AeroSafety WORLD

TRAINING FOR DIVERSITY
CRM in a multicultural cockpit

GEN Y WORKFORCE
Young professionals and safety culture

NO OFFENSE
Avoiding in-cockpit turbulence

HELICOPTER TREND
Stubborn human error

THE CRASH OF AF447

SUSTAINED STALL

THE JOURNAL OF FLIGHT SAFETY FOUNDATION

AUGUST 2012

SEMINARS AND Summits

For those of you who have attended any or all of our three main seminars, International Air Safety Seminar (IASS), European Aviation Safety Seminar (EASS) and our Corporate Aviation Safety Seminar — now re-branded as Business Aviation Safety Seminar (BASS) — I want to thank you! For those who haven't, I would like to encourage you to do so. Why, you ask, would I want to attend when my budget is limited and I have other required seminars and summits to attend?

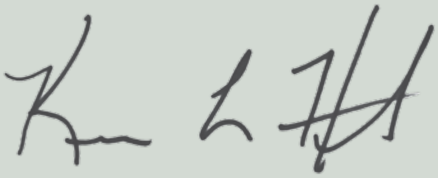
Well, over the past year-and-a-half, since our IASS in Milan, Italy, the Foundation staff began to make some subtle changes to the seminars in response to your feedback. Some of those changes include better check-in at the Foundation registration desk; the re-introduction of panel presentations; questions, comments and answers at the end of a speaker's presentation; and timely keynote speakers such as Capt. Richard de Crespigny, whose topic was the Qantas Flight 32 catastrophic engine failure and landing (p. 54). We have also decided to site the seminars in cities with greater nonstop flight possibilities to cut down on the need for connecting flights.

In the future, we want to add more social media interaction, speakers who have cutting edge topics not yet considered and possibly a debate. Our format has always been one of the hallmarks of the Foundation seminars, and we intend to build on that successful reputation. Many of you do not know that we have specific committees convening for each seminar to vet papers submitted for presentation. This ensures that we have quality topics to present. One way to look at a Flight Safety Foundation seminar is that we provide a "deep dive" into safety-related topics. We are not there to sell or promote products. We are there to provide information that you can use, and potentially apply to your situation.

All that being said, we are going to shake up our seminars somewhat. First, we will change the names in 2013 to International Aviation Safety Summit and Business Aviation Safety Summit. The reason for "Summit" instead of "Seminar" is that we are going to launch a new set of meetings called Regional Aviation Safety Seminars (RASS). The two large summits will be the showcases for the deep dive into aviation safety in general and in business aviation safety. The regional aviation seminars will focus on issues that pertain to specific regions of the world, with presentations, instruction and vendor breakout presentations. We successfully completed a partnership RASS in Bali, Indonesia, this past May, with the International Civil Aviation Organization and with the mineral and mining industry participating. It succeeded largely because it was within a region and it had take-away information that could be immediately used by the participants. Each RASS will last for no more than a day-and-a-half, depending on the topics. RASS topics will change, depending on the region and its needs. For 2013, we are planning at least two regional seminars.

You may have noticed that I did not mention the EASS for 2013. Unfortunately, due to the economic conditions in Europe, we are going to put the EASS on hold. Once the European economies grow stronger, we will re-evaluate the need, and when that happens, a RASS-E (Regional Aviation Safety Seminar– Europe) may be scheduled.

We realize that attending a summit or seminar is a large expense of your time and funds. Our goal is to make the Foundation summits and seminars well worth that investment in safety knowledge for your situation!



Capt. Kevin L. Hiatt
Chief Operating Officer
Flight Safety Foundation

AeroSafetyWORLD

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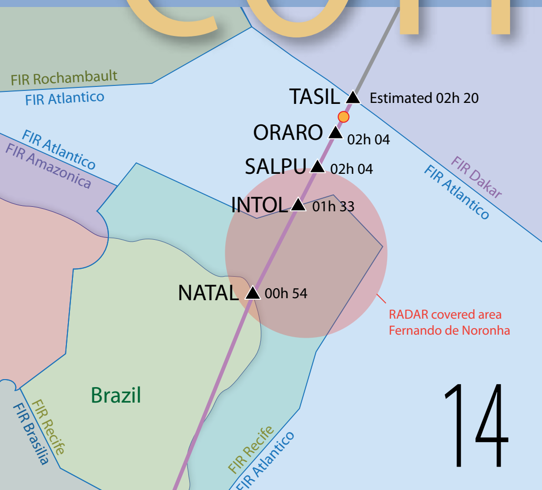

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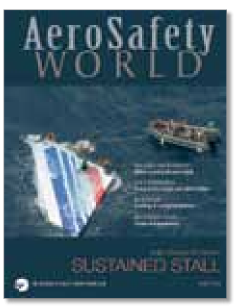

About the Cover
Debris is recovered following the crash of AF447.
© AP Photo/Brazilian Air Force

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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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STARTLE Effect

Beginning on p. 14, Mark Lacagnina delves into the causes of the crash of Air France Flight 447 (AF447) in June 2009 as laid out by the final report of France's Bureau d'Enquêtes et d'Analyses (BEA). Next month, we will take a closer look at some of the BEA's recommendations.

To anyone who has followed the investigation and read the interim reports, the final report did not contain any real surprises, but it did, among other things, shine a spotlight on training needs, situational awareness, crew resource management and the "startle effect," which, coincidentally, appears in two stories in this month's issue.

The first and most significant story involves AF447, the Rio de Janeiro to Paris nonstop flight that crashed into the Atlantic Ocean, killing all 228 people on board. As Mark details in his story on the BEA's final report, ice crystals blocked the aircraft's pitot probes, resulting in the production of unreliable airspeed information. The Airbus A330-200's electronic flight control system, reacting as it was designed to do, rejected the air data, disengaged the autopilot and autothrottle and reverted to a lower control law.

When the autopilot disengaged, the pilot flying (PF) "made rapid and high-amplitude roll control inputs," according to the English translation of the BEA's final report on the accident. "He also made a nose-up input that increased the aeroplane's pitch attitude up to 11 degrees in 10 seconds," the report said.

Investigators surmised that "the excessive nature of the PF's inputs can be explained by the startle effect and the emotional shock at the autopilot disconnection." Of course, the PF's initial, startled reaction was not the sole problem, but it did play a "major role in the destabilization of the flight path," the BEA report said.

Two years later, on an A340 flight from Caracas to Paris, a strong wind gust caused airspeed to increase momentarily to 0.87 Mach (p. 58). The pilots said that they were surprised when the master warning light illuminated and the aural overspeed warning sounded. The pilot not flying (PNF) manually disengaged the autopilot and "a pitch-up input on the PNF's sidestick going as far as three-quarters to the stop was recorded for six seconds," the BEA's report said. "This input was accompanied by an input to bank to the right then left. The PNF stated that he did not remember these inputs."

The report said that the control inputs likely were reflexive actions that resulted from the "startle effect" produced by the overspeed warning. "Sometimes this effect sparks primal instinctive reaction, instant and inadequate motor responses," the report said. "These basic reflexes may prove to be incorrect and difficult to correct under time pressure and may affect the pilot's decision-making ability."

In recommending that the European Aviation Safety Agency review the requirements for initial, recurrent and type rating training for pilots "in order to develop and maintain a capacity to manage crew resources when faced with the surprise generated by an unexpected situation," the BEA authors of the AF447 final report said: "Initial and recurrent training as delivered today do not promote and test the capacity to react to the unexpected. Indeed, the exercises are repetitive and well known to crews, and do not enable skills in resource management to be tested outside of this context."

Stay tuned for more on the BEA's recommendations next month.

Frank Jackman
Editor-in-Chief
AeroSafety World

Serving Aviation Safety Interests for More Than 60 Years

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially in 1947 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 1,075 individuals and member organizations in 130 countries.

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Leaving Failure as an Option

I read with great interest the article discussing SMS by William Voss (*ASW*, 5/12, p. 1), and the letter by Jeff Whitman (*ASW*, 6/12, p. 8), and I have to agree with both of them on their assessments. However, I want to add some thoughts on the role of innovation in framing the future of SMS.

The definition of innovation is "a new idea, device, or method, or "the act or process of introducing new ideas, devices, or methods." It has been my observation that most innovation does not come from government or academia, and, in fact, they often suppress creativity. Many of the initiatives passed through academia and the government are led by individuals who don't want to challenge the status quo. Additionally, we in the aviation community tend to be "rule followers," which makes us mostly compliant. This is a good thing, but I'm not sure that it lends itself to innovation and creative thinking (at least in my case). That said, I believe that any progress in SMS in the business aviation community will come from the rank-and-file operators such as maintenance technicians, flight attendants, pilots and schedulers who have a vibrant SMS in place and who see a real need for improvement.

For innovation to occur in SMS, we must leave failure as an option. Innovators use their failures to learn and improve their processes. We also need an avenue to share both our failures and our successes with each other. The many safety round tables that have grown up around the country are excellent conduits for the exchange of ideas and creative thinking. Last, we should consider bringing in individuals from our companies who have no background in aviation, and allow them to serve as "interpreters" to look at our SMSs. You might be surprised at the insights that they bring to the table. They may view the world from a different paradigm.

The French were very close to beating the Wright brothers in the development of the first airplane. However, the paradigm that the Europeans were using was that of a "coach" design for an aircraft. In other words, they believed that the airplane would fly on two axes, yaw and pitch. The paradigm that the Wright brothers were basing their design on was that they had been riding and building bicycles most of their lives, and as such they were very comfortable with leaning into the turn, i.e., roll. The *Wright Flyer* was therefore designed with three axes, yaw, pitch and roll. The rest is history.

SMS is already improving safety. It will continue to evolve as innovative flight departments develop their own creative ways to address SMS and challenge the paradigms in place. There will be some failures as well as some successes along the way, and I suspect that *ASW* and gentlemen like Mr. Voss and Mr. Whitman who care about business aviation and safety will be there to articulate the processes and help improve aviation safety on a global scale. For the time being, those of us on the front line of business aviation must be willing to experiment with our SMSs, and to pass along our results to our colleagues in the field. When this happens we will see real improvements in SMS. Thank you.

Cliff Jenkins
Director of Aviation
Milliken & Company

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

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

MAKING STRIDES IN Latin America

The team at Flight Safety Foundation (FSF) is busy gearing up for our largest event of the year. Now in its 65th year, the International Air Safety Seminar (IASS), will be held in Santiago, Chile, on Oct. 23–25, and will be hosted by the Directorate General of Civil Aviation of Chile. You can find further details and a draft agenda on our website at <flightsafety.org/IASS>.

The IASS was last held in South America in 1999, in Rio de Janeiro, Brazil, and quite a lot has changed in those 13 years. The region is now one of the largest and fastest growing in aviation. Growth demands attention to services and infrastructure — and most importantly, to safety management.

In an effort to expand our reach in the region, the Foundation is proud to partner with the Latin American and Caribbean Air Transport Association (ALTA). ALTA is a private, non-profit organization, whose member airlines represent more than 90 percent of the region's commercial air traffic. ALTA coordinates the collaborative efforts of its members to facilitate the development of safer, more efficient and more environmentally friendly air transport in the Latin American and Caribbean region for the benefit of the association's members, their customers and the industry.

Alex de Gunten, executive director of ALTA, said, "The ongoing partnership between ALTA and FSF underscores the ultimate goal of harmonization and standardization throughout the region to improve safety and efficiency."

Earlier this summer, the Foundation participated as a strategic partner in ALTA's 3rd Pan American Aviation Safety Summit in Bogotá, Colombia. The event was attended by more than 200 delegates from airlines, civil aviation authorities, aviation educational organizations, air transport associations and various other international aviation-related organizations.

Building on this success, the IASS will provide another forum for the aviation industry to meet in a collaborative environment to identify safety concerns, devise approaches to reduce risk and implement initiatives to improve safety. The seminar will cover safety, training, practical solutions, management, human factors and other issues for scheduled airlines, manufacturers and equipment suppliers, trainers, flight crews, maintenance personnel and industry executives. Delegates will hear remarks from dignitaries, civil aviation authorities and the CEOs of key airlines in the Latin American and Caribbean Region.

Also new this year, the Regional Aviation Safety Group–Pan America (RASG-PA) will be co-locating its event with the IASS. RASG-PA was established in November 2008 to be the focal point for harmonization and coordination of safety efforts aimed at reducing aviation risks in the North American, Central American, Caribbean and South American Regions and to promote the resulting safety initiatives by all stakeholders.

At last year's IASS in Singapore, we had more than 340 attendees representing 51 countries. We look forward to increasing those numbers this year. See you in Santiago!

— Kelcey Mitchell,
Director of Events and Seminars

SEPT. 10–21 ➤ Aircraft Accident Investigation. U.S. National Transportation Safety Board. Washington. Peter Knudson, <peter.knudson@ntsb.gov>, +1 202.314.6100.

SEPT. 12–14 ➤ Aviation Law Americas. Latin American and Caribbean Air Transport Association. Miami. <www.alta.aero/aviationlaw/2012>, +1 786.388.0222.

SEPT. 13–14 ➤ Aviation Human Factors and SMS Wings Seminar. Signal Charlie. Pensacola, Florida, U.S. Kent Lewis, <Lewis.Kent@gmail.com>, <www.signalcharlie.net/Seminar+2012>, +1 850.449.4841.

SEPT. 17–18 ➤ Flight Safety 2012. Flightglobal. London. <events.registration@rbi.co.uk>, <bit.ly/K4OT3A>, +44 (0)20 8652 3233.

SEPT. 19 ➤ Fatigue Risk Management and Operational Human Factors. Global Aerospace SM4 and the Minnesota Business Aviation Association. Minneapolis. <safety@global-aero.com>, <sm4.global-aero.com/upcoming-events>, +1 206.818.0877.

SEPT. 19–21 ➤ SMS Workshop and SMS Manual Development. ATC Vantage. Tampa, Florida, U.S. <info@atcvantage.com>, <bit.ly/OCyfrQ>, +1 727.410.4759.

OCT. 2–4 ➤ CAE Flightscape Users Conference. CAE Flightscape. Montreal. EunKyung Choi, <fsconference@cae.com>, <bit.ly/T0PNyQ>, + 1 613.225.0070, ext. 3224.

OCT. 8–12 ➤ Aviation English for Pilots and Air Traffic Controllers. Joint Aviation Authorities Training Organisation. Hoofddorp, Netherlands. <jaato.com/courses/69>.

OCT. 10–11 ➤ EASA Annual Safety Conference. European Aviation Safety Agency. Cologne, Germany. Gian Andrea Bandieri, <asc@easa.europa.eu>, <bit.ly/y2HfJp>, +49 221 89990 6044.

OCT. 16–19 ➤ SMS II and SMS Audit. MITRE Aviation Institute. McLean, Virginia, U.S. <maimail@mitre.org>, +1 703.983.5617.

OCT. 17–18 ➤ Latin America and Caribbean Engineering and MRO Summit 2012. Latin American and Caribbean Air Transport Association and UBM Aviation. São Paulo, Brazil. <www.alta-ubma-mrosummit.com>, +1 786.388.0222.

OCT. 20 ➤ AAAE Safety Risk Assessment Compliance Workshop. American Association of Airport Executives. New Orleans. Janet Skelley, <janet.skelley@aaae.org>, +1 703.824.0500, ext. 180.

OCT. 22–24 ➤ SAFE Annual Symposium. SAFE Association. Reno, Nevada, U.S. Jeani Benton, <safe@peak.org>, <www.safeassociation.com>, +1 541.895.3012.

OCT. 23–25 ➤ 65th annual International Air Safety Seminar. Flight Safety Foundation and Latin American and Caribbean Air Transport Association. Santiago, Chile. Namratha Apparao, <apparao@flightsafety.org>, <flightsafety.org/iass>, +1 703.739.6700, ext. 101.

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

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

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

Safety News

Proposed Penalty for Boeing

The Boeing Co. faces a proposed civil penalty of $13.6 million for its alleged failure to meet a government deadline to submit service instructions for airlines to install systems designed to reduce the risk of fuel tank explosions.

"Manufacturers must provide the necessary instructions so the airlines can comply with this important safety regulation," U.S. Transportation Secretary Ray LaHood said.

The U.S. Federal Aviation Administration (FAA) says that, since the July 1996 crash of a Trans World Airlines Boeing 747 — which investigators attributed to an explosion of flammable vapors in a fuel tank — it has issued 283 directives aimed at preventing vapor ignition in and around aircraft fuel tanks.

One directive, issued in 2008, set a Dec. 27, 2010, deadline for Boeing and Airbus — the companies responsible for the affected airplanes — to "develop design changes and service instructions for installing systems to further reduce fuel tank flammability" and submit the plans for FAA approval, the FAA said. The agency's plans called for the installation of systems that would replace the oxygen-rich air in the fuel tanks with nonflammable nitrogen.

"Boeing missed the deadline for submitting service instructions for the 747s by 301 days, delivering them to the FAA on Oct. 24, 2011," the FAA said. "The company was 406 days late in submitting service instructions for the 757s. In total, 383 U.S.-registered Boeing aircraft are affected by these delays."

Airbus met the 2010 deadline.

© Ramon Berk/Dreamstime.com

Under the Fuel Tank Flammability Rule, airlines are required to retrofit half of their affected airplanes by 2014 and the remainder by 2017. The FAA said that most operators — including those that received the late instructions from Boeing — will be able to meet those deadlines.

The manufacturer has 30 days from its receipt of the FAA letter to respond to the allegations.

African Action Plan

International aviation organizations are urging African nations to adopt a plan designed to correct deficiencies and strengthen regulatory oversight in the region's aviation system.

The Africa Strategic Improvement Action Plan calls for establishing and funding independent civil aviation authorities in African nations; implementing "effective and transparent safety oversight systems," accident-prevention measures that address runway safety and loss of control, flight data analysis (FDA) programs and safety management systems (SMS); and requiring all African air carriers to undergo the International Air Transport Association's (IATA's) Operational Safety Audit.

These key areas were identified through IATA and International Civil Aviation Organization (ICAO) analysis of air transport accidents that occurred in Africa between 2006 and 2010.

"This analysis identified … the main contributing factors to accidents [as] insufficient regulatory oversight and the lack of SMS implementation," ICAO said. "Implementation of tools such as FDA could have pinpointed precursors to the major accident types, namely runway excursions, controlled flight into terrain and loss of control. Runway excursions alone accounted for about a quarter of African accidents."

Hansueli Krapf/Wikimedia

TAWS Requirement

Canadian operators of certain smaller aircraft have been given two years to install a terrain awareness and warning system (TAWS) in their airplanes.

Denis Lebel, minister of transport, infrastructure and communities, said the new requirement will "significantly increase safety for small aircraft, which fly into remote wilderness or mountainous areas where the danger of flying into terrain is highest."

Transport Canada said that the requirement will apply to operators of "private turbine-powered and commercial airplanes with at least six passenger seats."

Lebel said the regulations comply with International Civil Aviation Organization standards. In the past, the Transportation Safety Board of Canada has recommended wider use of TAWS "to help pilots assess their proximity to terrain."

Positioning Problem

Operators of airplanes with General Electric (GE) CF6-80C2 engines should be required to take steps to ensure the correct assembly of a spray shield and support bracket unit that — when incorrectly installed — has been associated with engine fires, the U.S. National Transportation Safety Board (NTSB) says.

The NTSB issued a safety recommendation to the U.S. Federal Aviation Administration (FAA), calling on the FAA to issue an airworthiness directive to "require the incorporation of [GE] Aircraft Engines Service Bulletin 73-0242, 'Fuel and Control — (73–00–00) — Spray Shields and Support Bracket — Improvement' to prevent fires on CF6-80C2 engines due to mis-assembly of the two-piece support bracket and spray shield on the front of the integrated drive generator fuel-oil heat exchanger."

The NTSB cited a Feb. 8, 2012, engine fire aboard an American Airlines Boeing 767-300ER shortly after takeoff from John F. Kennedy International Airport (JFK) in New York for a flight to Haiti. The pilots shut down the engine, discharged two fire extinguisher bottles into the engine, declared an emergency and returned to JFK. None of the 213 people in the airplane were injured.

The investigation is continuing, but the NTSB said that investigators found that "numerous wires and cables on the lower half of the engine showed signs of insulation that had been burned away or partially melted." They also found that the support bracket and spray shield had been assembled incorrectly, with the bracket over the spray shield. The incorrect positioning of the two parts "distorted the fuel tube flange, resulting in an inadequate clamping of the seal between the fuel tube flange and the … fuel-oil heat exchanger." Part of the seal was missing.


