time as all such persons have disembarked, in which the airplane sustains substantial damage, or the airplane is missing or is completely inaccessible, or death or serious injury results from being in the airplane, or direct contact with the airplane or anything attached thereto, or direct exposure to jet blast." Occurrences involving experimental test flights or hostile actions, such as sabotage or hijacking, are not included.

3. According to Boeing's definition, a *hull loss* includes events in which "the airplane is missing, or the search for the wreckage has been terminated without it being located, or the airplane is completely inaccessible."

4. Boeing defines *substantial damage* as "damage or failure which adversely affects the structural strength, performance or flight characteristics of the airplane, and which would normally require major repair or replacement of the affected component." If an airplane can be flown to a repair base within 48 hours of an accident, Boeing does not consider the damage to have been substantial.

5. The CAST/ICAO taxonomy is described in detail at <www.intlaviationstandards.org>.

6. Flights include scheduled commercial passenger and cargo operations, charter passenger and cargo operations, maintenance test, ferry, positioning, training, and demonstration flights.

Ice Binds Aileron

CRJ pilots regained full roll control after descending into warmer air.

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

Heavy Rain on Takeoff

Bombardier CRJ700. No damage. No injuries.

The CRJ was cruising at 35,000 ft during a scheduled flight with 66 passengers and four crewmembers from Oklahoma City, Oklahoma, U.S., to Chicago the morning of April 18, 2010, when the flight crew noticed that the airplane was not turning normally toward a navigation waypoint. The pilots also received a warning that the automatic flight control system was encountering excessive aileron forces.

"The captain disconnected the autopilot and attempted manual control of the ailerons," said the report by the U.S. National Transportation Safety Board (NTSB). "He found that aileron forces were excessive and response to aileron control was limited."

While responding to the control problem, the crew pulled the roll-disconnect handle, which segregates roll control, with the left control wheel controlling only the left aileron and the right control wheel controlling the right aileron.

None of the corrective actions reduced the excessive control forces or improved aileron response. The crew decided to divert the flight to Kansas City, Missouri. The CRJ was descending through about 20,000 ft when aileron control returned to normal. The airplane subsequently was landed at Kansas City without further incident.

Recorded flight data showed that the ailerons had responded normally during preflight control checks and during the departure in heavy rain. The airplane encountered ambient temperatures below freezing in instrument meteorological conditions (IMC) about 11 minutes after takeoff.

"During climb, about 20 minutes into the flight, FDR [flight data recorder] data indicates that the left aileron … was not responding properly to autopilot inputs," the report said. "The right aileron was responsive to autopilot inputs."

After the autopilot was disengaged, manual control forces up to 25 lb (11 kg) resulted in only slight movement of the interconnected ailerons. The report said that the left and right aileron control circuits remained bound after the roll-disconnect handle was pulled.

The control binding ceased when the captain applied a control wheel force of 34 lb (15 kg) for 6 seconds as the airplane descended into warmer air.

"Examination of the control system did not reveal any areas where [mechanical] binding had occurred," the report said. "However, the events of the flight were consistent with water accumulating in the aileron control system, freezing at higher altitudes and temporarily binding the aileron control system."

Two Excursions in Two Days

Boeing 737-900ERs. Minor damage. No injuries.

The combination of rubber deposits and standing water on the runway significantly reduced braking effectiveness and likely led to the landing excursions of two 737-900ERs on consecutive days at the airport in Pekanbaru, Indonesia, according to reports published recently by the country's National Transportation Safety Committee (NTSC).

Significant tailwinds also were among factors similar to both serious incidents, which occurred on February 14 and 15, 2011, on Runway 36 at Pekanbaru and involved aircraft operated by the same company.

In the first incident, the 737 was en route from Jakarta with 212 passengers and seven crewmembers. Nearing Pekanbaru, the flight crew was advised that visibility was 1 km (about 5/8 mi) in heavy rain. They entered a holding pattern until visibility increased to 3 km (2 mi), which was above the minimum required to conduct the instrument landing system (ILS) approach to Runway 36.