Kristoferb/Wikipedia

A similar engine fire occurred on a Delta Air Lines 767-300ER on July 12, 2006, shortly after takeoff from Rio de Janeiro, Brazil, the NTSB said. The airplane returned to Rio de Janeiro for a landing that resulted in a hot brake warning and deflation of six main landing gear tires, the board said. Damage to the engine was "virtually identical" to the damage found on the American Airlines 767.

In Memoriam

Two key figures in aviation safety — Robert L. Helmreich and Bryan Wyness — have died.

Helmreich, a pioneering developer of crew resource management initiatives and the line operational safety audit, died July 7. He was 75.

He was a psychology professor at the University of Texas at Austin and the principal investigator of the University of Texas Human Factors Research Project, which studies individual and team performance, human error and the influence of culture on behavior in aviation and medicine.

He served in the U.S. Navy and received bachelor of science, master of science and doctoral degrees from Yale University.

He was awarded the Flight Safety Foundation–Boeing Aviation Safety Lifetime Achievement Award in 2005, two years before he retired from the University of Texas and was named a professor emeritus. He also was a recipient of the American Psychological Association's Franklin Taylor Award and the University of Texas' highest honor, the Pro Bene Meritus Award.

Wyness, a commissioner with the New Zealand Transport Accident Investigation Commission (TAIC), died July 20 in a motorcycle accident. He was 71.

He was first appointed to the TAIC in 2004, after a long career with Air New Zealand, where he had been vice president for flight operations. He also was a former member of the Flight Safety Foundation International Advisory Committee.

ATC Consolidation

Plans to consolidate a number of relatively small air traffic control (ATC) facilities into large integrated facilities over the next 20 years will depend on the U.S. Federal Aviation Administration's (FAA's) ability to meet a number of technical and financial challenges, a report from a government oversight office says.

The U.S. Department of Transportation's Office of Inspector General (OIG) said that the challenges include successfully aligning ongoing construction projects; coordinating the projects with the offices of the Next Generation Air Transportation System (NextGen), the elaborate overhaul of air traffic management; and finalizing cost estimates.

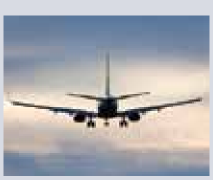
The FAA already has approved a plan to consolidate 49 ATC facilities into one integrated facility handling traffic in New York, New Jersey and the Philadelphia area. The agency has not yet determined where to build the $2.3 billion facility, the report said.

The FAA operates 561 ATC facilities nationwide, many of which are outdated, the report said.

In Other News …

New requirements for Australian pilots to undergo more training and checking exercises in **simulators** are expected not only to improve training but also to reduce aircraft wear and tear and limit the risk of training accidents, the Australian Civil Aviation Safety Authority says. The requirements take effect in 2013.

… The European Parliament's transport and tourism committee has approved a non-binding resolution urging member states to meet their obligations to implement the **Single European Sky**, reasoning that Europe's air traffic control "urgently" needs modernization to enhance safety.



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SAR Upgrade Urged

French aviation accident investigators are calling for better coordination of search and rescue (SAR) plans in maritime and remote areas.

Pawel Kierzkowski/Wikipedia

Recommendations accompanying the Bureau d'Enquêtes et d'Analyses (BEA) final report on the June 1, 2009, crash of an Air France Airbus A330, operating as Flight 447, into the Atlantic Ocean said there was no SAR coordination plan between Brazil and Senegal for the section of the South Atlantic where the airplane struck the water.

"This lack of a plan caused a considerable delay in the start of SAR operations," the report said. All 228 people in the airplane were killed in the crash (p. 14).

The BEA recommended that the International Civil Aviation Organization (ICAO) "ensure the implementation of SAR coordination plans or regional protocols covering all of the maritime or remote areas for which international coordination would be required in the application of SAR procedures, including in the South Atlantic area."

Related recommendations said that ICAO should "define the framework for the training of SAR operators" and that French civil aviation authorities should develop a framework for SAR training in France.

Compiled and edited by Linda Werfelman.

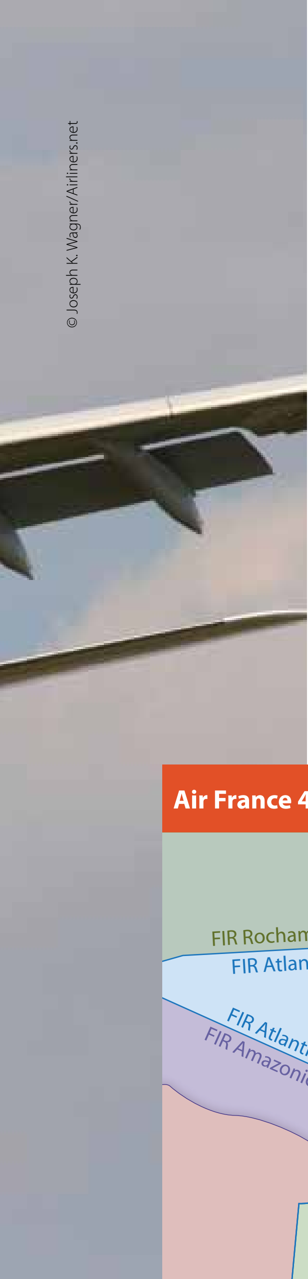
Sustained Stall

Blocked pitot tubes, excessive control inputs and cockpit confusion doomed Air France 447.

BY MARK LACAGNINA

Within four and a half minutes in the early hours of June 1, 2009, an Airbus A330-200 operating as Air France Flight 447 from Rio de Janeiro, Brazil, to Paris, departed from cruise flight at 35,000 ft and descended into the Atlantic Ocean, killing all 216 passengers and 12 crewmembers. Glimpses of what might have gone wrong emerged from several interim reports issued by the French Bureau d'Enquêtes et d'Analyses (BEA) during its long investigation of the accident. In July 2012, the bureau published a nearly 300-page final report providing a full picture of what likely happened during those critical moments.

According to the report, the trouble began when the A330's pitot tubes were obstructed by ice crystals, causing the various air data sources to produce unreliable airspeed information. Reacting as designed, the electronic flight control system (EFCS) rejected the air data, disengaged the autopilot and autothrottle, and reverted to a lower control law that provides fewer protections against flight-envelope deviations. Startled by the unexpected and unfamiliar situation, and with turbulence making sidestick control inputs difficult, the pilot flying (PF) inadvertently commanded a steep nose-up pitch change while leveling the airplane's wings. The flight crew — a copilot and a relief pilot filling in for the resting captain — recognized the loss of reliable airspeed data but did not conduct the associated checklist procedure. Confusion reigned on the flight deck, and crew coordination vanished. Without automatic angle-of-attack protection, the airplane entered a stall. The crew either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believed that the stall warnings were spurious or mistook the airframe buffeting as a sign of an overspeed. No recovery action was taken, and the A330 remained in a stall as it descended to the sea.

Based on the findings of the investigation, the BEA made 41 recommendations to various organizations worldwide on topics including pilot training, equipment certification, air traffic control (ATC) and search and rescue (see p. 13).[1]

Augmented Crew

Air France 447 had an augmented flight crew comprising a captain and two copilots. When the airplane departed from Rio de Janeiro at 2229 coordinated universal time (1929 local), the captain was in the left seat and serving as pilot not flying (PNF), and one of the copilots was flying from the right seat.

The captain, 58, had 10,988 flight hours, including 1,747 hours as pilot-in-command in type. The PF, 32, had 2,936 flight hours, including 807 hours in type. The other copilot was 37 and had 6,547 flight hours, with 4,479 hours in type.

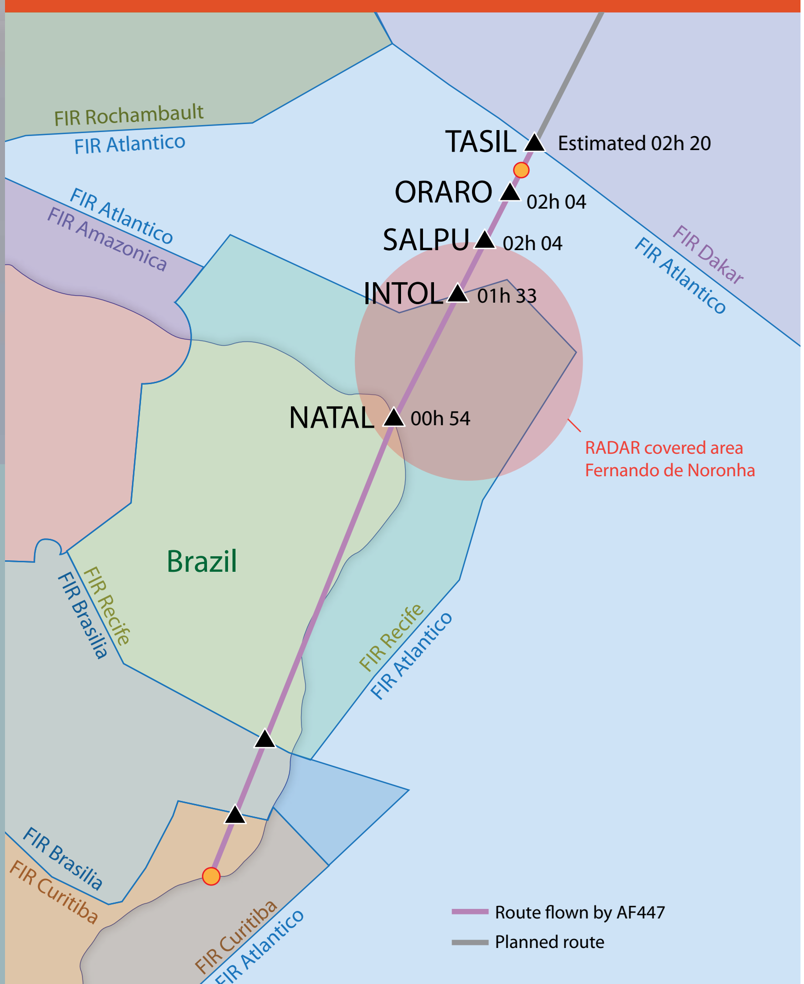
About two hours after departing from Rio, the flight crew received information from the airline's operations center about an area of convective activity developing along the route between the SALPU and TASIL navigation waypoints (Figure 1). Shortly thereafter, the PF remarked that the airplane was "entering the cloud layer," and the light turbulence to which the flight had been exposed increased slightly.

The report said that statements captured by the cockpit voice recorder indicated that the PF became preoccupied with the conditions they might encounter as the flight progressed through the intertropical convergence zone (ITCZ). Several times, he expressed concern about the turbulence and the relatively warm outside air that limited the airplane's performance and precluded a climb to Flight Level (FL) 370 (approximately 37,000 ft), to get above the clouds. He suggested that they request clearance from ATC to climb to FL 360, which is not a standard level for their direction of flight.

"Some anxiety was noticeable" in the PF's statements, the report said. "The captain appeared very unresponsive to the concerns expressed by the PF about the ITCZ. He favored waiting and responding to any turbulence noted." The report said that the captain had crossed the ITCZ many times and likely considered the present conditions as normal.

Preparing for a rest break at 0152, the captain woke the other copilot, who was in the crew rest facility, and summoned him to the cockpit. The copilot took the left seat vacated by the captain and was briefed by the PF about the flight conditions. The turbulence had subsided, but the PF said that they could expect more turbulence ahead and that they presently could not

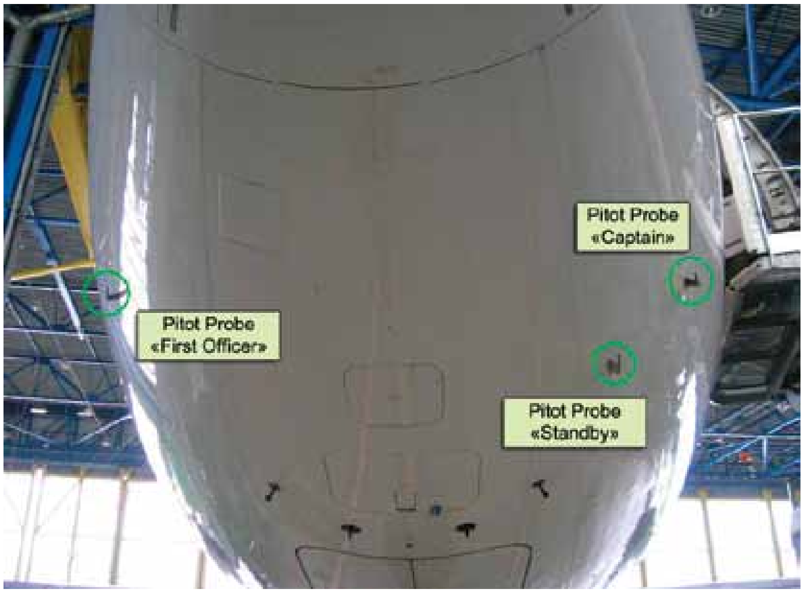
Air France 447 Flight Path



FIR = flight information region

Source: Bureau d'Enquêtes et d'Analyses

Figure 1



All three pitot probes were blocked by ice crystals, and airspeed information became unreliable.

Bureau d'Enquêtes et d'Analyses

attempt to climb above the clouds. The PF also noted that they had not been able to establish a position-reporting data link with the Dakar Oceanic flight information region.

The captain did not contribute any information to the briefing before he left the cockpit at 0200 and went to the crew rest facility. He also did not specifically designate which copilot would serve as the "relief pilot" — that is, the captain's replacement — although he implied that the copilot in the right seat (the PF) would fill that role. The report said that the decision was questionable considering the significantly higher experience level of the other copilot.

At this point, the A330 was nearing the ORARO waypoint, which is between SALPU and TASIL, and entering the ITCZ. Airspeed was 0.82 Mach, and the pitch attitude was 2.5 degrees nose-up. The turbulence increased again, and the PF advised the cabin crew that the turbulence soon would intensify. "You'll have to watch out there," he said. "I'll call you when we're out of it."

At 0208, the PNF, who was examining the weather radar display, suggested that they "go to the left a bit." The selected heading then was adjusted 12 degrees left. In addition, "the crew decided to reduce the speed to about Mach 0.80, and engine deicing was turned on," the report said.

Exiting the Envelope

At 0210:05, the autopilot and autothrottle disengaged, and the PF announced, "I have the controls." The PNF responded, "All right."

The airplane, which already had been near its performance limits in high-altitude cruise, "exited its flight envelope" within a minute of autopilot disengagement, the report said. "Neither of the two crewmembers had the clarity of thought necessary to take the corrective actions. However, every passing second required a more purposeful corrective piloting input."

The airspeed shown on the left primary flight display (PFD) decreased rapidly from about 275 kt to 60 kt. A few moments later, the airspeeds shown on the integrated standby instrument system and the right PFD also decreased.

The ice crystal icing that had blocked the A330's pitot probes is a phenomenon that is not well understood, according to the report. "In the presence of ice crystals, there is no visible accretion of ice or frost on the outside, nor on the nose of the probe, since the crystals bounce off of these surfaces. However, the ice crystals can be ingested by the probe air intake. According to the flight conditions (altitude, temperature, Mach), if the concentration of crystals is greater than the capacity for deicing of the heating element and evacuation by the purge holes, the crystals accumulate in large numbers in the probe tube." The resulting disruption of total pressure measurement produces unreliable airspeed information, causing reversion from normal to alternate flight control law.

The airplane had pitched about 2 degrees nose-down and had begun rolling right when the autopilot disengaged. "The PF made rapid and high-amplitude roll control inputs, more or less from stop to stop," the report said. "He also made a nose-up input that increased the aeroplane's pitch attitude up to 11 degrees in 10 seconds." As a result, the airplane began to climb rapidly. The aural and visual stall warnings activated twice, briefly.

"The excessive nature of the PF's inputs can be explained by the startle effect and the emotional shock at the autopilot disconnection," the report said. "Although the PF's initial excessive nose-up reaction may thus be fairly easily understood, the same is not true for the persistence of this input."

The PNF was not immediately aware of the PF's control inputs or that, because of the unreliable airspeed data, the EFCS control law had changed from normal, which would prevent the airplane from reaching stall angle-of-attack, to alternate, which would not prevent a stall. He reacted to the stall warnings by saying, "What was that?"

The PNF then noticed the airspeed anomalies, as well as the reversion to alternate control law. At 0210:16, he announced, "We've lost the speeds," and added, "alternate law protections." The PF also noticed the airspeed anomalies. "We haven't got a good display of speed," he said.

However, neither pilot called for the abnormal/emergency checklist that addresses unreliable airspeed indications. Among the checklist actions is disengagement of the flight directors, which can — and did in this case — present erroneous cues in the absence of consistent airspeed information.

The report said that the pilots did not focus on the problem involving the abnormal airspeed indications because they might have perceived "a much more complex overall problem than simply the loss of airspeed information."

Several messages appeared on the electronic centralized aircraft monitor (ECAM), and the PNF read them out "in a disorganized manner," the report said, also noting that none of the ECAM messages provided an "explicit indication that could allow a rapid and accurate diagnosis" of the situation.

At 0210:27, the PNF observed indications that the airplane was climbing and said, twice, "Go back down." The PF acknowledged and made several nose-down sidestick inputs that reduced the pitch attitude and the vertical speed. However, the report said that, possibly due to an erroneous flight director prompt to increase the pitch attitude, the PF did not make control inputs sufficient to halt the climb.

At 0210:36, the airspeed information shown on the left PFD returned to normal; the indication was 223 kt. "The aeroplane had lost about 50 kt since the autopilot disconnection and the beginning of the climb," the report said.

'I Don't Have Control'

The PNF was calling the captain to return to the cockpit at 0210:51, when the stall warnings activated again. Pre-stall buffeting began seconds later. "The crew never referred either to the stall warning or the buffet that they had likely felt," the report said.

The PF applied takeoff/go-around thrust but continued to apply nose-up control inputs. This is how pilots typically are trained to react to stall indications at low altitude, the report said, noting, however, that "at this point, only descent

Airbus A330-200

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The widebody twin-engine A330 was developed simultaneously with the four-engine A340, both of which entered service in 1994. The A330-200 is the extended-range version, introduced in 1998 with a shorter fuselage and a higher fuel capacity than the base-model A330-300. Engine options for both models include General Electric CF6-80, Pratt & Whitney PW4000 and Rolls-Royce Trent 700 series turbofans, all rated at approximately 70,000-lb (31,752-kg) thrust.

The twin-aisle aircraft accommodates up to 293 passengers. Maximum weights are 230,000 kg (507,058 lb) for takeoff and 180,000 kg (396,828 lb) for landing. Typical operating speed is 0.82 Mach. Maximum range with reserves is 6,650 nm (12,316 km).

In 2012, maximum takeoff weight was increased to 240,000 kg (529,104 lb), with extra fuel capacity that boosted range to 7,050 nm (13,057 km). Currently, 464 A330-200s are in operation worldwide.

Sources: Airbus, *Jane's All the World's Aircraft*

… through a nose-down input on the sidestick would have made it possible to bring the aeroplane back within the flight envelope."

The buffeting, aerodynamic noise and misleading flight director indications might have caused the PF to believe that an overspeed situation existed, the report said. He reduced thrust to idle and attempted to extend the speed brakes.


U.S. National Aeronautics and Space Administration

The upset occurred soon after the A330 entered clouds in the intertropical convergence zone.

The EFCS autotrim system reacted to the PF's continued back pressure on the sidestick by moving the horizontal stabilizer to its full airplane-nose-up position, where it remained until the end of the flight. "The PF continued to make nose-up inputs," the report said. "The aeroplane's altitude reached its maximum of about 38,000 ft; its pitch attitude and angle-of-attack were 16 degrees."

At 0211:38, the PF told the PNF, "I don't have control of the plane at all." The PNF responded by announcing, "Controls to the left," and pressing the pushbutton on his sidestick to transfer flight control priority from the PF's sidestick to his sidestick.

"The PF almost immediately took back priority without any callout and continued piloting," the report said. "The priority takeover by the PF could not be explained but bears witness to the de-structuring of the task sharing" between the pilots.

The captain likely noticed the airframe buffeting and the airplane's high pitch attitude while returning to the cockpit at 0211:42. The continuous aural master warning and intermittent stall warning, the confusing instrument indications and the stress conveyed by the two copilots when they told him that they had lost control of the airplane likely made it difficult for the captain to grasp the situation, the report said. "Subsequently, his interventions showed that he had also not identified the stall."