Although the tower controller advised the crew that surface winds were calm, they noticed that the flight management system (FMS) was showing a tailwind of 11-12 kt.

The landing proceeded without incident until the thrust reversers were stowed at 70 kt about 1,000 ft (305 m) from the end of the 7,349-ft (2,240-m) runway. "According to performance calculations, the aircraft should [have been] able to stop on the remaining runway," the report said. However, even after applying maximum manual braking, the pilot felt no significant deceleration.

The aircraft came to a stop with the right main landing gear off the side of the runway. Examination of the runway revealed areas of standing water up to 3 cm (1 in) and buildups of rubber near the departure end.

"The failure of the aircraft to stop most likely [was] due to the significant deterioration of both the runway friction and brake effectiveness as [the] result of the existing combination of rubber deposits and water spots," the report said.

The next evening, the crew of another 737-900, inbound from Medan with 226 people aboard, conducted the ILS approach and landing on Runway 36 in light rain. Although the tower controller advised that the surface winds were calm, recorded flight data showed a 15-kt tailwind. In this case, however, "the pilot did not see the wind information in the computer display unit," the report said.

Hearing the crew of a preceding aircraft report that the runway was slippery, the 737 pilot set the autobrakes to maximum. However, investigators determined that under the existing conditions, "the runway length available was not sufficient for the aircraft to stop on the runway."

Similar to the incident the day before, the landing proceeded normally until the thrust reversers were stowed. Deceleration decreased, and the pilot applied maximum manual braking and redeployed the thrust reversers. The aircraft came to a stop 12 m (39 ft) off the end of the runway.

There were no injuries in either incident, and aircraft damage was minor.

The report noted that the airport operator scheduled runway cleanings every six months, and the last one had been performed about six weeks before the incidents occurred. However, post-incident tests showed that runway skid resistance was below the minimum requirement, resulting in poor braking action when the runway was wet.

The incorrect wind velocity reports provided by the tower controllers were attributed to inaccuracies resulting from turbulence created by nearby buildings and vegetation surrounding the airport's anemometer.

Following the incidents, the airport authority repaired the runway surface to prevent accumulations of standing water and established a new requirement for "on-condition" runway cleaning.

Thrown Forward on Touchdown

Boeing 767-300. Substantial damage. No injuries.

Before departing from Cancún, Mexico, on Oct. 3, 2010, the flight crew examined a forecast indicating that visual meteorological conditions (VMC) would prevail at the estimated time of arrival at the destination, Bristol, England.

As the aircraft neared Bristol, however, the airport was reporting 1,400 m (7/8 mi) visibility in rain and mist, scattered clouds at 100 ft and a broken ceiling at 400 ft, said the report by the U.K. Air Accidents Investigation Branch (AAIB).

While conducting the ILS approach to Runway 09, the commander saw an FMS indication of a 52-kt crosswind. The tower controller advised that the surface winds were from 120 degrees at 12 kt, visibility was 3,000 m (about 2 mi) in moderate rain and that the runway was wet.

The commander recalled that there was "a surprising amount of turbulence" during the approach. He asked the copilot to monitor the FMS wind display and call out any substantial change.

The 767 was about 400 ft above the ground when the commander spotted the runway. The report noted, however, that his vision was somewhat obscured by rain on the windshield, despite use of the windshield wipers. Because of undulating terrain, the ILS glideslope cannot be used below 200 ft, and only the initial portion of the runway can be seen on approach.

The commander disengaged the autopilot and autothrottle, and hand flew the final approach. Both pilots confirmed that the precision approach path indicator (PAPI) showed that the aircraft was on the proper glide path. The report noted, however, that the proper tracking of the PAPI glide path resulted in several nuisance "GLIDESLOPE" warnings by the enhanced ground-proximity warning system.

"The commander recalled making a normal nose-up pitch input prior to touchdown and that the touchdown was unusually hard," the report said. FDR data indicated a peak vertical acceleration of 2.05 g when the aircraft touched down on the main landing gear.

"Both the commander and copilot reported that they were thrown forward during the touchdown, and that this resulted in the commander inadvertently moving the control column forward, to a nose-down position," the report said, noting that the pilots had not locked the inertia reels on their shoulder straps. "The aircraft then rapidly de-rotated before the nose gear contacted the runway."

None of the 270 people aboard the aircraft was injured during the hard landing, and the aircraft was taxied to the stand. The commander filed a hard landing report, and subsequent inspection of the 767 revealed substantial damage to forward fuselage crown skins and stringers.

Investigators found that the operator's flight monitoring system had not revealed an unusually high rate of hard landings (i.e., those involving peak vertical accelerations of 1.8 g or more) on Bristol's Runway 09. "This accident might have been avoided if the unusually high rate of hard landings by Boeing 767 aircraft on Runway 09 had triggered safety action to reduce the rate or stop operations of the type onto the runway," the report said.

Turbulence Hurts Cabin Crew

Airbus A340-300E. No damage. Two serious injuries.

Inbound from Dakar, Senegal, the A340 was about 100 nm (182 km) from the destination in Johannesburg, South Africa, the afternoon of Dec. 29, 2012, when the flight crew switched on the "Fasten Seat Belt" signs.

"The flight deck crew indicated that although it was cloudy during the descent with isolated thunderstorms visible, the weather radar did not indicate turbulence or moisture in the clouds that deemed it necessary to instruct the cabin crew to take up their seats and fasten their harnesses," said the report by the South African Accident and Incident Investigation Division.

The A340 was descending through 20,676 ft about 10 minutes later when it encountered severe turbulence. Recorded flight data indicated that the turbulence lasted about 8 seconds and caused peak vertical accelerations ranging from +1.551 g to –0.121 g.

"Two cabin crewmembers, who were busy in the rear galley of the aircraft securing trolleys and bins, suffered serious injuries due to falls and collisions with aircraft furnishings, as they were not seated nor restrained at the time," the report said. None of the other 241 people aboard the aircraft was hurt.

"One of the cabin crewmembers could not get up from the floor," the report said. "The other member managed to use the interphone and informed the in-flight service coordinator of their injuries," the report said.

'One of the cabin crewmembers could not get up from the floor.'

The captain reported the injuries to air traffic control (ATC) and requested and received clearance for a priority approach and landing at Johannesburg. "The aircraft was met by paramedics at the parking bay, and the two injured cabin crewmembers were stabilized, removed from the aircraft via a passenger assistance unit and transported to hospital via ambulance," the report said.

Faulty APU Emits Smoke

Boeing 757-200. No damage. One minor injury.

The passengers were disembarking from the 757 after a flight from Dalaman, Turkey, to Glasgow, Scotland, the afternoon of Oct. 11, 2012, when the commander detected a strong odor and saw a blue haze emanating from behind the instrument panel and the overhead circuit breaker panel.

The engines had been shut down, but the auxiliary power unit (APU) was operating. The commander initially suspected an electrical fire, but the odor and the density of the haze suggested otherwise, the AAIB report said. He opened the flight deck door and saw that the passenger cabin was filling with thick smoke.

The passengers in the forward cabin already had exited, and the commander ordered an immediate evacuation of all the remaining passengers. The flight attendants and the copilot assisted them in using escape slides as well as the airbridges to get out of the aircraft. One of the 231 passengers sustained minor injuries during the evacuation.

"The APU was identified as the source of the smoke and fumes in the cabin," the report said. It was declared inoperative and scheduled for return to the manufacturer three days later for a detailed examination.

The 757 departed from Glasgow the next morning for a flight with 241 passengers and eight crewmembers to Tenerife, Spain. The flight crew, who were aware of the previous incident, detected a strong odor of fuel or oil during takeoff. "As the aircraft reached its cruise altitude, both pilots started to feel unwell, with some lightheadedness and dizziness," the report said.