The airplane was descending through 35,000 ft at 10,000 fpm with a 40-degree angle-of-attack and with roll oscillations reaching 40 degrees. "Only an extremely purposeful crew with a good comprehension of the situation could have carried out a maneuver that would have made it possible to perhaps recover control of the aeroplane," the report said.

At 0212:02, the PF said, "I have no more displays," and the PNF said, "We have no valid indications."

"At that moment, the thrust levers were in the 'IDLE' detent and the engines' N1s [fan speeds] were at 55 percent," the report said. "Around 15 seconds later, the PF made pitch-down inputs. In the following moments, the angle-of-attack decreased, the speeds became valid again and the stall warning triggered again."

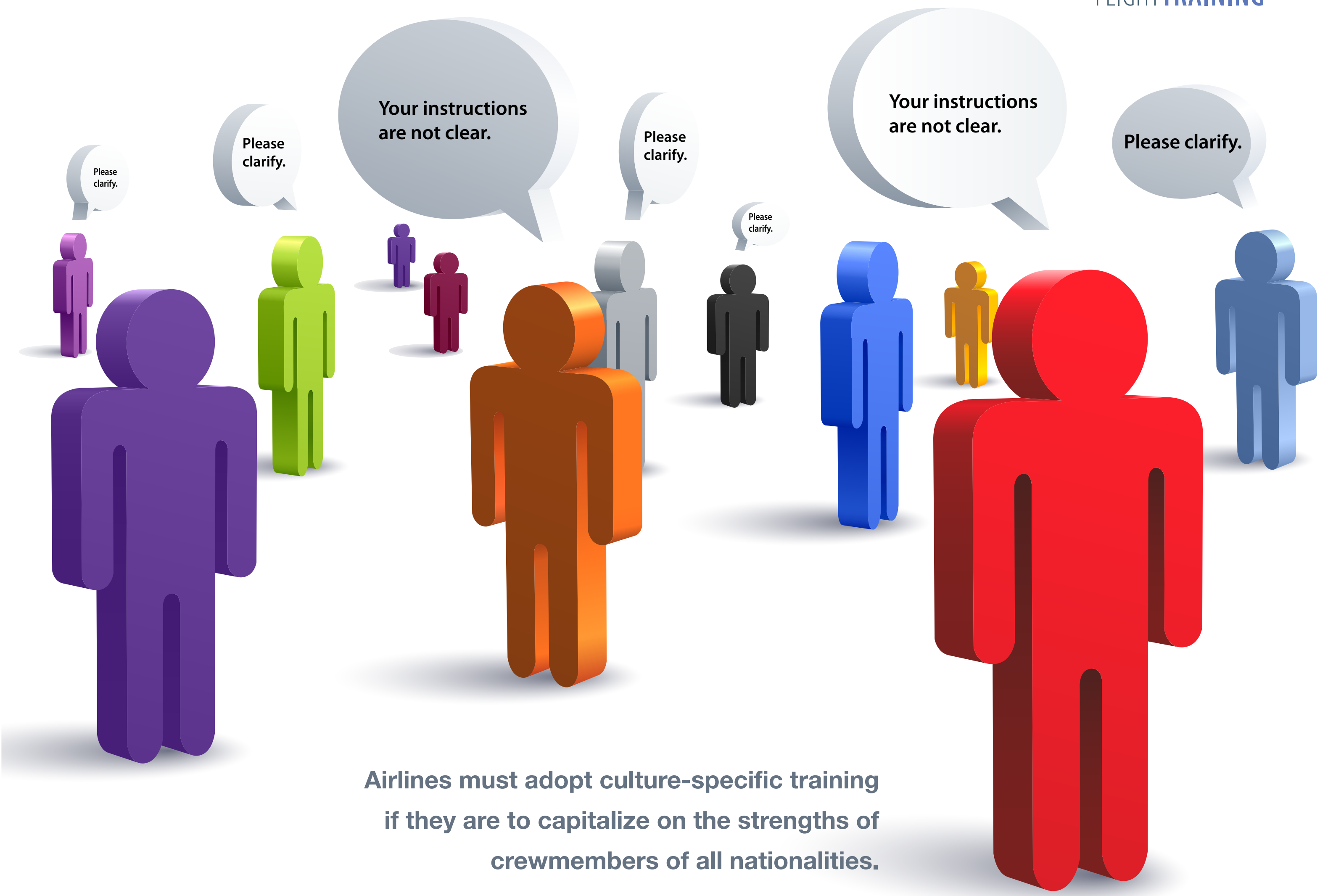
At 0214:17, the ground-proximity warning system began to generate "SINK RATE" and "PULL UP" warnings.

The flight data recorder ceased to function at 0214:28. "The last recorded values were a vertical speed of 10,913 fpm, a groundspeed of 107 kt, pitch attitude of 16.2 degrees nose-up, roll angle of 5.3 degrees left, and a magnetic heading of 270 degrees," the report said. "No emergency message was transmitted by the crew. The wreckage was found at a depth of 3,900 m [12,796 ft] on 2 April 2011."

This article is based on the English translation of the BEA's "Final Report on the Accident on 1st June 2009 to the Airbus A330-203, Registered F-CZCP, Operated by Air France, Flight AF 447, Rio de Janeiro–Paris." The report is available in English and the original French at <www.bea.aero>.

Note

1. The recommendations will be discussed in the September issue of *AeroSafety World*.



Airlines must adopt culture-specific training if they are to capitalize on the strengths of crewmembers of all nationalities.

BY DAVID M. BJELLOS

Multicultural CRM

© Mark Stay/iStockphoto.com

The 2005 crash of a Helios Airways Boeing 737-300 — with its pilots incapacitated by hypoxia after they failed to recognize a cabin pressurization system malfunction — is a prime example of what can happen when communication and crew resource management (CRM) break down in a modern, multicultural cockpit.[1]

All 121 people in the airplane were killed when the 737 depressurized and ran out of fuel, the engines flamed out and the airplane crashed in Grammatiko, Greece, during what was to have been a flight from Larnaca, Cyprus, to Prague, Czech Republic, with a stop in Athens.

In its final report on the accident, the Hellenic Air Accident Investigation and Aviation Safety Board said the crew had failed to recognize that the cabin pressurization mode selector was in the wrong position.

The Helios crew exhibited poor CRM before takeoff and during climb, and the difference in their nationalities and primary languages — the captain was German, and the first officer was Cypriot — contributed to poor communication during the confusing, high-stress event.

Stressors reduce the ability of humans to exchange information even when they are fluent in the same language. The added dimension of a dynamic environment and complex set of specialized tasks in the cockpit adds to the difficult undertaking of effective communication.

In the Helios accident, a blaring cabin altitude warning horn and the illumination of master caution lights

Prior to the 1980s, there were relatively few multicultural, multilingual cockpits.

(due to lack of equipment-cooling airflow in the aircraft's unpressurized state) degraded the crew's cognitive abilities and processes; inter-cockpit communications were reduced, perhaps in part because English was a second (or possibly third) language for the crew.

New Phenomena

Prior to the 1980s, there were relatively few multicultural, multilingual cockpits. As the number increased, many developing countries did not appreciate the value of CRM. The Helios accident report indicated that CRM training was in place at the airline, but it was perfunctory. Like many early detractors of CRM training, Helios management may have felt that it was of little benefit to them due to the (then) lack of quantitative data on accident reductions directly attributed to applied CRM principles.[2]

How, then, do we expect new entrants into global aviation to implement innovative solutions to bridge the gulfs that separate pilots in language, professional expectations and cultural interaction in many of today's cockpits so as to maintain an exceptional record of safety? The answer includes involvement at all levels, with renewed emphasis directly on pilot crewmembers.

A Different Approach?

It would be impossible to account for all the variables that exist among cultural norms and address each individually. Therefore, the CRM model of the future must return to the basic premises of advocacy, communication and inquiry. That means that commanders and subordinates will be required to "re-learn" the way they communicate during high-workload periods and emergencies. This does not mean that they must learn a new "language"; rather, it introduces new idiomatic principles.

To understand the new principles, it is vital to introduce some basic terms from psychology that help define how groups within a profession interact culturally:

- Power distance (PD) — One's perception of (and response to) hierarchy, seniority or rank.
- Individualism and collectivism (IND) — A reference to whether a person's goals are self-oriented (individualism) or team-oriented (collectivism).

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- Uncertainty avoidance (UA) — The threat level perceived during high-stress events. High uncertainty avoidance involves a preference for standard operating procedures (SOPs), direct face-to-face communications and leaving as little as possible to chance. Low uncertainty avoidance involves acceptance of high stress and higher exposure to risk as part of the job, with more tolerance and flexibility.[3]

Once learned, these three basic premises must be applied at the individual pilot level through a three-step developmental mode:

- Awareness — Be mindful that you cannot accurately profile another crewmember simply because of assumptions about his or her national culture or language.
- Knowledge — Incorporate the skills learned from your company's formal CRM courses and recognize key phrases and terms that will better enable communication success and understanding of another's perceived strengths and weaknesses.
- Skill — Apply the lessons learned to your daily flying activities, and recognize what works (and, more importantly, what does not) with your colleagues.[4]

Returning to the basics of early CRM will require trainers to incorporate explicit phrases — the new idiom — for crewmembers of different primary languages and cultures to employ when a message is ambiguous.

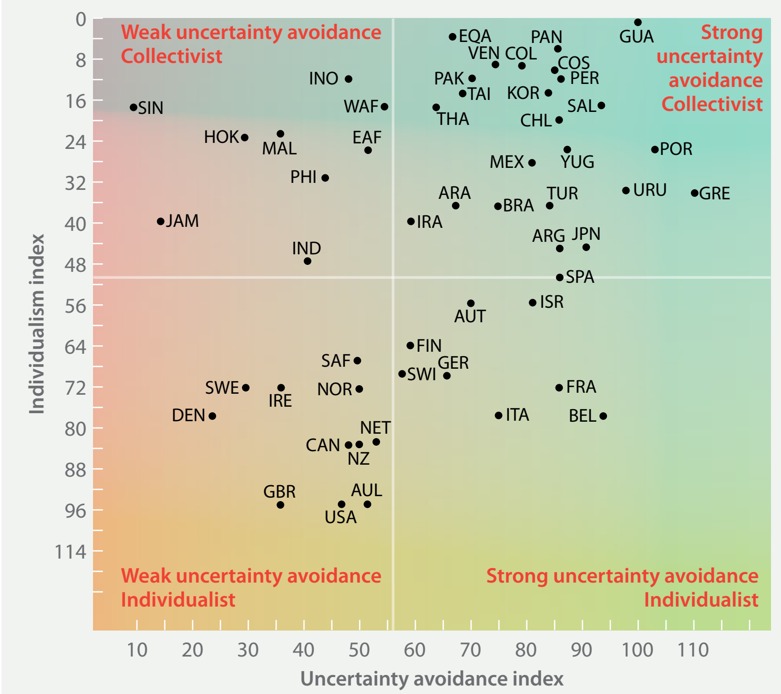
"Please confirm you would like me to perform the following procedure …" and "Your instructions are not clear — please clarify …" are examples of procedural, word-specific SOPs planned for the latest iteration of CRM.

Error Management CRM

Well into its third decade, CRM has evolved through several generations — with advances in the cockpit, in airspace and, increasingly, in many other facets of aviation, such as air traffic control (ATC), dispatch and maintenance. Of significance to aviators was the fourth generation — developed by CRM pioneer Robert Helmreich, who died in July (see p. 12) — which incorporated CRM procedures into the implementation of the U.S. Federal Aviation Administration's advanced qualification programs (AQP).

As described by Helmreich, "The AQP gave airlines the ability to develop innovative training reflecting the needs and cultures of their organizations. Two of the requirements of AQP have been the integration of CRM into technical training and the provision of full mission, non-jeopardy simulation (line oriented flight training, or LOFT). As part of this integration of CRM with technical training, some airlines began to 'proceduralize' CRM by adding specific behaviors to their checklists and to require formal evaluation of crews in full mission simulation (line operational evaluation or LOE)."[5]

Individualism and Uncertainty Avoidance



Relearning is required to ensure proper communication when dealing with people of multiple cultures. This figure compares various countries according to their extent of individualism and uncertainty avoidance, defined on this page and on p. 20.

Source: David M. Bjellos; Hofstede, Geert. *Culture's Consequences: Company Values, Behaviors, Institutions and Organizations Across Nations*, 2nd Edition. Thousand Oaks, California, U.S.: Sage Publications, 2001.

Figure 1

The true value-added benefit of AQP-type training is the ability of trainers to tailor innovative programs that combine competency (accuracy of airmanship skills) with crews using scenario-based simulation where the outcome is not certain until completion. Training and checking then become continuous and contiguous, and simulator instructors are able to evaluate the decision-making processes (broadly defined as aeronautical decision making, or ADM) and not just the outcome of a particular maneuver. Examples of good scenario-based training profiles might include the Nov. 4, 2010, uncontained engine failure on a Qantas A380 en route from Singapore to Sydney, New South Wales, Australia (p. 54),[6] or the June 1, 2009, loss of control and crash into the Atlantic Ocean of an Air France A330 (p. 14).

Accumulated LOFT and LOE data have shown that better ADM is a direct result of better CRM.

The current model of CRM — the "sixth generation" — added the "error management" CRM (EM-CRM) approach, which was more broadly accepted among diverse national cultures than earlier versions. This model broadens its scope by "trapping" errors before they become consequential and by mitigating the consequences of errors that have eluded earlier defenses.[7]

Aviator's Mindset

Certain high-risk/high-stress professions such as aviation and medicine attract individuals with specific psychological characteristics, particularly communicative processes. These processes are called behavioral markers.[8]

One of the negative behavioral markers of aviation professionals is denial of vulnerability to stressors like fatigue and danger. EM-CRM's central task is to convince pilots that error is unavoidable; as pilots capitalize on the strengths of their aviation culture, such as pride and motivation to succeed, they also need to understand their weaknesses. Although an organization's training procedures emphasize error-managing techniques, culture-specific CRM for flight crews of all languages and cultures most likely will help crewmembers interact better, personally and professionally, and their cultural differences will be viewed as strengths, not shortcomings, by top management.[9]

Another negative behavioral marker is a pilot's prejudicial attitude toward mistakes by fellow aviators. As trainers and universities expand their non-punitive policies on error, they report tremendous resistance from aviators to accept other people's errors, while willingly admitting their own. This ironic intolerance must be understood and acknowledged by all airmen before CRM can be effectively applied in real life.

Establishing Expectations

The foundational components of effective EM-CRM are full and interactive briefings and strict adherence to SOPs. Knowing that many flight crews meet for the first time at the pre-flight briefing, it might appear difficult to quickly establish team spirit and encourage open dialogue. The airlines' training programs must encourage trust and reinforce their non-punitive policy on error as part of that SOP. With organizational emphasis on the commitment to further reduce error-inducing conditions, captains can then more effectively brief all crewmembers on expectations and obligations to diminish hesitation and uncertainty, either of which constitutes a serious safety threat.[10]

Training the Trainers

Early CRM programs exported from the United States were not always well received in other countries. Having junior first officers question the authority of senior commanders was met with incredulity in high PD cultures.[11] Therefore, each airline must tailor the EM-CRM to meet the specific needs of its pilots. Even within regions with common languages or other characteristics — such as some countries of the Middle East, Latin America and Asia — EM-CRM is not transferable from one airline to another.[12]

Trainers should encourage flight crewmembers to communicate clearly with each other. Just as pilots have no problem asking ATC to "say again" or "please clarify" instructions, they should be unwilling to accept an instruction from an aircraft captain or a reply from a first officer that is imprecise or unclear.

With practice, this becomes a repeatable and consistent tool for pilots to use to overcome misunderstandings during all flight scenarios, and especially during high-stress events.

The Cost of Failure

Many successful airlines outside the Western hemisphere — such as Emirates, EVA Air and Singapore Airlines — operate with robust multicultural CRM/ADM training, and their focus on safety has paid significant results. But what of the emerging-market nations, including China, India, Indonesia, growing Middle Eastern countries and Vietnam, which are rapidly filling their ranks with skilled, Western-trained (and, increasingly, Eastern-trained) expatriate pilots and staff?

Many air carriers in these countries are purchasing advanced equipment. However, some lack the *ab* *initio* training and multi-crew pilot licensing that are used by most Western European carriers with superlative safety records. It is vitally important that new entrants create proactive, sixth-generation CRM-based training, as have their Western counterparts. Recurring regional instances of safety lapses using advanced equipment suggest that neglecting or overlooking human factors issues — including effective CRM training — will continue to adversely affect commercial aviation accident rates.

Conclusions

Helios Airlines employed 33 percent of its workforce seasonally, in spring and summer only, to move people quickly, and this transience of staff contributed to individualism over collectivism in the airline's approach to safety. The first officer had a history of not following checklist SOPs, and the captain was considered brusque and distant by both pilots and cabin crewmembers, the accident report said. The barriers of personality conflict, language, cultural traits and the captain's weak advocacy of good teamwork were all exacerbated by the airline's lackluster CRM program, and the results were disastrous.

If airlines globally expect to reach safety parity, they must fully commit to airline- and culture-specific EM-CRM training as a primary tool in overcoming cultural resistance at both national and company levels. For aviators and trainers, an opportunity exists to learn from the new idiom and a new ethos, and to integrate fresh thinking into problem solving. This CRM approach will capitalize on the strengths of each participant. As with all highly technical pursuits, that most complex of components — the human — remains both our problem and our solution.

David M. Bjellos manages an aviation department that operates fixed-wing and rotary-wing aircraft. He holds a master's degree in aeronautical science from Embry-Riddle Aeronautical University and is a member of the Flight Safety Foundation Corporate Advisory Committee and the Chief Pilots Roundtable.

Each airline must tailor the EM-CRM to meet the specific needs of its pilots.

Notes

1. Hellenic Air Accident Investigation and Aviation Safety Board. Aircraft Accident Report 11/2006, Helios Airways Flight HCY522, Boeing 737-31S, at Grammatiko, Hellas, on 14 August 2005.
2. Helmreich, Robert L.; Merritt, Ashleigh, C. Safety and Error Management: The Role of Crew Resource Management. University of Texas Aerospace Crew Research Project, Department of Psychology, The University of Texas at Austin. 2000.
3. Li, C.; Harris, D.; Yu, C. "Routes to Failure: Analysis of 41 Civil Aviation Accidents From the Republic of China Using the Human Factors Analysis and Classification System." Accident Analysis and Prevention. 2008.
4. Pedersen, Paul. A Handbook for Developing Multicultural Awareness (2000, 3rd edition). American Counseling Association.
5. Helmreich, Robert. "Red Alert." Flight Safety Australia Volume 10 (September–October 2006). <casa.gov.au/fsa/2006/oct/24-31.pdf>.
6. The A380's crew shut down the damaged engine and returned to Singapore for landing. None of the 469 people in the airplane was injured. The Australian Transport Safety Bureau is continuing its investigation of the occurrence.
7. Helmreich and Merritt.
8. Helmreich, R.L.; Wilhelm, J.A.; Klinect, J.R.; Merritt, A.C. (2001). "Culture, Error and Crew Resource Management." In E. Salas, C.A. Bowers, and E. Edens (editors), *Applying Resource Management in Organizations: A Guide for Training Professionals* (pp. 305–331). Princeton, N.J., U.S.: Erlbaum.
9. Helmreich and Merritt.
10. Ibid.
11. Ibid.
12. Ibid.

Further Reading From FSF Publications

Werfelman, Linda. "Assert Yourself." *AeroSafety World* Volume 6 (May 2011): 46–48.