The pilots donned their oxygen masks, declared an urgency and diverted the flight to Manchester, England. The cabin was not affected by smoke or fumes, and the flight crew's symptoms subsided during the diversion. They landed the 757 without further incident in Manchester.

"The aircraft underwent an engineering check, and engine ground runs were carried out," the report said. "No further faults were found, and it was suspected that some residual oil may have remained in the conditioning or equipment cooling systems after the previous day's incident and associated engineering activity."

TURBOPROPS

Pilots Agree to Press On

CASA 212-200. Destroyed. Eighteen fatalities.

The aircraft departed from Medan, Indonesia, for an unscheduled 30-minute visual flight rules (VFR) flight to Kuta Cane the morning of Sept. 29, 2011. Although VMC prevailed over most of the route, the cockpit voice recorder (CVR) captured a conversation between the pilots about clouds ahead and the absence of a gap to fly through.

"Both pilots agreed to fly into the cloud," said the NTSC report.

The CVR recording indicated that the pilots became uncertain about the aircraft's position shortly thereafter. The report said that this likely resulted from loss of situational awareness when the crew lost visual reference with the ground. About 25 seconds after the pilots agreed to continue the VFR flight into IMC, the CVR recording ceased.

Searchers tracked the CASA's emergency locator transmitter signal to where the aircraft had struck a steep mountain slope at 5,055 ft about 16 nm (30 km) from the Kuta Cane airport. All 18 people aboard the aircraft had been killed.

The report said that inadequate crew coordination due to a "steep cockpit transition gradient" was a factor in the accident. There was no evidence that the pilots used checklists or conducted any briefings. Moreover, "the investigation did not find any evidence that the flight crew had received ALAR [approach and landing accident reduction] and CFIT [controlled flight into terrain] training," the report said.

Rudder Trim Disconnected

ATR 72-212A. No damage. No injuries.

Shortly after departing from Papeete, French Polynesia, for a scheduled flight the afternoon of June 25, 2011, the captain noticed that the ball in the slip indicator was displaced fully right.

"He used the rudder trim as far as the stop to reduce the load on the rudder," said the report by the French Bureau d'Enquêtes et d'Analyses. "He managed to move the ball halfway back between the centre and the instrument right-hand stop." The copilot confirmed that the ball in his slip indicator was in the same position.

Concerned that they would not be able to trim the airplane properly if the left engine failed, the flight crew turned back to Papeete. "During speed reduction on final, the crew indicated that the sideslip decreased," the report said. "The crew landed without further mishap."

Examination of the ATR revealed that the rudder trim tab control rod was not connected. Investigators found that a maintenance check had been completed the day before the incident occurred and that the control rod had been disconnected during repair of corrosion on the lower rudder torque tube.

After the torque tube was reinstalled, "the technician who closed up the access panels did not notice that the tab control rod was disconnected," the report said. The anomaly was not found during subsequent post-maintenance visual inspections and a flight control deflection check.

The report said that factors contributing to the incident were initial work cards that did not detail disconnection of the trim tab control rod and limitations in the company's maintenance computer system that prevented entry of intermediate stages in a maintenance task.

Flight Nurse Aids Sick Pilot

Beech King Air B200. No damage. No injuries.

The King Air was descending from 17,000 ft to 8,000 ft during a medevac flight from Bundaberg, Queensland, Australia, to Brisbane the afternoon of Nov. 5, 2012, when the pilot stopped responding to ATC communications. At ATC's request, flight crews of other aircraft in the area tried to hail the pilot but were unsuccessful.

Before beginning the descent, the pilot had engaged the autopilot's vertical navigation mode and had set 8,000 ft in the altitude selector. The autopilot subsequently leveled the aircraft at an altitude recorded by ATC as 8,100 ft. The power levers remained in the position set for the descent, however, and airspeed began to decrease.

"As the flight continued, the flight nurse became concerned, as she had not yet sighted the geographic features she normally observed," said the report by the Australian Transport Safety Bureau. "The nurse then turned her VHF radio on and heard a number of broadcasts from various persons attempting to contact [the pilot]."