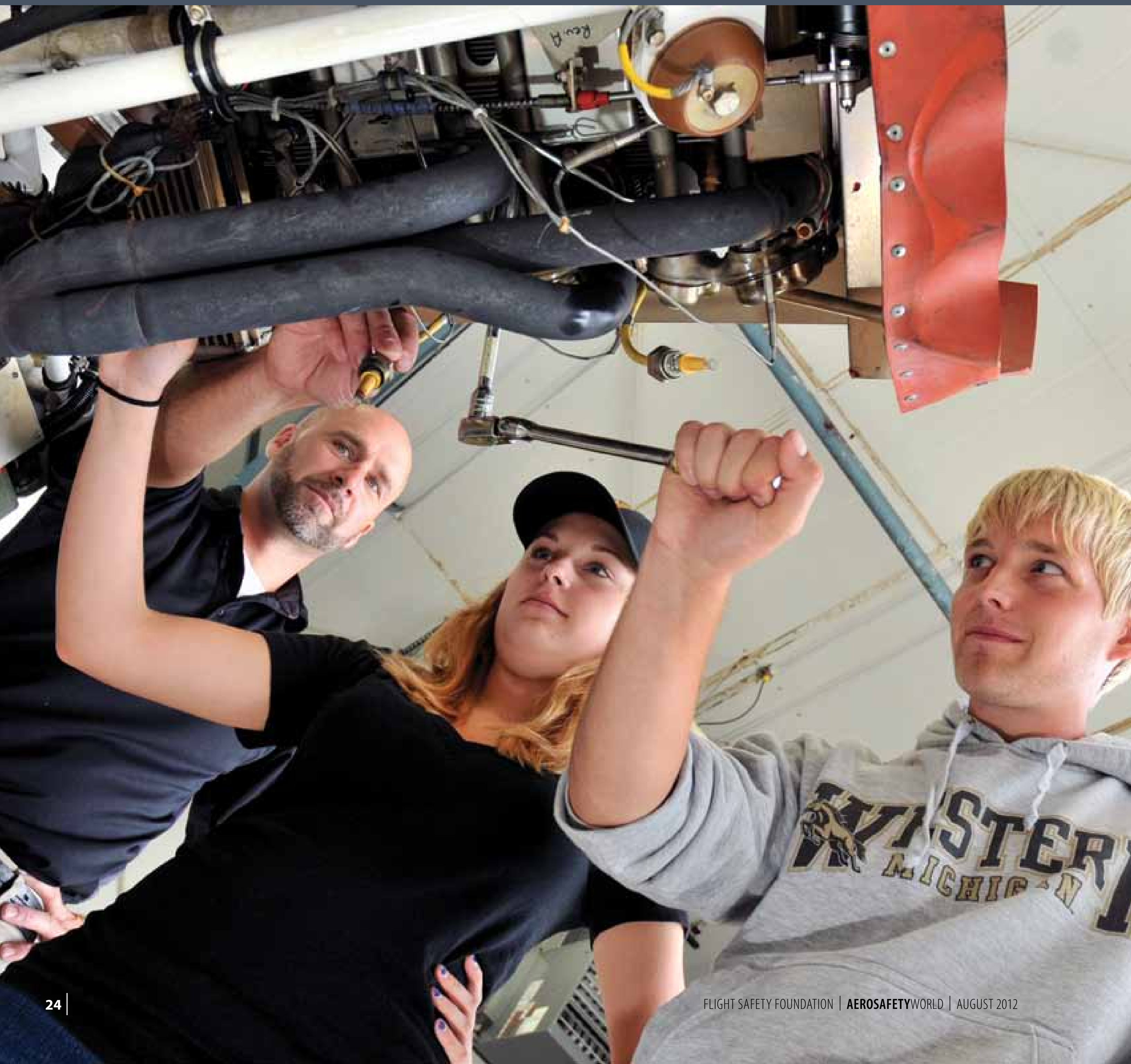
Frisinger, Shari. "Emotionally Enabled." *AeroSafety World* Volume 5 (August 2010): 19–23.

Lacagnina, Mark. "Missed Opportunities." *AeroSafety World* Volume 2 (January 2007): 18–24.

BY WAYNE ROSENKRANS | FROM ORLANDO

Positive Space for Gen Y

Engaging young aviation professionals without stereotyping strengthens multi-generational safety culture.



Fascination with generational differences among today's working aviation professionals has moved beyond specialists in recruiting and training to others with direct responsibilities for operational safety. A recent indicator was the number of presentations and discussions during the World Aviation Training Conference and Tradeshow (WATS 2012) in Orlando, Florida, U.S., in April about integrating Generation Y (Gen Y) into the industry. Gen Y — one of several popular terms, such as *millennials* — refers to people born between 1982 and 2004 by some definitions (Figure 1).

People who train pilots, maintenance technicians and flight attendants for regional and major airlines raised a few concerns relevant to safety, but also pointed to advantageous attributes based on their experiences with this generation (see "Cabin Crew Adaptations," p. 28). Several Gen Y college students acknowledged the concerns and encouraged collaborative solutions free of stereotyping. They also shared their personal ambitions and adaptation to industry safety culture. Maintenance technology students said that most Gen Y classmates have had lifelong mechanical interests and hands-on experiences, quickly adapt to the most advanced instructional/reference technology and now expect to earn international certifications.

"As a group, Millennials are unlike any other youth generation in living memory," Neil Howe and William Strauss, specialists in generational issues in the United States, wrote 12 years ago in one of their series of books.[1] "They are more numerous, more affluent, better educated and more ethnically diverse. More important, they are beginning to manifest a wide array of social habits … including a new focus on teamwork, achievement, modesty and good conduct. Only a few years from now, this can-do youth revolution will overwhelm the cynics and pessimists."

They predicted that Gen Y would be differentiated from older coworkers in the degree to which they are *special*, that is, raised with the sense that they are collectively "vital to the nation and to their parents' sense of purpose"; *sheltered*, that is, partly "the focus of the most sweeping youth safety movement in American history"; *confident*, with high levels of trust, optimism and a sense of their generation's power and potential but, individually, relatively fearful of failure and prone to pursue "less risky career goals"; *team-oriented* with "strong team instincts and tight peer bonds"; *achieving* in relation to standardized testing with a "mindset of planning ahead for an orderly future"; *pressured* in terms of expectations "to study hard, avoid personal risks [and] excel"; and *conventional*, that is "comfortable with their parents' values" and supportive of social mores.

Shelby Beauregard, ambassador for recruitment and outreach for the College of Aviation at Western Michigan University (WMU), spoke on behalf of about 30 WMU students who consider many Gen Y attributes valid, though not necessarily applicable outside the United States or to specific individuals. Overall, this group is concerned that aviation employers will prejudge them as members of Gen Y without knowing them as individuals, she said.

"When I [attended] last year, I learned that some aviation professionals were afraid to retire because they were afraid of what my generation was going to do," Beauregard said. "So how do we bridge this generation gap we all feel? … There are many stereotypes that have been placed on Generation Y, and many of these stereotypes are seen as weaknesses. But I think

Workforce Generations Today

Birth Year Range[1]	Generation
1922–1945	Traditionalists
1946–1964	Boomers
1965–1980	Generation X
1981–2000	Millennials[2]

Notes:

1. Depending on research cited, birth dates for Generation Y typically vary from the early 1980s to the early 2000s.
2. Some demographic specialists prefer this term instead of *Generation Y*.

Source: Sherry Saehlenou, Boeing Commercial Airplanes

Figure 1

that these weaknesses are often misunderstood and misinterpreted, and that they can actually become strengths for companies."

The assertion that this generation sees itself as "entitled" is the most common stereotype she has heard, but she said that "achievement-oriented" is a truer descriptor. However, their lifestyle aspirations often are seen by older aviation professionals as out of synch with aviation workplace demands. Citing a few tragic, news-making events that have shaped their ideas about spending time with family since 2001, Beauregard said, "All of the [life] events that have happened to us constantly remind us that life is short, so we enjoy flexibility in our schedules … a work[-life] balance. … Generation Y is ambitious; we are not afraid to take on the big tasks. And we appreciate when our creativity and our input are accepted into the workplace."

Craig Bentley, a captain and vice president of operations, Cape Air/Nantucket Airlines, also mentioned these professional/lifestyle aspirations. "What has that translated to for those of us in the hiring community at the regional airlines?" he said. "We see new-hire pilots who request vacation time prior to serving the customary one year … at the airline, [the point] where most [airlines] would begin to offer that benefit. We also see numerous requests for time off and restrictions on the days that they can work, which was unheard-of years ago. But they have busy social calendars, their families are important. … We definitely see that at our airline."

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Some of the Gen Y attributes that ring true to the students also are relevant to aviation safety. "We like clear instructions," Beauregard said. "We work in groups. … I have been taught from a young age that working in a group and working as a team is the way to get things done."

At the same time, this generation's penchant for high-stimulation digital environments — such as habitually texting, accessing social networks and listening to music during study, work and leisure activities — and its reputation for leaving employers after one or two years are among topics worth cross-generational dialogue in aviation environments, she suggested.

"We have to remember that we are four generations working in this industry together, and we all have one dream," Beauregard said. "[Gen Y] wants to learn from you, so talk with us, not to us. … We also we need mentorship, [so] connect with us … and share your passion."

Gen Y First Officers

John Colquitt, describing his preparations before being hired by American Eagle Airlines, recalled that he had spent an unexpectedly long, and sometimes discouraging, period as a flight instructor. He applied to four air carriers and two cargo operators, and received interview invitations from two. Colquitt said that his interview preparation was a team effort by a study group, and included Internet-based research on current questions that other applicants to airlines had posted after actual interviews.

Members of the study group role-played to practice answering expected interview questions, then "took it a step further" by imagining how interviewers might ask more probing questions and rehearsing how they would buttress answers. They also practiced attitude instrument flying and conducting instrument flight procedures on personal computers equipped with Microsoft Flight Simulator, a control yoke, rudder pedals and a throttle quadrant, he said.

Flight time as a certificated instrument flight instructor and familiarity with analog instrumentation proved to be advantages after being hired in August 2010, recalled Colquitt, who described his training experience on two aircraft types. "[If the simulator] instructor says, 'Hey, we are going to shoot NDB [nondirectional beacon] approaches' … [I'm] like 'OK, I can do this because [I] taught that,'" he said. Sometimes, however, his simulator partner would struggle to recall how to conduct that type of approach "because he was raised on GPSs [global positioning system avionics] and GPS approaches," he said.

Colquitt fielded a question about how disconcerting economic news affects his outlook about his new airline career. "I bring myself to the airline and to the situation [with] the sense that I am not entitled to anything; this is an incredible opportunity," he said. "[I think,] 'You're going to let me fly this $30 million airplane? Awesome, let's go — this is fun!' … That is what drives my positive attitude a lot of the time. … Now, I do see the signs … and I am trying to be smart with my decisions professionally."

Surprising Failures

Areas of failure by Gen Y and other pilot applicants in regional airlines' pilot hiring processes also were highlighted. "We have found in our own syllabus that if somebody is not getting through the simulator training program … either they can't keep up with the pace of the program, or they are far behind on instrument skills and procedures," said Paul Preidecker, a captain and chief instructor, Air Wisconsin Airlines. "I am not talking about [instrument] scanning, although that is certainly part of it. I am talking about fundamental knowledge of instrument procedures. This, of course, is a surprise to us. … Maybe we are taking an 'old school approach' and trying to apply it to the 'new school,' but I don't think so."

During the technical portion of face-to-face interviews by the airline, "we put a METAR [aviation routine weather report] in front of them and just say, 'Read this to us,'" he said. "There are people coming to us who cannot do that. In moments of exasperation, when I say, 'What's the problem?' [their] common comment is, 'Well, I don't get it in raw format. I pull out my iPhone and read the decoded version.' [Then I tell them,] 'That's great, except we don't do that in our airplanes. We hand [flight crews] raw data and say, 'You need to know the weather.' So that's a weakness.

"We give them [the type of instrument approach chart] that they are used to using and say, 'Alright, the glideslope is out of service on this runway. What is the missed approach point on a non-precision approach?' We hear a variety of disappointing answers. … We make an assumption that a commercial–instrument-rated pilot knows those things. If we discover [such weaknesses] in an interview, the chance that they will get hired is not so good."

Research by Air Wisconsin into the underlying causes of such applicant failures suggested that some Gen Y pilots may be unfamiliar with piloting fundamentals associated with legacy systems because of their sometimes-exclusive experience with advanced avionics and flight systems.

When asked the question about the missed approach point, one applicant erroneously "said very confidently, 'It's at the end of the runway,'" Preidecker recalled. "We said … 'Suppose you are in the clouds, and you can't really see? He said, 'I don't know, I just look on my [Garmin] G1000.'[2] Has there become an over-reliance on automation? Perhaps. … A lot of the people we are hiring right now … only know the new way.

Some leaders of U.S. regional airlines said they highly value pilot applicants who bring advanced jet training, flight instructor experience and high academic performance.

Cabin Crew Adaptations

Integrating Generation Y (Gen Y/millennial) flight attendants into the airline industry has required a bit of flexibility in the training community, according to several specialists. "The millennials are coming up with their own experiences, their own ways of communication — which we need to learn," Sherry Saehlenou, cabin safety instructor, Boeing Commercial Airplanes, told a session of the World Aviation Training Conference and Tradeshow 2012. "They want to know what is expected from them right from the top, and then [to be shown] the steps leading up to it. … They want their information in chunks, they want it right now. … They want it simple, and they want you to be honest. So eliminate the unnecessary."

She said that one Gen Y student explained to her, "We get 80 texts in a day. We are so connected. … So you [had] better tell me in the first two sentences why I need to read your email. … Life is moving so quickly that I don't have time [otherwise]."

Generational differences can exacerbate interpersonal communication barriers, a potential safety issue for crewmembers, said Colette Hilliary, flight/cabin attendant program manager, FlightSafety International. "We don't want to box anyone in [with stereotypes], but we do understand that the generations are diverse. … [Gen Y people] are very confident [about] their preferred methods of communication … and sometimes are impatient with people like me who haven't kept up with the leading edge of technology," she said.

One effect is that a choice of communication method can be emotionally divisive, said Shari Frisinger, president, CornerStone Strategies. "I hate when people text me … especially if [they] are in the next room. My thought is, 'You're texting me? I am not worth [the] five steps to come over and talk to me?' So we have to look at this, again, from the other person's point of view, from the different generations."

In 2011, Austrian company Flight Attendant Safety Training trained 2,000 new flight attendants for Lufthansa with particular attention to the attributes of Gen Y students, said CEO Wolfgang Jabornik. "They are used to doing last-minute learning, and they do not read manuals because they [prefer to] learn with trial-and-error," he said. "They also have a shorter attention span than earlier generations, and they lose interest very quickly if the learning environment does not facilitate [creativity]."

Johan Bostrom, a captain and director, training operations, Novair, focused on lessons learned while teaching a six-week course in 2011 at the Swedish charter airline. "We graduated 36 brand-new cabin crew between the ages of 21 and 45," he said. "The majority of the students actually were born in the late 1980s and early 1990s — [Gen Y] people." Trainers had been "nervous" that their exciting new computer-based training modules and online testing were not ready in time for this group, he said.

"To our surprise, [Gen Y students] weren't so eager to go online for the course-related issues," said Anna Mellberg Karlsson, chief cabin safety instructor, Novair. Moreover, in post-training feedback, they rarely mentioned technology and preferred studying a printed manual in the classroom. Gen Y students, however, immediately adapted to using a new Internet portal outside the classroom to access online manuals and weekly company bulletins. "[Other flight attendants] from age 37 and up … didn't like it at all when we put our manual on our portal and took their books away, and there is also hard resistance against Web-based training among them," Karlsson said.

In the airline's crew resource management (CRM) course, Gen Y pilots and flight attendants "actually are very assertive," Bostrom said. "Today, we [still] need to train our crew to be assertive, but to understand when [to be assertive]." Karlsson added that among Gen Y CRM students, "The majority are 'blind' to hierarchy."

Ann-Charlott Strandberg, head of training and quality manager, Cabin Aviation Training, said that about three-fourths of the Swedish company's first 500 students were born between 1981 and 1990. "We've had to change our methods of training to suit the students," she said. This involves taking a learning-style inventory and customizing lessons accordingly for each category of student.

Instructors encourage appropriate classroom Internet uses, such as Google/YouTube research conducted on smartphones, but struggle to enforce a "Facebook-free environment in the classroom during classes," Strandberg said. They ended up creating a Facebook group for students and instructors to post after-hours questions, answers and comments about the course.

— WR

Somewhere in between [the old way and only having automation experience] is probably what we are looking for."

A counter-impression of recently hired Gen Y pilots came from Cape Air's Bentley. He noted that pilot applicants trained by professional academies or flight programs accredited by the Aviation Accreditation Board International have experienced a washout rate of less than 5 percent in company training. As a result, the airline's hiring process for these applicants omits simulator checks and written exams, he said.

"The most important thing that we look for … is a safety mindset," Bentley said. "Where do they get that? Early in their training, hopefully, where they understand what a just culture is and the value of open, non-punitive reporting programs. … Some of the key things we look for are fundamental stick and rudder skills … good communication skills, leadership qualities, the ability to be a lifelong learner [and] to change to the demands in the industry, whether they be regulatory or economic. … So I would put it to … the industry that [given Gen Y technical prowess], we will spend a lot less time training the new aviators on the gadgets that we have in our airplanes, and a lot more time teaching them the fundamentals of flying an airplane."

Chief pilot offices and airline training departments swap anecdotes about Gen Y pilot behavior that falls outside company expectations, and companies' corrective responses. "Stories from my colleagues … sort of let me know that what I experience at Cape Air and our group is not unique in the industry," Bentley said. "There is the story of a first officer at a [major air] carrier who was skateboarding across the ramp on his way to preflight his airplane for the first flight of the day. … There is the story of the [commuter air carrier] captain who was jumpseating home and thought it would be a great idea if she used the [skate shoe wheels] in her sneakers to get down the jetway to ask for [a] ride home. In the past, those indiscretions might have been met with stiff consequences." He advised mentoring and leadership to "help steer [young aviators] in the right direction so that we have what the public demands."

Contextual Issues

"Any way you cut it, this is a difficult business … the last 10 years since 9/11 have been extremely difficult," said Paul Railsback, a captain and director of operations, Airlines for America (formerly the Air Transport Association of America). "Anybody who comes into this industry needs to realize — and needs to be emotionally prepared for the fact — that this is … probably going to remain a tough business for some time, although I think that the consolidation that is taking place is probably going to be good for the industry and good for the employees. … We may end up hiring entry-level [airline] pilots for their first airline to be a major airline, which we have never done before. This would be a major paradigm shift for us if it happens."

Gen Y's professional/lifestyle aspirations have been reiterated in two surveys, including one with responses from 206 University of North Dakota (UND) aviation students, primarily concerning the proposed rulemaking to implement a 2010 U.S. law mandating airline transport pilot (ATP) certificates and 1,500 hours of flight time for airline first officers (*ASW*, 9/10, p. 12), said Kent Lovelace, chairman, UND Department of Aviation.

"It goes back to those generational priorities that some of these young people have," Lovelace said. "Time away from family and friends is a big concern, and it is a priority. … We all maybe have those feelings." He suggested industry consideration of explicitly setting up schedules and other practices to make aviation careers more attractive to Gen Y.

"Another [theme in the UND survey] was the kind of flying they want to do, which is more hands-on flying as opposed to autopilot-FMS [flight management system], which obviously for an airline career isn't necessarily realistic," he said.

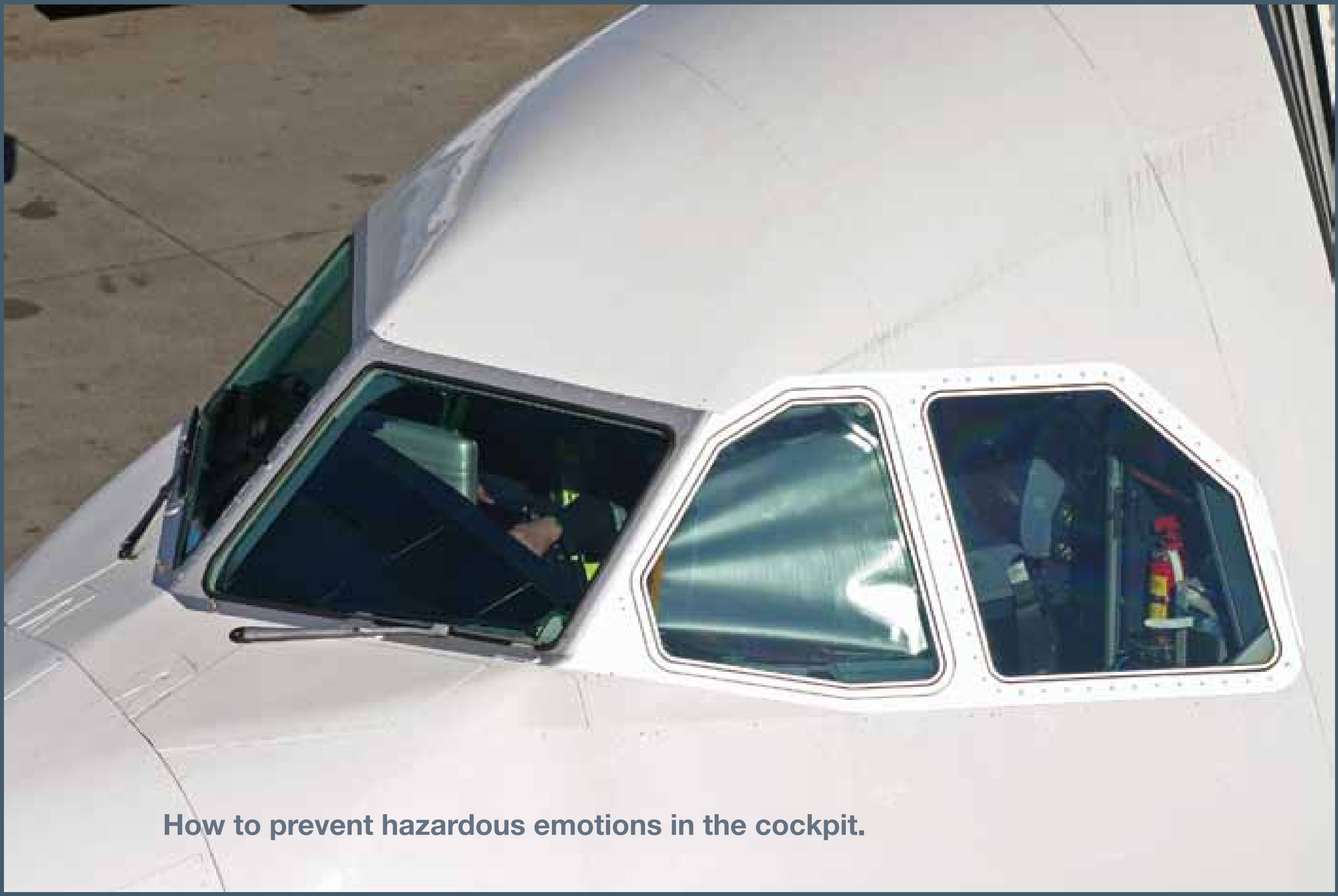
Other responses reflected firm commitments to stay the course to airline flight decks, however. "So, we still have a lot of determined young people out there that want this career," Lovelace said, quoting a student who wrote, "I've had the dream to fly for an airline forever, since I was three or four years old. I won't let anything stand in my way."

'We may end up hiring entry-level [airline] pilots for their first airline to be a major airline, which we have never done before.'

Notes

1. Howe, Neil; Strauss, William. *Millennials Rising: The Next Great Generation*. Cartoons by Matson, R.J. New York: Vintage Books, 2000.

2. The Garmin G1000 is an all-glass, integrated avionics suite designed for installation by original equipment manufacturers.



How to prevent hazardous emotions in the cockpit.

Angry Birds

BY HEATHER BALDWIN

In May 2011, a European regional airline captain, in what he thought was jovial banter, called his first officer (FO) a derogatory name during preflight preparations. Later, he ignored the FO's advice to avoid dark storm clouds. The FO, still seething from the preflight put-down and now furious about the heavy turbulence they were encountering, called the captain a "control freak," and a heated argument ensued. They flew the return trip in virtual silence, and both pilots subsequently were fired for their unprofessional and unsafe conduct. [1]

While the situation falls at the extreme of pilot anger and miscommunication, it highlights the complexities of cockpit communication. Pilots often fly with crewmembers they barely know — or have never met — and with whom they may well have innate personality conflicts. If they are former military, they may have firm notions about rank and hierarchy that are not shared by their flying partner. They may be dealing with marital or financial difficulties that make them more irritable than usual. They might have slept poorly in an unfamiliar hotel in a far-flung time zone. Add to all that the high-pressure environment of commercial flight — and the inability of pilots to "step out of the office" and walk off anger — and it's easy to see how a brusque, unthinking comment can bruise an ego, fuel a temper and become the source of a multi-day standoff.

"Negative interactions between cockpit crewmembers can contribute to an environment where people feel unsafe or unsure about saying what's on their mind," said Ron Nielsen, a retired US Airways captain, professional counselor and founder of FearlessFlight. "I have been in many crew situations where 'elephants' in the cockpit were as much a part of the crew as either of the pilots." Nielsen and other behavioral specialists say that eliminating these elephants and maintaining a congenial, professional relationship in the cockpit is a matter of learning good relationship-building and conflict-resolution skills. Here are five steps for becoming better at both:

Know Your Style

Better understanding your flying partner starts with better understanding yourself, said Nielsen, who recommends that all pilots take the DISC personality assessment.[2] When Nielsen used to counsel with "difficult" pilots, one of his first moves was to administer a DISC assessment, which helps people better understand their own behavioral style and what other behavioral styles are likely to cause conflict or tension. This knowledge minimizes personality clashes by helping pilots understand the "why" behind their differences.

Nielsen once counseled a captain whose DISC assessment revealed that he highly valued both adherence to standards and not imposing his will on others. These values would often clash when an FO wasn't exactly following procedures but the captain was reluctant to force the issue. "The captain would just sit there and wait," Nielsen recalled. "It took the FO about three seconds to get steamed, and then there was a war in the cockpit." Once the captain understood these aspects of his personality and became conscious of how they were affecting his FOs, he made some changes and his workplace relationships improved dramatically.

Seek to Understand

When you first meet the person with whom you'll be flying on a trip, be careful not to judge too quickly, advised Michael Crom, executive vice president and chief learning officer at Dale Carnegie & Associates. "Check your assumptions; they may not be accurate," said Crom.

If someone initially comes across as cold, it may simply mean they are slow to warm up to unfamiliar people, not that they are difficult. Or if you make a joke and the other pilot doesn't react, it doesn't mean that person is a jerk, Crom said. It could mean that he or she has heard the joke 10 times before, or is a serious person, or is thinking hard about something else and not able to process the joke while processing the other information. Be open to other possibilities. Too-quick judgments lead to misunderstanding and miscommunication.

Be Slow to Anger

Pilots can head off personal conflict before it ever gets started by making a conscious decision to keep their anger in check. "The things that start arguments seem important in the moment, but when you think about it later, you realize they were really petty," said Doug Staneart, chief executive officer of The Leaders Institute, an organization focused on next-generation leadership development.

For instance, the captain who called his FO a derogatory name was certainly unprofessional, but had the FO not allowed it to light the flames of anger, both pilots might still be employed. "The natural human reaction when we feel insulted or offended is to get angry and respond in kind," said Staneart. "But generally people aren't intentionally trying to make the other person mad."

"You've got to be able to distinguish between what was said and your interpretation of what was said," added Larry Barkan, an expert in conflict resolution and associate of The Pivotal Factor, a consulting firm. The vast majority of the time people are not aware that they have caused offense and did not mean to do so. "Hold onto

Better understanding your flying partner starts with better understanding yourself.

your anger until you understand the other person's intent," said Barkan. "Be willing to give up being right and making the other person wrong."

Question Mistakes

Occasionally, one pilot needs to point out another's mistake. To bring attention to an error without creating hostility, use a question, said Staneart. Questions feel less threatening than direct orders or factual statements, so they are more likely to keep the atmosphere congenial.

For instance, if an FO shows no sign of initiating the descent at the right time, the captain could say, "Hey, would you mind beginning the descent in the next five to ten miles?" Or if a pilot misses an item on a checklist, the other could say, "Could you double check those last three items?" This approach will elicit cooperation and appreciation for cool handling of a lapse, whereas an admonition or biting remark will create animosity.

To bring attention to an error without creating hostility, use a question.

Unfortunately, the latter approach is all too common. Nielsen once flew with a captain who painstakingly adhered to standard operating procedures. One day after about three legs, the captain called for a checklist, and Nielsen started calling the items. "I'd done it about 50,000 times and even though it [the checklist] was in front of me, he could tell I was doing it from memory," he said. "He let me get about two-thirds of the way down the list and then he said, 'Read the [expletive] checklist!' I'd been doing this all trip, so obviously his ire had been gradually rising until he finally blew."

Had the captain said, "Hey, Ron, could you reference the checklist more accurately?" Nielsen said he'd have been happy to comply. Instead, with just a few heated words, the captain destroyed their working relationship for the remainder of the trip.

Speak Up

No matter how well someone manages cockpit relationships, there will be times when a flying partner causes feelings of anger, frustration, offense or other negative emotions. When that happens, speak up as soon as it is feasible, because silence gives tacit approval to the action, fosters misunderstanding and is unfair to the offender, who likely has no idea he or she caused bad feelings.

Start by asking permission. Questions such as "Can I give you feedback on something?" or "Can I tell you how your last comment landed with me?" are good openers and will prepare the person to receive input. Barkan likens the "permission" question to letting someone know you are going to throw a ball. "If I throw you a ball without telling you it's coming, you might not catch it because you aren't ready," said Barkan. "It's the same thing in resolving conflict."

Next, describe how their words or behavior impacted you and what you'd like the person to do instead. For example,

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"When you swear at me, it feels demeaning. When you'd like me to do something differently, my request is that you point out the problem without using profanity." Then leave it there. Many people make the mistake of going on to explain themselves, but that's a trap.

"Use as few words as possible because the more you explain yourself, the weaker your argument becomes," said Barkan. "If you get into the reasons you feel insulted or offended, you'll wind up in a discussion of whether your reasons are valid."

Last, gain commitment by asking, "Will you do that?" Don't ask "Can you?" or "Could you?" or "Will you try?" And make sure your tone of voice is neutral so the other person doesn't feel threatened or challenged. Most of the time, you'll get a "yes" and the conflict will be resolved, paving the way for a positive working relationship. If you get a "no," seek to understand the other pilot's point of view with genuine curiosity, not judgment.

In an emergency, safety must take precedence over worries about interpersonal relationships. If the left engine is on fire, the captain shouldn't be fretting about how to best communicate this. But those situations are rare. The rest of the time, it's worth paying attention to the critical skills of relationship building and conflict resolution in order to create a more cooperative, more enjoyable and ultimately safer working environment.

Heather Baldwin is a Phoenix, Arizona–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.

'Innerview' Conversation Starters

Cockpit conversations can be tricky. What do you talk about with a person you've never met and with whom, based on initial impressions, it seems you have little in common? The age-old advice about avoiding conversational minefields such as politics and religion still holds true today, and smart pilots will sidestep these topics. So how do you start a good conversation that builds a positive relationship?

Ask your flying partner about himself or herself, says Michael Crom, executive vice president and chief learning officer, Dale Carnegie & Associates. "Most people like to talk about themselves, and if you're interested in *me*, that's a pretty interesting topic," said Crom. Furthermore, by getting co-workers to open up about their backgrounds, their hobbies, their families and more, you will better understand them, decreasing the likelihood of conflict.

The key to doing this well is to plan ahead. Crom and his team arm clients with a list of "innerview" questions so they are always prepared to build relationships and gain insights into others. The questions, he said, should not feel like an interrogation but should be sprinkled naturally into conversations. When delivered with an attitude of genuine interest and nonjudgment, they help to open the lines of communication so pilots better understand and appreciate their flying partners and foster a positive atmosphere in the cockpit. Here are some examples:

Factual Questions

Where did you grow up?

What kind of activities were you involved with as a child?

What was your first job?

Where did you go to school?

How long have you worked here?

What is your family situation?

What do you do outside of work?

Causative Questions

Why did you pick that particular school?

How did you happen to work for this company?

How did you get involved with that particular hobby?

Value-Based Questions

Tell me about a person who had a major impact on your life.

Tell me about a turning point in your life.

Tell me about a high point in your life.

What was a particularly low point for you? What got you through it?

— HB

Notes

1. *Daily Mail Online*. April 19, 2012.
2. DISC, or DiSC, is a behavioral model developed by William Moulton Marston, a psychologist. As described in Marston's 1928 book *Emotions of Normal People*, the model comprises four primary behavioral styles: dominance, inducement, submission and compliance. DISC self-assessments are available via the Internet.

persistent problem

BY CLARENCE E. RASH

An analysis of U.S. helicopter accident rates shows no decrease in pilot error.

Although annual accident rates for U.S.-registered civil helicopters decreased and leveled off in the past decade (Figure 1, p. 36), the role of human error — primarily pilot error — persists (*ASW*, 12/11–1/12, p. 34).

Sixty-nine percent of the 1,653 accidents in the U.S. National Transportation Safety Board (NTSB) database involving U.S.-registered civil helicopters from 2001 through 2010 were attributed to pilot error.[1] This implies that approximately seven of every 10 accidents were a consequence of human action — or lack of action — by pilots (Figure 2, p. 36).

Exactly what constitutes human error? One formal definition is "an inappropriate action or intention to act, given a goal and the context in which one is trying to reach that goal."[2]

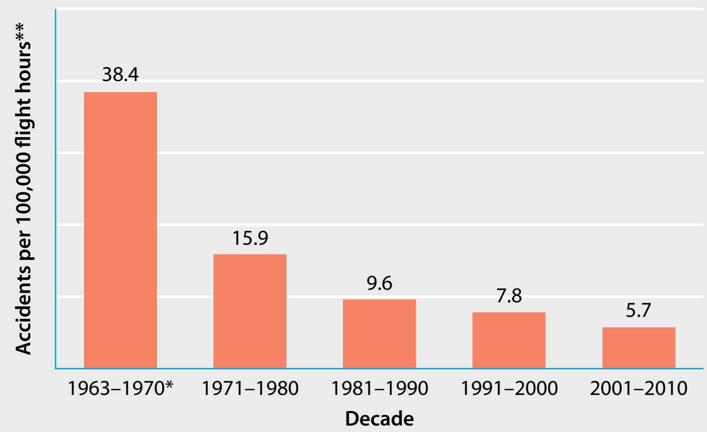
Human error can include any of the following:[3]

- Failing to perform, or omitting, a task;
- Performing a task incorrectly;
- Performing an extra or non-required task;
- Failing to perform a task within the required time limit; and,
- Failing to respond adequately to an emergency situation (which abruptly changes not only the goal but also the tasks required to achieve the new goal).

Humans are a remarkably robust species — creative, flexible and adaptive to our surroundings and the constantly changing demands placed on us. Our weaknesses include frequent inability to maintain alertness (attention) and to respond to a situation with the correct actions.[4]

Realistically, human error may be unavoidable. However, it can be reduced significantly through training, mistake-proofing designs and developing prevention strategies such as checklists. Errors can increase with fatigue, physical and emotional stress, use of alcohol and other drugs and medications, and a host of other environmental and psychosocial factors.[5] These

Accident Rates Involving U.S.-Registered Helicopters, 1963–2010



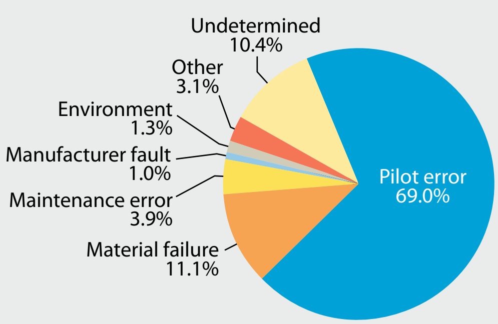
*The first helicopter accidents in the U.S. National Transportation Safety Board database occurred in 1963.

**Estimated flight hours

Source: Clarence E. Rash

Figure 1

Accidents by Causal Factor, 2001–2010



Note: Does not total 100 percent because of rounding.

Source: Clarence E. Rash

Figure 2

factors can negatively influence the ability to observe, detect and assess ongoing events. This can lead to slow reaction times and poor decision making, both of which can lead to errors.

Cognitive science describes several primary types of human errors, each corresponding to different stages in the cognitive or decision-making process.[6] In one model, human errors are typed as either *slips and lapses* or *mistakes*.

Slips and lapses correspond to errors in execution and/or recall of learned steps of an action sequence; for example, a person may intend to perform an action but actually does something else instead. Errors of this type also include forgetting to reposition a switch, or shutting off the wrong engine during an emergency.[7] Slips and lapses usually occur when attention resources are insufficient for a task or are overwhelmed by other events. For example, in the Three Mile Island nuclear power plant accident in Middletown, Pennsylvania, U.S., in 1979, the attention resources of the safety monitoring personnel were overwhelmed by more than 100 simultaneous warning signals.

Mistakes are errors that correspond to incorrect intentions or plans. These are errors in choosing an objective or specifying a method of achieving it. Mistakes are identified as being rule-based or knowledge-based.[8] Rule-based mistakes are made when the wrong rule is selected for action — that is, actions match intentions but do not achieve their intended outcome due to incorrect application of a rule. An example is the use of the wrong type of fuel in an engine. Knowledge-based mistakes are made when the wrong plan is created for a particular situation. In this type of mistake, the plan may suffer from a lack of knowledge or understanding of the situation. An example is when a pilot incorrectly diagnoses a problem with a new navigation system without having a full understanding of how the system works.

Learning From Mistakes

To characterize the types of human error associated with individual accidents, it is necessary to apply a formal accident causal factor analysis and classification system to accidents in which the NTSB identified pilot error as the first event causal factor.

One system for analyzing human error in aviation accidents is the Human Factors Analysis and Classification System (HFACS). HFACS was originally developed for the U.S. Navy and Marine Corps as an accident investigation and analysis tool.[9] Since its original application, it has been used worldwide by both military and civilian organizations as a supplement to standard accident investigation and analysis methods. HFACS is widely recognized for its ability to produce comprehensive human error data.

HFACS is a broad human-error approach for investigating and analyzing the human causes of aviation accidents. Based upon human performance specialist James Reason's Swiss cheese model of latent and active failures, HFACS addresses human error at all levels of the system, including the condition of the aircrew and organizational factors.

HFACS captures data for four top levels of human-related failure:

- Unsafe acts;
- Preconditions for unsafe acts;
- Unsafe supervision; and,
- Organizational influences.

These four top levels of human-related failure are expanded into 11 causal categories that are further expanded into 10 subcategories, described as follows:[10,11]

Unsafe Acts

The *unsafe acts* level is divided into two categories: errors and violations. These categories differ in "intent."

Errors are unintended mistakes and are further categorized as skill-based errors, decision errors and perceptual errors.

Examples of skill-based errors include inadvertently omitting an item on a checklist, failing to prioritize actions and omitting a procedural step.

One accident in which a skill-based error was cited as the major causal factor was the Nov. 10, 2002, collision of a Eurocopter AS 350B with a transmission line in Kingman, Arizona, U.S. The purpose of the flight was to film a traveling motor home for a television series. While maneuvering 60 to 75 ft above ground level to maintain the best angle for the camera, the pilot saw a cable in the flight path. He initiated a rapid deceleration, but the helicopter struck the cable and then the ground. The two passengers received minor injuries and the helicopter was substantially damaged in the crash. The NTSB report cited as the probable cause the pilot's "inadequate visual lookout and failure to maintain adequate clearance from transmission wires while performing low altitude operations."[12]

Examples of decision errors include using the wrong procedure, misdiagnosing an emergency and performing an incorrect action. One such accident involved a dynamic rollover during the attempted Oct. 29, 2002, takeoff of a Hughes 369D in Kaaawa, Oahu, Hawaii, U.S., because of what the NTSB called "the combined effects of the soft, sloping terrain and the pilot's failure to redistribute the passengers to a more favorable lateral [center-of-gravity] condition." The pilot and a passenger on the on-demand air taxi flight were seriously injured and the second passenger received minor injuries in the crash, which destroyed the helicopter.[13]

Perceptual errors are those made because of visual illusions or spatial disorientation. An accident attributed to perceptual error was the Sept. 17, 2010, crash of a Robinson R44II into a lake near Duluth, Minnesota, U.S. The pilot said that, after taking off around midnight from a beach at the lake, he had "a sinking feeling in the seat all of a sudden" and saw that the vertical speed indicator displayed a descent. He could not determine the helicopter's height above the water because of the darkness, and the helicopter hit the water at about 60 kt and was destroyed. The pilot received minor injuries. The NTSB said the probable cause was the pilot's "failure to identify and arrest the helicopter's descent due to spatial disorientation."[14]

Violations are willful errors. Examples include violating training rules, performing overly aggressive maneuvers and intentionally exceeding mission constraints. Violations are subcategorized as routine violations, which tend to be habitual by nature and often tolerated by governing authority, and as exceptional violations, which are willful but rare departures from mandated procedures and are not necessarily indicative of an individual's typical behavior or condoned by management.[15]

The most common violations were improper preflight planning and inspections. Inadequate in-flight fuel management also was commonly cited in accident investigation reports. In an October 2002 accident involving a Bell 47G3B1 helicopter, a commercial pilot had completed a timber spraying operation near Highfalls, Georgia, U.S., and felt a surge of engine power, then a power loss. The helicopter struck trees during the autorotative landing. The NTSB said there was no fuel in the helicopter's fuel tanks and cited as the probable cause the pilot's "inadequate fuel management and subsequent loss of engine power due to fuel exhaustion, and an in-flight collision with trees."[16]

Preconditions for Unsafe Acts

The *preconditions for unsafe acts* level is divided into two major categories: substandard conditions of operators and substandard practices of operators.