The flight nurse checked on the pilot and found that his chin was slumped onto his chest and that he was not alert. She was attempting to rouse the pilot when the aircraft pitched nose-up, and the stall warning horn sounded.

"The pilot regained alertness and initiated recovery actions," the report said. "He reported disconnecting the autopilot and applying an amount of engine power."

The flight nurse monitored the pilot's condition as he re-established radio communications with ATC and followed vectors for an approach to Brisbane. Shortly after he switched to the tower frequency, he began to hyperventilate, and his hands began to shake; but he was able to land the aircraft.

"The nurse recalled that the landing and subsequent taxi speed appeared faster than normal [and that] the pilot's emotional and physical state worsened," the report said. "She encouraged the pilot to complete the 'After Landing' checklist and offered reassurance."

The pilot's physical condition improved slightly as he parked the aircraft and shut down the engines. The flight nurse summoned assistance in helping deplane the two patients and the pilot. "The emotional and physical state of the pilot at the time was reported as poor," the report said.

The report did not specifically state the cause of the pilot's incapacitation but noted that drug testing "returned a positive reading for an illicit substance which had affected the pilot's sleep cycle." Investigators found that he had begun reporting significant sleep disturbances four days before the incident and that "the pilot was experiencing a fatigue level well above that of a normal day worker when ready to retire to bed."

The report noted that the flight nurse had completed annual cabin safety and emergency training provided about six months before the incident occurred: "The training provided guidance on how to respond to a pilot incapacitation from

Shortly after he switched to the tower frequency, he began to hyperventilate, and his hands began to shake.

both a medical and operational perspective. This included using the autopilot, the communications system, the flaps, landing gear and power levers."

The flight nurse said, however, that more practical training on using the aircraft's radios would be beneficial. The operator subsequently revised its cabin safety and emergency training, and developed a "First Actions" checklist to guide flight nurses in responding to pilot incapacitation.

PISTON AIRPLANES

'We're Losing It'

Cessna 340A. Destroyed. Three fatalities.

About 14 minutes after departing in IMC from Chehalis, Washington, U.S., for a business flight the morning of Oct. 25, 2010, the pilot reported an engine failure and that he was returning to the airport.

Recorded ATC radar data showed that the airplane was at 14,800 ft when it began a right turn at a turn rate of 8 degrees per second. Shortly thereafter, the airplane began a rapid descent, and the pilot radioed, "We're losing it."

The descent rate averaged 5,783 fpm until radar contact was lost at 10,700 ft. "The airplane impacted a 30-degree slope of a densely forested mountain at about 2,940 ft in a near vertical, slightly right-wing-low attitude," the NTSB report said. All three occupants were killed in the crash, which occurred near Morton, Washington.

The report said that, based on the findings of the investigation, "it is most likely that the pilot experienced a partial loss of power of the right engine and, after incorrectly initiating a right turn into the failed engine, allowed the rate of turn to increase to the point that the airplane became uncontrollable before impact with terrain." The cause of the power loss was not determined.

Unaware of Closed Runway

Piper Seneca II. Substantial damage. No injuries.

Before departing from Carrizo Springs, Texas, U.S., the evening of April 3, 2012, the pilot contacted a flight service specialist and asked if there were any temporary flight restrictions along his intended route to San Marcos. The specialist advised that there were none.

The NTSB report said that the pilot did not request a standard briefing or specifically request information about pertinent notices to airmen (NOTAMs). Therefore, he was not aware of a NOTAM that had been issued a week earlier to advise that Runway 08/26, one of three runways at San Marcos, was closed for construction.

As the Seneca neared the destination at dusk, the pilot listened to the automatic terminal information system (ATIS) broadcast, which did not include information about the runway closure, the report said. The control tower was closed.

After landing on Runway 08, the airplane struck construction barriers. The main landing gear separated, and the left wing was substantially damaged. The pilot, alone in the airplane, was not hurt.