The substandard conditions of operators category is divided into three subcategories: adverse mental states, such as complacency, "get-home-itis" and misplaced motivation; adverse physiological states, such as medical illness and physical fatigue; and physical/mental limitations, such as inadequate reaction time and incompatible intelligence/aptitude.

The substandard practices of operators category has two subcategories: crew resource management, including problems such as failure to use all available resources and failure to coordinate; and personal readiness, which includes problems of self-medication and violation of crew rest requirements.

Unsafe Supervision

The *unsafe supervision* level is divided into four categories: inadequate supervision, such as failure to provide training, failure to provide operational doctrine and failure to provide oversight; planned inappropriate operations, such as failure to provide correct data, failure to provide sufficient personnel and failure to provide the opportunity for adequate crew rest; failure to correct a known problem, such as failure to initiate corrective action and failure to report unsafe tendencies; and supervisory violations, such as authorizing an unnecessary hazard and failure to enforce rules and regulations.

Organizational Influences

The *organizational influences* level is divided into three categories: resource/acquisition management, including lack of funding, poor equipment design and insufficient manpower; organizational climate, including policies on drugs and alcohol, value and belief culture, and chain-of-command structure; and organizational process, including quality of safety programs, influence of time pressure and the presence or absence of clearly defined objectives. In this analysis of pilot error, there are no errors in this category.

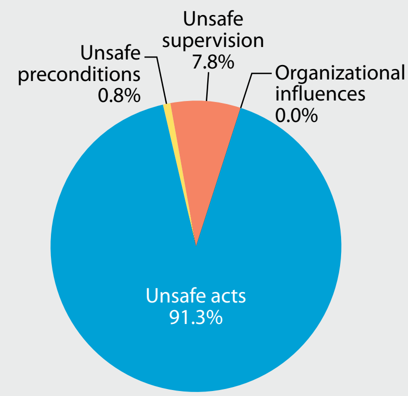
Pilot Error Analysis

Most narratives in the NTSB accident database include causal factor statements that use key words and phrases described in the HFACS, but a significant number of narratives lack sufficient detail to allow indisputable classification. As a result, in the following accident analysis, some educated judgments were necessary. Determination of error type and category was based on the accident investigators' full narratives, with emphasis on the initial causal factor in the accident sequence.

A summary of the classification analysis using the four top levels of the human-related failure HFACS scheme is presented in Figure 3. Unsafe acts accounted for 91.3 percent, 7.8 percent were classified as unsafe supervision, and 0.8 percent were classified as preconditions for unsafe acts. As expected, the HFACS analysis of only pilot error meant that no accidents were placed in the organizational influences classification.

An examination of the decade percentages for all failure types shows that an overwhelming number of accidents each year are classified as unsafe acts (Table 1). Accidents in other categories were recorded in far fewer numbers. Throughout the decade, the percentages for each failure type are fairly consistent; this implies that the human factors at the root of each error type have not changed over time.

Pilot Error Classifications



Note: Does not total 100 percent because of rounding.

Source: Clarence E. Rash

Figure 3

Unsafe Acts

In the unsafe acts category, errors (83.4 percent) greatly exceeded violations (7.9 percent) for the decade. Within the errors category, skill-based errors (53.1 percent) exceeded decision errors (25.6 percent)

Summary of Pilot Error Accidents, 2001–2010, Classified as Unsafe Acts

Unsafe Acts	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2001–2010
Errors	**85.5%**	**81.1%**	**82.7%**	**88.6%**	**84.7%**	**87.4%**	**86.7%**	**74.7%**	**80.2%**	**80.8%**	**83.4%**
Decision errors	26.5%	26.5%	21.6%	30.7%	27.7%	26.2%	26.7%	24.2%	24.8%	19.2%	25.6%
Skill-based errors	53.0%	49.2%	57.6%	50.0%	54.0%	55.3%	59.2%	40.4%	52.5%	60.3%	53.1%
Perceptual errors	6.0%	5.3%	3.6%	7.9%	2.9%	5.8%	0.8%	10.1%	3.0%	1.4%	4.7%
Violations	**7.7%**	**11.4%**	**10.8%**	**2.6%**	**2.2%**	**5.8%**	**5.0%**	**14.1%**	**10.9%**	**11.0%**	**7.9%**
Routine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exceptional	7.7%	11.4%	10.8%	2.6%	2.2%	5.8%	5.0%	14.1%	10.9%	11.0%	7.9%
Total	**93.2%**	**92.5%**	**93.5%**	**91.2%**	**86.9%**	**93.2%**	**91.7%**	**88.8%**	**91.1%**	**91.8%**	**91.3%**

Source: Clarence E. Rash

Table 1

by a factor of two. Perceptual errors averaged a relatively low 4.7 percent; however, perceptual errors are the most difficult type to discern, and their incidence most likely is underrepresented.

As would be expected, most skill-based errors were failures by the pilot to perform at the subconscious skill level expected of a rated pilot and were dominated by failures to maintain adequate visual awareness. Decision errors were more difficult to generalize, with failures ranging from inappropriate responses to emergencies to continued visual flight into instrument meteorological conditions (IMC).

All of the violations failures were subcategorized as exceptional, meaning that the actions were determined to be intentional departures from authorized and recognized safe procedures.

Preconditions for Unsafe Acts

Accidents in which preconditions for unsafe acts were the initial causal factor averaged 0.8 percent of all accidents annually over the decade, and were fairly evenly distributed between substandard operator conditions and substandard operator practices, at 0.4 percent each, and the respective subcategories.

Substandard operator conditions included both mental factors such as complacency and preoccupation with personal affairs and physiological factors such as impairment due to a recurring stroke.

Incidents of substandard operator practices involved lapses in personal readiness, including impairment due to use of medications or illegal drugs and fatigue caused by lack of sleep — resulting, in one incident, in the pilot falling asleep at the controls.

Unsafe Supervision

In this analysis, the classification of pilot error at the unsafe supervision level (7.8 percent) was used almost exclusively to characterize failures of instructor pilots to maintain adequate supervision of student pilots during training or of rated pilots during check rides. The NTSB accident narratives repeatedly cited improper supervision or failure to take corrective action as the causal factor.

Human Error and Blame

Human error may be inevitable. But pilot action is seldom the sole factor in an aviation accident. Aircraft are complex, high-tech systems consisting of thousands of components. Weather conditions are equally complex and frequently changing. A pilot makes most flight decisions using cockpit displays that are intended to present aircraft and environmental condition statuses and trends. However, these displays and the transfer of flight status data from display to pilot often are fraught with human factors engineering challenges. No matter how skilled and experienced a pilot, how many fail-safe systems are employed in the aircraft, or how good an organizational safety culture may be, there is always a level of residual and random error.[17]

Although great strides have been made in reducing accident rates, in such a demanding setting as aviation, accidents will continue to occur. As such, it is important to understand that the pilot-related human error classification is not a statement of blame but an important step in understanding the role of human error and in identifying potential sources of systematic error.

Clarence E. Rash is a research physicist with 35 years of experience in military aviation research and development, and the author of more than 200 papers on aviation display, human factors and protection topics. His latest book is Helmet-Mounted Displays: Sensation, Perception and Cognition Issues, *U.S. Army Aeromedical Research Laboratory, 2009.*

Notes

1. Another 4 percent were attributed to maintenance error; and less than 1 percent involved errors attributed to manufacturer, ground or control tower personnel.

2. Felciano, R.M. *Human Error: Designing for Error in Medical Information Systems.* Stanford University. 1995.
3. Adams, C. *What is Human Error?* <ergonomics.about.com/od/ergonomicbasics/a/What-Is-Human-Error.htm>.
4. Lee, C. *Human Error in Aviation.* <carrielee.net/pdfs/HumanError.pdf>.
5. Rash, C.E.; Manning, S.D. "Stressed Out." *AeroSafety World* Volume 4 (August 2009): 39–42.
6. Reason, J. *Human Error*. Cambridge, U.K.: Cambridge University Press. 1990.
7. Wildzunas, R.M. "They Shut Down the Wrong Engine!" *Flightfax*, 25(9), 1–3. 1997.
8. Reason.
9. Shappell, S.; Wiegmann, D. *Human Factors Analysis and Classification System – HFACS.* Washington: U.S. Department of Transportation, Federal Aviation Administration. DOT/FAA/AM-00/7. 2000.
10. Shappell, S.; Wiegmann, D. *Unraveling the Mystery of General Aviation Controlled Flight Into Terrain Accidents Using HFACS.* Presented at the 11th International Symposium on Aviation Psychology, Ohio State University, Columbus, Ohio, U.S. 2001.
11. Rash, C.E.; LeDuc, P.A.; Manning, S.D. Cooke, N.J.; Pringle, H.L; Pedersen, H.K.; Connor, O. (editors). "Human Factors in U.S. Military Unmanned Aerial Vehicle Accidents," pp. 117–131 in *Human Factors of Remotely Operated Vehicles*. Elsevier. 2006.
12. NTSB. Report No. LAX03LA027. Nov. 10, 2002.
13. NTSB. Report No. LAX03LA017. Oct.29, 2002.
14. NTSB. Report no. CEN10LA556. Sept. 17, 2010.
15. Reason.
16. NTSB. Report No. ATL03LA007.
17. Whittingham, R.B. *The Blame Machine: Why Human Error Causes Accidents.* Elsevier Butterworth-Heinemann, Oxford, England. 2004.

Straight to the SOURCE

Jon Ross/U.S. Federal Aviation Administration

New FAA programs find and fix hidden risks.

BY JOSEPH TEIXEIRA

In the United States, 99.998 percent of air traffic operations take place according to the U.S. Federal Aviation Administration's (FAA's) strict safety guidelines. However, with controllers guiding as many as 7,000 flights at any one time, even a fraction of a percent of deviation can put an aircraft at risk.

Without waiting for accidents or incidents to occur, the FAA has found a way to identify and correct potential risks. Two FAA voluntary safety reporting programs for front-line employees already are producing results.

The confidential, nonpunitive programs draw information from the men and women

who guide the nation's airplanes and maintain the equipment necessary to keep the National Airspace System (NAS) running. One program was designed to engage air traffic controllers, and the other was designed for technical operations specialists; both were developed in partnership with their respective unions.

The programs go to the source for advanced knowledge. The FAA trusts its front-line employees to be our greatest resource to eliminate risk in the NAS.

Getting Results

The controllers' Air Traffic Safety Action Program (ATSAP) is attracting substantial participation. More than 60 percent of controllers have voluntarily submitted at least one ATSAP report — more than 48,000 total — since the program was implemented in 2008.

Most importantly, the program gets results. After reviewing ATSAP reports, safety panels comprising representatives from the FAA's Air Traffic Organization (ATO) and Air Traffic Safety Oversight Service, and the National Air Traffic Controllers Association (NATCA) have asked for corrections that have been implemented in 150 cases.

Thanks to ATSAP, pilots now get better information about runways that have been shortened for construction, trees have been removed to improve coverage of an airport surveillance radar system, and condensation that obstructed controllers' vision has been cleared from tower cab windowpanes.

The FAA sees another safety benefit from ATSAP: It encourages reflection that leads to learning. Reporting a safety event requires a controller to describe what happened and what should have happened.

The sheer act of explaining what you did and why you did it is the fundamental tenet of voluntary safety reporting. That's how you learn, and that learning often extends beyond the individual who files the report.

Managers See Value

Nysei Moses, a front-line manager at the airport traffic control tower and terminal radar approach control facility in Norfolk, Virginia, said she and other front-line managers were worried at first that controllers would use ATSAP's non-punitive element as an opportunity to take less care when performing their duties. Instead, the program has had the opposite effect, she said. Controllers are reading the program's regular briefing sheets (which do not include information that could identify the reporter) and learning from colleagues' experiences.

"The briefing sheets make the controller know that the things he or she is doing at the point of decision aren't isolated," Moses said. "Other controllers are experiencing the same kinds of breakdowns, and we need to get to the point that we're not setting ourselves up for it to happen again. The information is helping controllers watch for those things and correct those things early, rather than waiting for something to happen and filing an ATSAP report afterward."

The fact that the reports are written by fellow controllers enhances the likelihood that the information will be compelling and remembered. Controllers hear the language and terminology used by other controllers, and it resonates with them much more than anything an outsider could tell them.

Moses has been able to use the information from the briefing sheets to help guide new controllers through training and prepare them to handle air traffic on their own. "With the information from ATSAP, I can see early trends with new controllers," she said. "And we can help people who struggle in training break some of the bad habits that may eventually lead to bigger issues. I hope it becomes entrenched in the operation. I hope we stop calling it a program, and it just becomes part of how we do things."

As it becomes entrenched, ATSAP will continue to help solve safety issues that have nothing to do with the performance of people. In most safety situations, it is not the human being who is the hazard; it is the policy, procedure, training or situation.

Along those lines, ATSAP reports have helped identify and resolve issues with computer-based instruction, a restricted area over Washington,

The FAA said that the success of a safety reporting program for controllers has prompted demonstration of a similar program for technical operations specialists.

Report Gets a WINKK

As a result of an Air Traffic Safety Action Program (ATSAP) report, pilots flying between two busy Northeast U.S. airports now can use a route that they readily can program into their flight management systems, making it easier for controllers to issue the route clearance and reducing pilot-controller communications.

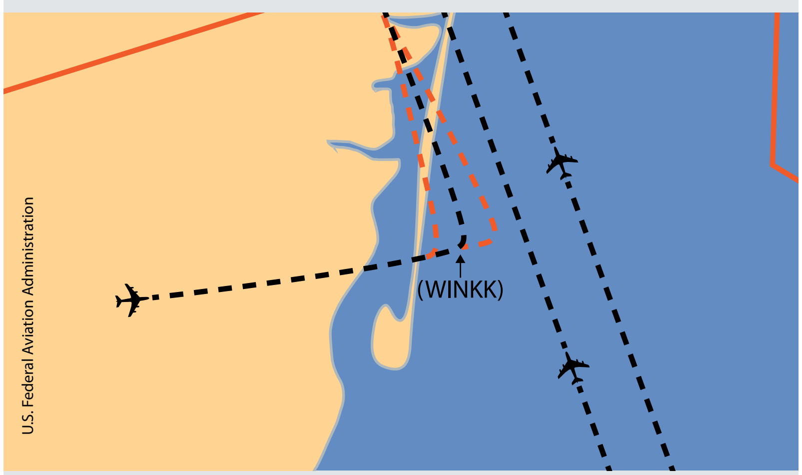
Before the change, the route between Philadelphia International Airport and John F. Kennedy International Airport in New York included a turn at the intersection of an airway and a radial from a nearby navaid. Pilots often had difficulty programming the intersection into their on-board computers and sometimes said they could not accept the clearance. With no other available routing, controllers at Philadelphia had to issue radar vectors as part of the clearance, which required coordination with controllers at New York Center.

On most days, that was not a big deal. Only a few scheduled flights operate from Philadelphia to Kennedy. But when thunderstorms or other impediments impacted the region's airspace, it got complicated. When weather or other issues prevent airplanes from landing at Kennedy, the flights often are diverted to Philadelphia. Once the problem clears, the diverted planes head back toward Kennedy.

Many of the diverted pilots work for international carriers or have flown across the country. During that long flight, they may have faced weather-related problems, endured holding, had to divert and encountered unfamiliar airspace. If a controller does not issue a straightforward route, all those factors create risk. But because a controller filed an ATSAP report, the risk is now reduced and the route is more efficient.

The controller's report recommended a new area navigation fix at the intersection of the airway and the radial. After local and national safety experts studied the issue, the U.S. Federal Aviation Administration created the new fix, called WINKK, on an accelerated schedule. Controllers can now issue a simple route, and pilots can focus on other duties.

— JT



A controller's report of a difficult intersection between Philadelphia and New York prompted the creation of a new waypoint: WINKK.

D.C., and a policy issue that resulted from combining sectors at a major terminal radar approach control facility.

Controllers See Value

Resolving systemic issues, some of which have been problems for years, encourages more controllers to use the program. When controllers see that ATSAP is an effective means to resolve long-standing issues, they become strong advocates for the program, said Lisa Cyr, a controller at Albuquerque (New Mexico) Center and NATCA national lead for the FAA's recurrent training program.

As part of implementing the recurrent training program, which draws much of its teaching material from ATSAP reports, Cyr traveled to nearly a dozen air traffic facilities and talked to 300 controllers and managers from all over the country. She heard many stories about how ATSAP's effectiveness won over front-line employees who were suspicious of the program when it first was introduced.

One example came from her control area at Albuquerque Center. After controllers who initially were doubtful about ATSAP saw that it resolved some minor safety issues at the facility, they began to file regular reports on a major problem. Two of the area's sectors, one that handled high-altitude traffic and another that handled very-high-altitude traffic, often had trouble with radio frequencies.

The clarity of transmissions on the frequencies was bad and getting worse, Cyr said. As a result of several ATSAP reports on the problem, the frequencies are being fixed. Now, controllers who initially were skeptical of the program are some of its most vocal proponents at the facility, Cyr said.

In its development of a safety culture, the FAA wants to create an environment in which employees can report safety events without fear of punishment. "We presume the good intent of our controllers and are more interested in the free flow of information than we are in punishing for errors," ATO Chief Operating Officer David Grizzle said. "This allows us to identify and address systemic risk."

Tech Ops Signs Up

Thanks in large part to ATSAP, the FAA has collected 10 times more data in the last three years than it used to receive through traditional reporting systems. The agency expects similar success with the voluntary safety reporting program created for its technical operations (tech ops) specialists.

The Technical Operations Safety Program, or T-SAP, is currently in its demonstration phase in the FAA's Central Service Area. The ATO would like to extend the 18-month demonstration phase, which began in October 2011, for one year, and the program will expand to the other two service areas.

The program already is showing positive results. More than 2,200 employees are eligible to submit reports, and 74 reports have been submitted, several of which have resulted in positive changes.

One report alerted officials that computer screen savers could interfere with the monitoring of airport surface detection equipment used by air traffic controllers. The problem could delay a technician's response to a malfunctioning system, increasing the chances of a runway incursion. A maintenance alert was issued, allowing sites to set up the screen savers properly, and a national change proposal has been submitted to disable automatic screen savers.

Airlines Trade Data

ATSAP and T-SAP are based on the voluntary safety reporting programs in use at several airlines. Nearly 100 aviation companies have operated such programs, and their origin can be traced back to the early 1970s, when United Airlines began using a voluntary safety reporting program.

Now, one of the biggest opportunities to improve understanding and communication on safety issues has been realized by linking the FAA's ATSAP with the airlines' Air Safety Action Programs.

So far, three airlines are connected through the Confidential Information Sharing Programs (CISP): American, Southwest and United. The FAA has agreements in place with Republic Air Holdings airlines, and they will begin actively participating soon. CISP gives the FAA and the airlines access to information they otherwise would not have, elevating managers' awareness of safety issues and providing a more complete picture of safety incidents.

According to Mike Blake, NATCA lead representative for CISP, the program has identified several issues, and efforts are currently under way to resolve them. In one instance, a contradiction between an approach plate and a letter of agreement between two facilities brought airplanes across a navigation fix at unexpected altitudes. Pilots filed Aviation Safety Action Program (ASAP) reports on the issue, and those were shared with the FAA through CISP. The letter of agreement is being modified.

FAA analysts review 50 to 100 CISP reports each week that provide a huge chunk of data that the FAA aggregates to identify and resolve systemic issues. The FAA currently is organizing data as part of an effort to study issues brought up by pilot reports on tail wind landings and security measures around special events, such as NASCAR races and VIP travel.

The airlines frequently share "lessons learned" from ATSAP reports with their pilot groups, and ATSAP has published (with permission) information from pilot reports as well, shedding light on the root causes for certain miscommunications or misunderstandings.

There is no lack of interest in the program on the part of system users. Twenty-seven airlines have expressed a desire to participate.

Reducing Risk

The airlines' enthusiasm for sharing data and voluntary safety reporting is reflected in the way controllers, tech ops specialists and managers are embracing ATSAP and T-SAP as a means to address FAA safety issues long before lives are put at risk.

"The FAA has never been better positioned to embrace every opportunity to identify, understand, correct and communicate the root causes of risk in the system," Grizzle said.

Joseph Teixeira is vice president for safety and technical training at the FAA Air Traffic Organization.

InSight is a forum for expressing personal opinions about issues of importance to aviation safety and for stimulating constructive discussion, pro and con, about the expressed opinions. Send your comments to Frank Jackman, director of publications, Flight Safety Foundation, 801 N. Fairfax St., Suite 400, Alexandria VA 22314-1774 USA or jackman@flightsafety.org.

Last year's Paris Air Show was marked by an event that received wide media coverage: The right wingtip of an Airbus A380 struck a building at Le Bourget airport as the aircraft was maneuvering on the ground. Most ground damage incidents receive little, if any, public attention, but ground damage is a significant financial, operational and safety issue, particularly given the airline industry's razor-thin profit margin.

Flight Safety Foundation several years ago estimated that "ramp accidents cost major airlines worldwide at least $10 billion a year. These accidents affect airport operations, result in personnel injuries and damage aircraft, facilities and ground-support equipment." The Foundation also estimated that 27,000 ramp accidents and incidents — one per 1,000 departures — occur worldwide annually.[1]

Many definitions of ground damage are offered by regulators and industry trade associations. Perhaps the most relevant is in Chapter 660 of the International Air Transport Association (IATA) *Airport Handling Manual* (*AHM*).[2] The definition includes the

A ground accident program, ground damage database and revised ground handling services agreement promise to reduce ground damage.

Covering the Ground

© Alastair Gardiner/Airliners.net

A Fokker F-27-500 engine was damaged in a collision with a towed ground power unit at Edinburgh Airport, Scotland.

BY MARIO PIEROBON

terminology most commonly used in insurance policies that cover the cost of damage. The *AHM* distinguishes between the costs of aircraft physical damage and consequential losses.

Aircraft physical damage includes labor costs; material costs; handling fees for parts and materials used for repair; aircraft finance costs and cost of capital while the aircraft is out of service; temporary leasing costs of aircraft spare parts when replacements and repairs are not readily available to ensure aircraft serviceability; costs to ferry the damaged aircraft to a repair station or base station; extra parking costs, including overtime and security for the damaged aircraft at the current location; and external survey/claims administrative costs.

Consequential losses include costs related to passengers and crew incurred within 72 hours of the event, including the cost of transportation on other carriers; compensation associated with non-passenger revenue (cargo, mail, etc.); the internal cost of investigation/claims administration; delay of services (other stations); revenue loss; aircraft delay costs, including sub-charter on flights other than the one involved; operational disruption; loss of priority payload due to aircraft change; catering costs; and crew changes and rescheduling/interruption.

Risks During Ground Operations

During airline ground operations, risks are "concentrated in the movement, control, guiding and synchronization of ground equipment with other pieces of equipment or other vendors working around the aircraft," said Bill Johnson, a consultant in airline operations, fuel efficiency and cost management. "Furthermore, training and supervision also represent a very important area of risk.

"Cargo operations are typically more vulnerable because of the extent of damage caused by large, solid, heavy objects. Also, cargo operations are frequently not as well supervised in that there are fewer people around the aircraft, and they are frequently night operations when company management is often limited in presence and experience. In addition, as cargo operations are by nature sporadic, work crews are often characterized by high turnover, supplemented by part-time and less experienced personnel, unfamiliar with the aircraft they are servicing and less familiar with the equipment they are operating."

He added, however, that major operators such as FedEx and UPS staff their own operations, their management is experienced in night operations, their teams are permanent and they have established safety programs and staff.

IATA recently launched the Ground Damage Database, the industry's first repository specifically for the collection and analysis of ground damage occurrences worldwide. Concerning the most common forms of damage based on data available to IATA, it is "too early to say, as we have only just started gathering industry data; however, preliminary analysis indicates the majority of damage is to hold compartments and doors," said Guenther Matschnigg, IATA senior vice president, safety, operations and infrastructure.

Safety Risks

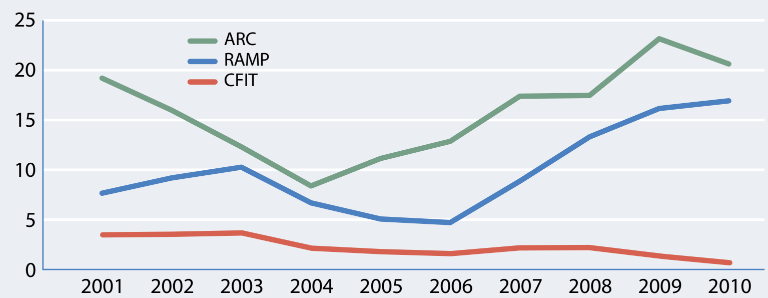
Ground damage is associated with safety risks that cannot be underestimated. About 243,000 people are injured each year in ground occurrence accidents and incidents; the injury rate is 9 per 1,000 departures.

Accidents involving ramp events are increasing as a percentage of all accidents (Figure 1, p. 46).[3] The figure does not tell the whole story — it does not include incidents as defined by the International Civil Aviation Organization.

Why are so many risks associated with ground operations? More important, why are ramp events increasing as a proportion of all accidents? Ivar Busk, who has been head of airside safety at SAS since 1982 and manager of SAS Group Insurance since 2004, lists the main reasons: time pressure on ground personnel, increased production and therefore congestion of airports, technology and change management, training and education of ground personnel, and human factors.

"The ever-increasing demand for quick aircraft turnaround puts considerable pressure on people working on the ramp," said Busk. "There is not only an airline's management-enforced policy of quick turnarounds, but I personally know of several examples of ground incidents directly linked

ARC, RAMP and CFIT Accidents, EASA Member State Airlines, 2001–2010



ARC = abnormal runway contact; CFIT = controlled flight into terrain; EASA = European Aviation Safety Agency; RAMP = ground handling

Source: European Aviation Safety Agency

Figure 1

with time pressure exercised by pilots, ATC [air traffic control], etc., on ground personnel," said Busk.

"Most of the world's big hubs have more flights today than ever, but they have grown without appropriate investments in their capacity. Airports struggle for efficient and effective space management and many incidents are linked to insufficient maneuvering space. The congestion of airports is also associated with a frequent alternation of gates between narrow-bodied and wide-bodied aircraft. This is one of the leading causes of confusion to ground personnel, which can be the basis of ground damage, especially during peak times."

Technology and Change Management

New technology increases production, but it also can have negative consequences, Busk said: "Some towbarless (TBL) tractors now operate like fly-by-wire (steer-by-wire), and airbridges also are becoming increasingly sophisticated, some operating nearly automatically. If there is a crash in the computer system, huge damage can result. It is very important at the time of new technology implementation to train ground personnel appropriately so that they can learn to manage new technology safely and proactively.

"The ground operations industry does not lack high quality standards, like the IATA *AHM*, but the training of personnel is a real problem — during turnarounds standards are not followed as strictly and professionally as they are followed in the cockpit during flight operations. The root cause more often than not lies at the budgeting and business planning phases, because investments in training are always easily postponed to the following year.

"Very often, there are a number of human factors reasons behind a damage incident, and if the relevant investigation is not carried out in detail, the conclusion often is that the person did not follow the procedure, and instead of going deeper into the case to find the root causes, the case is closed. Even on the ground, human factors need to be taken seriously into consideration as a leading cause of equipment damage."

Cost of Ground Damage

Airlines normally pay directly for any ground damage below deductibles and underwriters pay for ground damage above deductibles (the insurers' premium being equal to average claims plus administration costs plus profits). Refunds for ground damage caused by ground handling companies are normally included in turnaround charges to airlines. The whole cost of ground damage is paid directly or indirectly by the world's airlines.

One reason airlines bear the whole cost is that "after privatization, airlines set about horizontally integrating and thus divesting themselves of their cleaning, catering and other ground handling divisions," said Andrew Dixon, owner of Aviation Recovery and formerly accident recovery manager at British Airways. "This was in pursuit of economies of scale and to focus on what they do best through simplifying their business model. Whilst regulatory hurdles slowed airline integration, the same cannot be said for their former divisions. These handling divisions amalgamated at great speed and have formed companies that are now often larger than the flag carriers that used to control them. Where the engineering departments are now separate companies, the airlines now get real invoices for damage repairs. The balance of power has moved away from airlines. These giant handling companies now include internal insurance companies and have become very sophisticated.

"It is a more difficult problem for the airlines, and with the insurers raising the deductibles at the airlines' behest, the amounts at stake are increasing. The larger airlines have generally risen well to this task and have skilled and experienced teams chasing recoveries, but the smaller airlines are at a disadvantage, as they simply don't have enough volume of activity to build up sufficient experience and expertise."

New Risks in the Equation

While ground damage threatens safety on the ramp or taxiways, it is less likely to represent an immediate flight safety threat because harm to aircraft structural integrity is often detected before takeoff, partly because normal operating procedures dictate visual checks of airframe and engine surfaces before flight. The relative ease in detecting ground damage may not be here to stay, however.

The increasing use of composite materials in aircraft manufacturing may pose a new threat because often, after being hit, a composite surface returns to its original shape and the damage underneath is invisible.

"Safety occurrences have been attributed to the fact that the defect of composite material surfaces was missed during daily and weekly checks," said Philipp Reichen, an aerospace and aviation consultant and contractor specializing in engineering and maintenance. "A simple 'tap' test might not detect delaminations at early stages or in specific areas.

"Some of the most abused aircraft surfaces while on the ground are cargo and passenger doors, which might be hit several times a day by ground service equipment and can therefore be exposed to minor delaminations, which in turn could lead to problems sometime in the future."

The Boeing Co., with regard to the use of composites in the airframe and primary structure of the 787, says that "in addition to using a robust structural design in damage-prone areas, such as passenger and cargo doors, the 787 has been designed from the start with the capability to be repaired in exactly the same manner that airlines would repair an airplane today — with bolted repairs. The ability to perform bolted repairs in composite structure is service-proven on the 777 and [requires] comparable repair times and skills [to those] employed on metallic airplanes. (By design, bolted repairs in composite structure can be permanent and damage tolerant, just as they can be on a metal structure.)

"In addition, airlines have the option to perform bonded composite repairs, which offer improved aerodynamic and aesthetic finish. These repairs are permanent, damage tolerant, and do not require an autoclave."[4]

Increasing Maintenance Costs

The repair of composite surfaces will be a major step for most maintenance, repair and overhaul organizations (MROs). "Composite repairs demand new techniques and technologies that are not yet used by most MROs," said Reichen. "This could cause a concentration of repair stations with the required capabilities and increase the repair cost for structural damages associated with ground occurrences, as the investments in the new technologies are substantial."

According to Busk, "In the new technology of ground operations, the maintenance of sometimes very complicated pieces of equipment (such as automated airbridges and modern TBL tractors) creates the need for new types of maintenance skills that could increase the costs of ground damage."

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A truck driver was pinned inside the cab until rescued by firefighters following a collision with a Gulfstream II at Seattle King County International Airport.

Ground safety needs commitment of resources by airline management, but what tools are available for ground damage mitigation? More important, what should an industrywide effort to reduce ground damage concentrate on?

Ground Accident Prevention Program

Flight Safety Foundation was one of the first organizations to become proactive in addressing ground safety issues. In 2003, the Foundation launched the Ground Accident Prevention (GAP) program in response to industry requests. "The GAP program developed information and products in a practical format — 'e-tools' — designed to eliminate accidents and incidents on airport ramps (aprons) and adjacent taxiways, and during the movement of aircraft into and out of hangars," the Foundation says.

The e-tools on the Foundation's website include a ground accident prevention cost model, a set of videos illustrating safe aircraft towing, ground accident prevention leadership tip sheets and a template outlining ramp operational safety procedures. "The document is intended to assist ramp supervisors in the development or improvement of their organizations' written SOPs," the Foundation says. "The template is presented in Microsoft Word format to facilitate customization by the user, including revision, deletion and addition of information as necessary to tailor the document to the organization's ramp activities."

IATA's main initiatives are the Ground Damage Database, ISAGO (the IATA Safety Audit for Ground Operations) and *AHM/IGOM* (the *AHM* with the supplementary *IATA Ground Operations Manual*).

Matschnigg said of IATA's efforts, "The main difficulties are concerned with the wide range of reporting cultures, attaining a consolidated approach and pinpointing exact causes of ground damage. The Ground Damage Database is designed to answer these difficulties. *IGOM* establishes core ground handling procedures, *AHM* provides standards, ISAGO audits ground operations which currently use *AHM* standards as guidance and will include *IGOM* procedures in the near future. Based on the Ground Damage Database outputs, the standards/procedures of *AHM/IGOM* and ISAGO will be assessed for their abilities to reduce damages and potential risks."

Ground Handling Agreement

The most commonly used ground handling services agreement is IATA's Standard Ground Handling Agreement (SGHA).

According to Article 8 of the SGHA, the ground handling company "shall indemnify the carrier against any physical loss of or damage to the carrier's aircraft caused by the handling company's negligent act or omission, *provided always that* the handling company's liability shall be limited to any such loss of or damage to the carrier's aircraft in an amount not exceeding the level of deductible under the carrier's hull all-risk policy which shall not, in any event, exceed USD $1,500,000 except that loss or damage in respect of any incident below USD $3,000 shall not be indemnified."

Furthermore, "the carrier shall not make any claim against the handling company and shall indemnify it … against any legal liability for claims or suits, including costs and expenses incidental thereto… ."

The Association of European Airlines has proposed to IATA to amend the SGHA limits to the liability of ground handling companies. "The overall goal is that airlines should not suffer as they do today when ground damage occurs," said Busk. "Is it fair that airlines have to reimburse their stranded passengers as per the European Union passengers' bill of rights when damage is caused by a third party? Is it fair that airlines suffering ground damage are refunded by their service providers only the cost of physical damage, which is only a minor fraction of the total damage cost incurred? There is no other industry with such strict liability limits when somebody damages another party.

"Ground handlers tend to assume that a change in the SGHA will be followed by an increase in the premium charges they will have to pay to their underwriters, and therefore an overall increase in the aircraft turnaround charges to airlines, but by amending the SGHA we should aim at an improvement in the overall efficiency and safety awareness of ground operations, so that the cost of ground damage to the industry is reduced. This will not increase premiums."

Mario Pierobon works in business development and project support at Great Circle Services in Lucerne, Switzerland, and was formerly at the International Air Transport Association in Montreal.

Notes

1. Flight Safety Foundation (FSF). *Ground Accident Prevention (GAP)*. <flightsafety.org/archives-and-resources/ground-accident-prevention-gap>. The data, developed in conjunction with the FSF Ground Accident Prevention initiative, were the first attempt to arrive at a worldwide picture of ground damage costs. While they are now more than five years old, no more recent data have been calculated.
2. Available for purchase at <www.iata.org/ps/publications/pages/ahm.aspx>.
3. EASA (2011). *Annual Safety Review, 2010.* Cologne, Germany: EASA Safety Analysis and Research Department.
4. Boeing, *Aero Quarterly*, Quarter 4, 2006.

BY RICK DARBY

Progress Report

The accident statistics for 2011 offer encouraging signs.

If there can be such a thing as a good year for accidents, 2011 was that year in worldwide commercial jet aviation.

The 2011 record showed reductions in two of the most serious accident types, runway excursions and approach and landing accidents. Runway excursions — veer-offs and overruns — occurred in 25 percent of the 36 accidents last year, compared with 33 percent of the 40 accidents in 2010. Approach and landing accidents represented 58 percent of the total in 2011, versus 65 percent the previous year.

Absolute numbers of these types of accidents were lower as well: nine overruns in 2011, 13 in 2010; 21 approach and landing accidents in 2011, 26 in 2010. The data are derived from Boeing Commercial Airplanes' annual statistical summary.[1,2] Airplanes manufactured in the Soviet Union or the Commonwealth of Independent States are excluded for lack of operational data.

Total accident numbers have been declining, down from 62 in 2009 (Table 1, p. 50). On-board fatalities have dropped as well: 175 last year, compared with 555 in 2010 and 413 in 2009. Fluctuations in annual fatality numbers, however, are partially influenced by chance — an accident involving the same basic aircraft type might kill two people, the pilots, on a cargo flight and several hundred on a passenger flight. One 2011 fatal crash, in fact, did involve a scheduled cargo-carrying Boeing 747-400 that crashed into the sea while the flight crew was diverting because of an on-board fire, with the loss of the two pilots, the only crewmembers.

Four of the 36 accidents in 2011 (11 percent) involved at least one on-board fatality, versus eight of 40 in 2010 (20 percent) and nine of 62 (15 percent) in 2009. Seven of the 2011 accidents (19 percent) were major accidents, according to U.S. National Transportation Safety Board terminology.[3] Comparable percentages were 28 percent in 2010 and 21 percent in 2009.

In its accident data, Boeing emphasizes time frames longer than a year. Fatal accidents in passenger operations during the 10-year period 2002–2011 numbered 63 (Table 2, p. 51). The comparable number for 2001–2010 was 69. On-board fatalities in passenger operations in the most recent 10-year period totaled 4,486; in the previous 10 years, 4,711.

In scheduled passenger service, there were 60 fatal accidents in 2002–2011, compared with 67 in 2001–2010. However, all accidents in passenger operations increased from 308 to 317 in the most recent 10-year period. Accidents in cargo operations decreased from 80 to 74 in the most recent period.

The fatal accident rate in 2002 through 2011 for scheduled commercial passenger operations was 0.34 per million departures, and 0.62 for other types of operations, including chartered passenger, scheduled cargo, chartered cargo and maintenance testing. The equivalent rates for 2001–2010 were 0.40 and 0.67, respectively, for improvements of 15 percent and 7 percent.