The report said that the probable cause of the accident was "the pilot's failure to ensure that he was aware of the NOTAM describing the runway closure" and that a contributing factor was "the failure of air traffic control personnel to include the runway closure information on the recorded ATIS information."

Haste Makes Waste

Cessna 310. Substantial damage. One serious injury, two minor injuries.

The pilot and two friends were having lunch at Avalon, California, U.S., on Oct. 3, 2010, when the pilot noticed that the weather conditions were deteriorating rapidly. The pilot, who did not hold an instrument rating, told his friends that they should depart on their planned flight to Santa Ana while VMC still prevailed.

After boarding his two passengers, the pilot, who had flown the 310 to Avalon from Santa Ana earlier that morning, started the engines and performed an abbreviated engine run-up while taxiing to the runway.

"The takeoff roll was normal, but about 2 to 3 seconds after liftoff, the left engine failed and the airplane veered to the left," the NTSB report said. "The pilot pushed the nose down to maintain airspeed, and the airplane entered a cloud/fog bank, impacted terrain and was engulfed by fire." One passenger was seriously injured; the other passenger and the pilot sustained minor injuries.

Examination of the 310 revealed that the fuel selector for the left engine was in a position between "OFF" and the normal takeoff setting. "The pilot stated that it was his habit to shut off both fuel selector valves after each flight and that he did so after the previous landing," the report said.

The report concluded that the pilot likely did not notice the incorrect positioning of the fuel selector in his haste to depart from Avalon: "Residual fuel in the lines, gascolator and carburetor, combined with the limited flow capability of the misset selector valve, permitted the engine to be started and operated normally at low rpm. However, the high fuel flow demand of the engine operating at full power could not be maintained by the misset valve, and the engine failed in the initial climb due to fuel starvation."

HELICOPTERS

Tail Rotor Effectiveness Lost

Bell 206B. Substantial damage. Three fatalities.

The pilot landed the JetRanger at New York's East 34th Street Heliport to pick up two friends for a sightseeing flight the afternoon of Oct. 4, 2011. "The pilot had initially anticipated taking two passengers on the flight, but the two passengers brought two additional adults with them," the NTSB report said.

The pilot kept the engine running while the passengers boarded. "The pilot did not conduct a safety briefing or mention life vests available on board the helicopter, complete performance planning or perform weight-and-balance calculations before takeoff," the report said. Investigators determined that the JetRanger was 28 to 261 lb (13 to 118 kg) over maximum gross weight on takeoff.

During a left turn on departure, the low rotor rpm warning sounded and the helicopter yawed slightly right. The pilot turned back toward the heliport, inadvertently placing the JetRanger in a tailwind. "After the pilot increased collective pitch [to land], the helicopter entered an uncommanded right yaw that accelerated into a spin around the main rotor mast that could not be corrected by application of full left pedal," the report said.

The helicopter descended into the East River, rolled inverted and sank. One passenger drowned, and two passengers later succumbed to their injuries; the fourth passenger and the pilot escaped injury.

The report concluded that the JetRanger likely had lost tail rotor effectiveness, which typically results in an uncommanded right yaw and occurs during maneuvers at high power and low airspeed in a tailwind or left crosswind, and is aggravated by high gross weight.

Main Rotor Strikes Tail Boom

Eurocopter AS350-B2. Substantial damage. No injuries.

The pilot was starting the engine in preparation to transport two passengers from a drilling platform in the Gulf of Mexico the afternoon of Oct. 7, 2011, when he felt abnormal vibrations. After shutting down the engine, he found that the main rotor blades had struck the tail boom.

The helicopter had been in a 23-kt headwind, with possible turbulence from nearby structures. The NTSB report concluded that the pilot likely had not properly centered and locked the cyclic before start.

"A review of accidents involving the same make and model helicopters revealed that in all of the recorded tail boom strikes by main rotor blades during start, two conditions needed to be present: cyclic not centered and air turbulence pushing strongly on the main rotor blades," the report said.

Preliminary Reports, August 2013

Date	Location	Aircraft Type	Aircraft Damage	Injuries
Aug. 1	Eilat, Israel	Piper Navajo	substantial	1 fatal, 2 serious
The pilot was killed when the Navajo veered off the runway on landing and came to rest inverted in a ditch.				
Aug. 3	Jundiaí, Brazil	Beech 58 Baron	destroyed	4 fatal
The Baron struck terrain shortly after departing from São Paulo.				
Aug. 3	Conway, South Carolina, U.S.	Beech D55 Baron	destroyed	3 fatal
The pilot was attempting to return to the airport when the Baron struck a telephone pole and crashed about 2 nm (4 km) from the runway.				
Aug. 5	Akureyri, Iceland	Beech King Air B200	destroyed	2 fatal, 1 minor
The medevac aircraft struck terrain about 4 km (2 nm) from the runway during approach.				
Aug. 5	Eden Prairie, Minnesota, U.S.	Embraer Phenom 300	substantial	2 none
The airplane touched down fast and long, overran the runway and came to a stop on a highway.				
Aug. 5	Ackerly, Texas, U.S.	Hughes 369D	none	2 fatal, 1 none
Two linemen were being hoisted onto a power transmission tower when the long line on which they were suspended was severed on contact with a shield wire.				
Aug. 6	Gorontalo, Indonesia	Boeing 737-800	substantial	110 NA
The 737 overran the runway after the nose gear struck a cow on landing. No injuries were reported.				
Aug. 6	Khartoum, Sudan	Fokker 50	substantial	55 NA
The Fokker was being prepared for departure when the right propeller struck a ground power unit. Debris penetrated the fuselage and a cabin window, but no injuries were reported.				
Aug. 9	New Haven, Connecticut, U.S.	Rockwell 690B	destroyed	4 fatal
The pilot conducted the instrument landing system approach to Runway 02 and was circling to land on Runway 20 when the Turbo Commander crashed in a residential area, killing two people on the ground. Weather conditions included 9 mi (14 km) visibility, a 900-ft overcast and surface winds from 170 degrees at 12 kt, gusting to 19 kt.				
Aug. 10	Bienenfarm, Germany	Antonov 2T	substantial	13 minor
The biplane struck terrain shortly after departing on an air taxi flight.				
Aug. 13	Gulf of Mexico	Bell 407	substantial	3 minor
The pilot ditched the helicopter after the engine lost power during a flight between offshore platforms. The occupants were rescued by the U.S. Coast Guard.				
Aug. 14	Birmingham, Alabama, U.S.	Airbus A300F4-622R	destroyed	2 fatal
The airport was reporting 10 mi (16 km) visibility, winds from 340 degrees at 4 kt, a few clouds at 1,100 ft and a 3,500-ft broken ceiling at 0447 local time when the freighter struck trees on approach and crashed about 0.6 nm (1.0 km) from Runway 18.				
Aug. 16	Vilyuisk, Russia	Antonov 2TP	destroyed	11 NA
No fatalities were reported when the aircraft was destroyed during a forced landing shortly after departing on a scheduled flight.				
Aug. 19	Yellowknife, Northwest Territories, Canada	Douglas DC-3C	substantial	24 NA
Witnesses saw smoke emerging from the right engine after the DC-3 took off from Runway 16 for a scheduled passenger flight. The pilots were circling to land on Runway 10 when the airplane struck terrain. No fatalities were reported.				
Aug. 20	Sucre, Bolivia	Swearingen Metro 23	substantial	10 none
The Metro veered off the runway and ran down an embankment after the nosewheel steering system failed on landing.				
Aug. 22	Lake Manyara, Tanzania	Beech King Air B200C	substantial	7 NA
The pilot diverted toward Arusha after an engine lost power during an air taxi flight from Bukoba to Zanzibar. He then ditched the King Air after the other engine failed. The occupants were rescued by fishermen.				
Aug. 25	Guri'el, Somalia	Antonov 26B-100	substantial	50 NA
One pilot was injured when the aircraft struck a large rock while landing on an unpaved airstrip.				

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.

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