The 79 fatal accidents from 2002 through 2011 represented 20 percent

2011 Airplane Accidents, Worldwide Jet Fleet

Event Date	Airline	Model	Accident Location	Phase of Flight	Description	Damage Category	On-board Fatalities/ Occupants (External Fatalities)	Major Accident?
Jan. 3	American Airlines	737-800	Los Angeles	Takeoff	Tail strike	Substantial		
Jan. 9	Iran Air	727	(Near) Urumiyeh, Iran	Final approach	Missed approach at night	Destroyed	78/105 (0)	●
Jan. 10	AirAsia	A320	Kuching, Malaysia	Landing	Runway veer-off	Substantial		
Jan. 10	Africa Charter Airline	737-200	Hoedspruit, South Africa	Taxi	Rolled off the side of a taxiway	Substantial		
Jan. 13	American Airlines	757	Los Angeles	Takeoff	Tail strike	Substantial		
Feb. 16	Saudi Arabian Airlines	747-300	Madinah, Saudi Arabia	Landing	Runway veer-off	Substantial		
Feb. 24	US Airways	ERJ-190	New York	Landing	Galley cart struck a passenger's ankle			
March 27	Hapag-Lloyd Flug	737-800	Tenerife, Spain	Takeoff	Tail strike	Substantial		
March 30	Northern Air Cargo	737-300	Dayton, Ohio, U.S.	Initial climb	Pallet jack in the cargo hold fractured a structural frame	Substantial		
April 11	Comair	CRJ-700	New York	Taxi	Vertical stabilizer struck by a taxiing aircraft	Substantial		
April 13	Air France	A330	Caracas, Venezuela	Landing	Hard landing	Substantial		
April 17	China Cargo	777	Copenhagen, Denmark	Landing	Tail strike	Substantial		
May 6	Continental Airlines	737-800	Greenville, Mississippi, U.S.	Taxi	Taxiway tarmac collapsed under landing gear	Substantial		
May 18	Omega Air	707	Point Mugu, California, U.S.	Initial climb	Engine and pylon separated from the wing; veer-off	Destroyed		●
May 28	SBA Airlines	767	Caracas, Venezuela	Landing	Hard landing	Substantial		
June 25	Malev Hungarian Airlines	737-800	Heraklion, Greece	Landing	Tail strike	Substantial		
July 8	Hewa Bora Airways	727	Kisangani, Congo DR	Final approach	Crashed short of the runway on final approach	Destroyed	83/118 (0)	●
July 14	Delta Connection	CRJ-900	Boston	Taxi	Taxiway collision	Substantial		
July 28	Asiana Airlines	747-400	East China Sea near Jeju Island, South Korea	Cruise	Cargo fire	Destroyed	2/2 (0)	●
July 29	EgyptAir	777	Cairo	Load/unload	Smoke and fire on the flight deck	Substantial		
July 30	Caribbean Airlines Limited	737-800	Georgetown, Guyana	Landing	Runway overrun	Destroyed		●
Aug. 20	First Air	737-200	Resolute Bay, Canada	Final approach	Struck hill and broke apart	Destroyed	12/15 (0)	●
Aug. 29	Gulf Air	A320	Cochin, India	Landing	Runway veer-off	Substantial		
Sept. 2	Turkish Airlines	A340	Mumbai, India	Landing	Runway veer-off	Substantial		
Sept. 3	Mahan Air	A300-600	Mashad, Iran	Landing	Runway veer-off	Substantial		
Sept. 16	TAME	EMB-190	Quito, Ecuador	Landing	Runway overrun	Destroyed		●
Sept. 26	Aeropostal	DC-9	Puerto Ordaz, Venezuela	Landing	Hard landing	Substantial		
Oct. 7	Delta Air Lines	MD-88	Atlanta	Tow	Collision with tug	Substantial		
Oct. 10	Sky Airlines	737-400	Antalya, Turkey	Landing	No flaps, landing gear collapse	Substantial		
Oct. 18	Iran Air	727	Tehran, Iran	Landing	Gear-up landing	Substantial		
Nov. 1	LOT Polish Airlines	767	Warsaw	Landing	Gear-up landing	Substantial		
Nov. 10	SA-Airlink	RJ-85	Johannesburg, South Africa	Landing	Gear-up landing	Substantial		
Dec. 14	Air Canada	A321	Fort Lauderdale, Florida, U.S.	Taxi	Stopped abruptly during taxi because of potential collision			
Dec. 20	Sriwijaya Air	737-300	Yogyakarta, Indonesia	Landing	Landing overrun	Substantial		
Dec. 23	Austrian Airlines	A321	Manchester, England	Go-around	Wind shear and tail strike	Substantial		
Dec. 25	AMC Airlines	MD-83	Karachi, Pakistan	Landing	Nose landing gear up	Substantial		
	Total accidents: 36					**Totals:**	**175 (0)**	**7**

Source: Boeing Commercial Airplanes

Table 1

Accidents, Worldwide Commercial Jet Fleet, by Type of Operation

Type of operation	All Accidents		Fatal Accidents		On-board Fatalities (External Fatalities)*		Hull Loss Accidents	
	1959–2011	2002–2011	1959–2011	2002–2011	1959–2011	2002–2011	1959–2011	2002–2011
Passenger	1,424	317	483	63	28,553 (777)	4,486 (142)	680	129
Scheduled	1,307	294	437	60	24,427	4,470	611	122
Charter	117	23	46	3	4,126	16	69	7
Cargo	252	74	76	13	264 (330)	44 (72)	169	44
Maintenance test, ferry, positioning, training and demonstration	122	13	44	3	208 (66)	17 (0)	74	8
Totals	**1,798**	**404**	**603**	**79**	**29,025 (1,173)**	**4,547 (214)**	**923**	**181**
U.S. and Canadian operators	555	78	180	11	6,193 (381)	17 (8)	222	26
Rest of the world	1,243	326	423	68	22,832 (792)	4,530 (206)	701	155
Totals	**1,798**	**404**	**603**	**79**	**29,025 (1,173)**	**4,547 (214)**	**923**	**181**

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

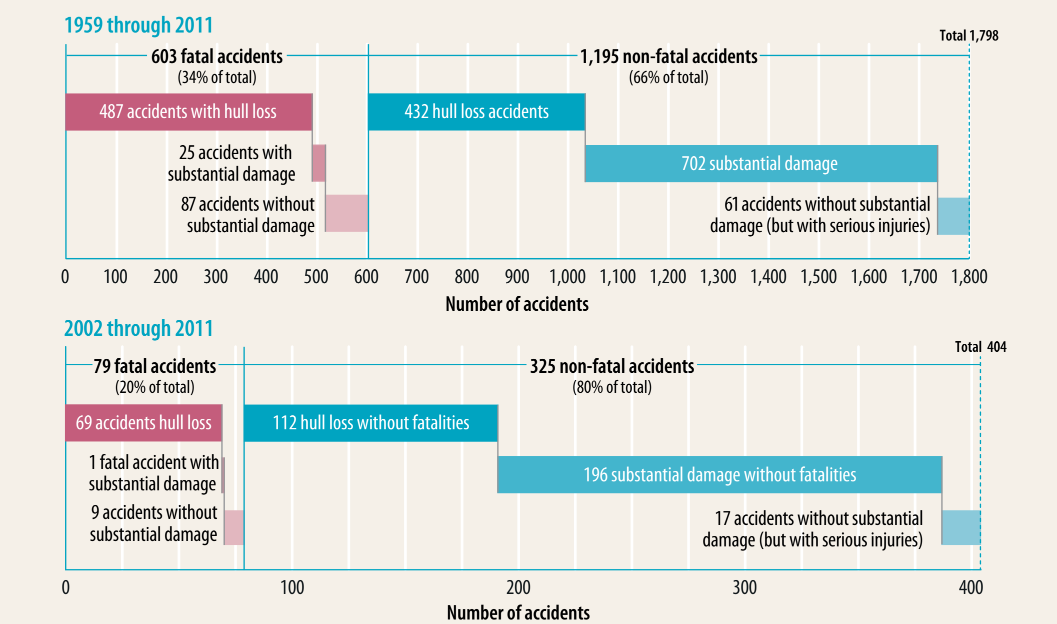
Source: Boeing Commercial Airplanes

Table 2

of the total accidents (Figure 1). The 87 fatal accidents from 2001 through 2010 were slightly more of the total, at 22 percent. A more striking difference can be seen in comparing the latest 10-year period with the 53-year period that began in 1959, around the beginning of commercial jet aviation. In that span, fatal accidents were 34 percent of the total.

Ideally, design improvements should result in a larger percentage of substantial damage accidents without fatalities. Little change is evident, however. From 2002 through 2011, the rate was 60 percent; from 1959 through 2011, it was 59 percent. The total period includes recent years, so a comparison of the most recent decades with the most distant might tell a different story.

Accidents, by Injury and Damage, Worldwide Commercial Jet Fleet

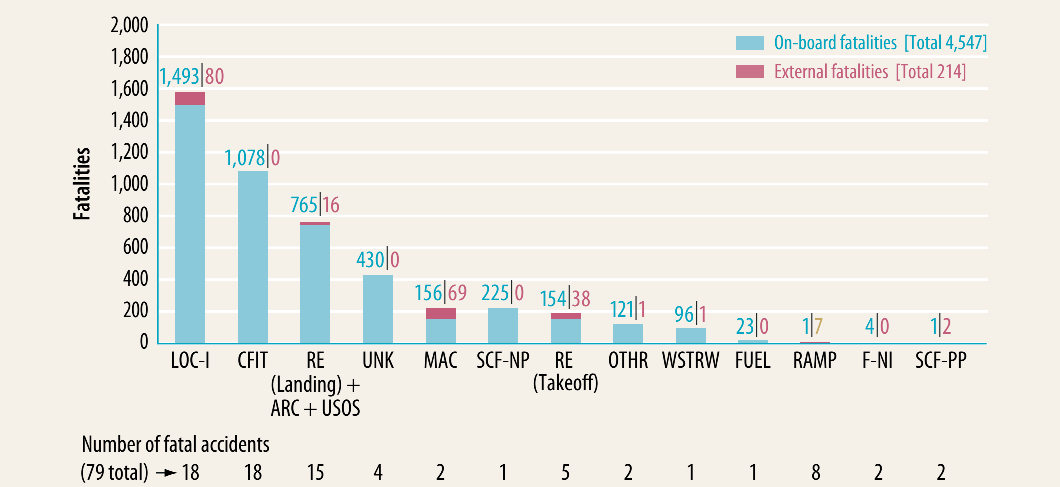


Source: Boeing Commercial Airplanes

Figure 1

Boeing examined fatal accidents using the standardized taxonomy of the U.S. Commercial Aviation Safety Team/International Civil Aviation Organization (CAST/ICAO).[4] For some 10-year periods, "loss of control–in flight" (LOC-I) has resulted in the most fatalities (Figure 2, p. 52). In the 2002–2011 period, LOC-I

Fatalities by CAST/ICAO Taxonomy Accident Category, Worldwide Commercial Jet Fleet, 2001–2010



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); FUEL = fuel related; LOC-I = loss of control – in flight; MAC = midair/near midair collision; OTHR = other; RAMP = ground handling; RE = runway excursion; SCF-NP = system/component failure or malfunction (non-powerplant); 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, fire/smoke (post-impact), ground collision, icing, low altitude operations, loss of control – ground, runway incursion – animal, runway incursion – vehicle, aircraft or person, security related or turbulence encounter.

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

fatalities as a percentage of all fatalities were reduced. Among on-board fatalities, 1,493 of a total 4,547, or 33 percent, were in the LOC-I category. In 2001–2010, it had been 1,765 of 4,774, or 37 percent.

The number of fatal LOC-I accidents, 18, was reduced in the most recent period from the previous 20.

Controlled flight into terrain (CFIT) claimed a higher percentage of lives among the total in 2002–2011, 24 percent, compared with 21 percent in the previous 10-year stretch. There was one more CFIT accident in 2002–2011 than in 2001–2010.

Otherwise, there was little change in percentages of on-board fatalities associated with CAST/ICAO categories between the two periods.

Boeing combines the RE category (runway excursion [landing]) with ARC (abnormal runway contact) and USOS (undershoot/overshoot) in the third-greatest source of on-board fatalities. That was involved in 17 percent of fatalities, similar to the previous period's 16 percent.

Runway excursions on takeoff (RE [takeoff]) accounted for 154 on-board fatalities in 2002–2011, 3 percent of the total. That matched the percentage for 2001–2010.

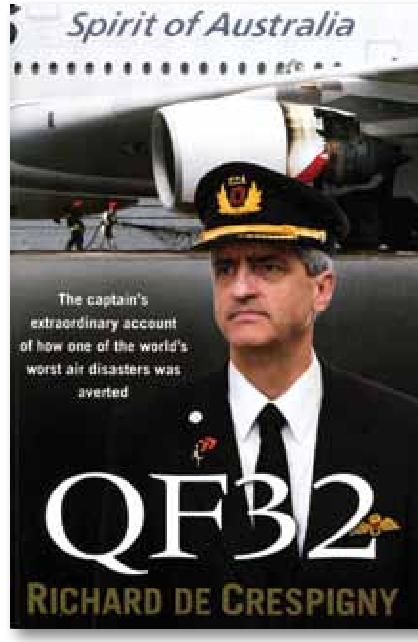
Notes

1. Boeing Commercial Airplanes. *Statistical Summary of Commercial Jet Airplane Accidents: Worldwide Operations 1959–2011*. <www.boeing.com/news/techissues/pdf/statsum.pdf>.
2. The data are limited to commercial jet airplanes over 60,000 lb (27,216 kg) maximum gross weight.
3. An airplane accident is defined 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 death or serious injury results from being in the airplane; direct contact with the airplane or anything attached thereto, or direct exposure to jet blast; the airplane sustains substantial damage or the airplane is missing or completely inaccessible." Occurrences involving test flights or hostile action such as sabotage or hijacking are excluded.
4. A major accident is defined as one meeting any of three conditions: the airplane was destroyed; there were multiple fatalities; or there was one fatality and the airplane was substantially damaged.
5. <www.intlaviationstandards.org>.

After Shock

An uncontained engine failure began an in-flight drama to save Qantas Flight 32.

BY RICK DARBY



BOOKS

Epic Fail

QF 32

De Crespigny, Richard. Sydney, Australia: Pan Macmillan Australia, 2012. 358 pp. Photographs, appendixes.

On Nov. 4, 2010, and the following day, jaws dropped all over the world as facts of the accident involving Qantas Flight 32 — QF32 — became known. The near disaster and its successful resolution were the stuff of compelling drama.

The flight began when Richard Champion de Crespigny, a Qantas captain and pilot-in-command of QF32, signed for *Nancy-Bird-Walton*, an Airbus A380, the world's largest passenger aircraft. The doors were closed and the airplane was now "his." Four minutes after a routine takeoff from Changi Airport in Singapore, headed for Sydney with 469 people aboard, the no. 2 engine (left inboard) was ruptured by an explosive failure while the airplane was climbing through 7,400 ft. De Crespigny describes what happened immediately afterward:

"The huge Rolls-Royce Trent 900 engine was destroyed. The extent of damage was unprecedented in Airbus's history. Two heavy chunks tore through the wing, traveling at approximately two times the speed of sound. The fan blades and chunks acted like the explosive core of a hand grenade, ripping wing panels into shrapnel that sprayed like missile fragments over the fuselage as far as the massive tail sections. One chunk also ripped through the aircraft's belly, severing hundreds of wires.

"Over 600 wires were cut, causing almost every aircraft system to become degraded. ... The hydraulics, electrics, brakes, fuel, flight control and landing gear systems were all compromised."

Understandably, many readers could be tempted to skip directly to the later chapters describing the accident and the efforts of the flight crew to return the airplane safely to Changi while the cabin crew worked to calm passengers and prepare for a possible evacuation.

But if they skip earlier chapters, readers will miss something important. The biographical background de Crespigny relates played an important part in the story; it made him the man he is and contributed to his ability as a team leader in the cockpit when every action was critical and so many lives were at risk.

De Crespigny came by his aristocratic name from noble Huguenot ancestors in the reign of French King Louis XIV in the 17th century. That family's mansion survives, up the road from Omaha Beach of Normandy invasion fame. Several of his ancestors were distinguished in various ways, including eccentricity. The Rev. Heaton de Crespigny fought a pistol duel in 1828 ("he was later defrocked and died in the Australian gold fields"). In 1883, Sir Claude de Crespigny tried to travel from England to France in a balloon, found himself at 17,000 ft, decided discretion was the better part of valor and crash landed in Holland. He also became the assistant executioner for the English county of Essex.

Richard de Crespigny's account of his young self suggests he was something of a "Wright brothers" type, fascinated with mechanical devices from an early age. He learned to rebuild a motorbike or car engine and start it working again. "The time bashing around on those bikes and fixing them gave me a respect for machinery that I took into my aviation career," de Crespigny says.

It's a long way from a bike to an A380 with four engines each normally producing 70,000 lb (31,752 kg) maximum thrust, 52 flight control surfaces, 16 wheels, and fly-by-wire systems. Still, it's likely that de Crespigny's keenness to understand the workings of equipment was a positive factor when he met the supreme test of his flying career.

"I have to learn the machine from the ground up, not from the buttons and checklists down," he says. "I don't like controlling machinery I don't fully understand … . I need to understand the philosophy of how the machine is designed and assembled so I can understand the limits and standard operating procedures. I have to know the purpose for every checklist, rather than just relying on computer displays."

When, as a Qantas pilot, he transitioned from the Boeing 747 to the Airbus A330 — the aircraft he flew before the A380 — he had a huge task of knowledge replacement: "I went through all the manuals, and I phoned engineers and I questioned designers and talked to test pilots until I fully understood what I was about to take control of."

Shortly after 1000 local time on Nov. 4, during QF32's climbout, two booming noises startled the flight crew and shook the airplane. De Crespigny selected "altitude hold" and pulled back the thrust levers. He soon realized that the autothrust system had failed.

'There was shock around me as the other pilots waited for me to speak.'

"There was shock around me as the other pilots waited for me to speak," he says. "With the aircraft flying straight and level, and at a constant speed, I now focused on the engine and warning display, the top display in the middle of the instrument panel. Engine [no.] 2 looked very sick. All of the [indications] for thrust, temperature and pressures were replaced with crosses telling us that there was no data to display. It appeared that all the sensors had been blown off that engine. This was a catastrophic failure."

As bad as the situation was — and de Crespigny did not yet know *how* bad — the airplane could fly and was controllable in cruise.

The captain was fortunate to have four other pilots in the cockpit for task sharing: First Officer Matthew Hicks; Second Officer Mark Johnson; and two check pilots, Capt. David Evans and Capt. Harry Wubben.

Fuel was available to fly a holding pattern, assess the situation and plan the landing. But even plentiful fuel turned out to be a mixed blessing, because the jettison valves and pumps were inoperable. There was no way to dump fuel, which would necessitate a seriously overweight landing.

The Airbus's electronic centralized aircraft monitoring (ECAM) system tells the pilots what is wrong and presents checklists designed to deal with it. "The ECAM checklists started

By the time the flight was an hour old, the ECAM had identified about 100 significant faults and checklists.

with engines, hydraulics, flight controls, then fuel, each of them with a series of fixes we had to perform to see if we could get the problem under control," de Crespigny says. "The explosions had obviously started a fire and disabled an engine, which we'd shut down, hopefully containing or extinguishing the fire. But the fix for the fire in engine [no.] 2 was only the beginning of it: engines [nos.] 1, 3 and 4 were degraded in different forms, the fuel system was in a total mess, the hydraulics and electrics and pneumatics were plundered, and even our flight controls were compromised."

By the time the flight was an hour old, the ECAM had identified about 100 significant faults and checklists.

De Crespigny says, "The aircraft was so injured, and so many of the 250,000 sensors were complaining, that I had reached the limit of my ability to absorb them all. The ECAM threw up so many failures, degradations and checklists — especially in the fuel system — that I could not evaluate all the interactions and consequences of the cascading failures. I just wasn't confident how much of the aircraft we had left."

The turning point came, he says, when he decided to concentrate on what *was* working. As everyone knows, the landing involved no injuries, but that wasn't the end of the ordeal; leaking fuel in the vicinity of brakes heated to 500 degrees C (932 degrees F) by the landing speed and overweight condition created a fire hazard that prevented the passengers and crew from exiting the plane. It was another 52 minutes before disembarkation was judged safe and the first passenger descended the airstairs. The no. 1 engine would not shut down, even with water sprayed directly into it. It continued turning for three and a half hours after the landing.

The author's description of the calculation of landing parameters, discussion (and sometimes disagreement) among the flight crewmembers, contact with air traffic control, announcements to the passengers and further automated warnings makes a grippingly suspenseful story. The book fills in details that news reports could not convey at the time, not only of technical issues but about crew resource management.

The cabin crewmembers, headed by customer service manager Michael von Reth, prepared for an emergency evacuation while, perhaps more difficult under the circumstances, calming and reassuring the passengers. This involved identifying any passengers who showed signs of losing control, which could have initiated contagious panic throughout the back of the plane. Von Reth had to give special care to a few passengers, but only a few.

QF32 shows occasional signs of hasty preparation, such as some repeated information. But with a series of events of such complexity, even that may help the reader understand the big picture. De Crespigny mentions the awards the crew received, including the Flight Safety Foundation Professionalism Award. "This last award is remarkable because it included Michael von Reth in the citation, the first time a cabin crewmember had ever been recognized in the FSF's 65-year history," he says. Actually, the Foundation has given a different award, for heroism, to several cabin crewmembers including Richard DeMary, the lead flight attendant who risked his life to help rescue passengers from the burning cabin of USAir Flight 1016 following a crash in 1994.

In any case, there was indeed plenty of credit to go around. As for Richard de Crespigny, he sums up the attitude that helped him in his role during the emergency: "I'm old school in this respect: On board, I believe the pilot's job is exactly as written in the federal laws; pilots are 'responsible for the safety of the passengers and crew' regardless of what stands between them and disaster. Whether it's a fly-by-wire computer or a few cables connected to your rudder pedals, your job is to know your plane, be unafraid of the plane and to *fly the plane*."

FSF video interviews with de Crespigny and von Reth can be accessed at <flightsafety.org/media-center/news>.

Long Float Leads to Overrun

Light, variable winds were reported, but an 11-kt tail wind was encountered.

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

Standing Water on Runway

Bombardier CRJ700. Substantial damage. No injuries.

About 45 minutes after departing from Delhi, India, for a scheduled flight to Kanpur the morning of July 20, 2011, the flight crew asked an air traffic controller at Kanpur's Chakeri Airfield for the current weather conditions. The controller said in part that the surface winds were variable at 5 kt, visibility was 2,000 m (1 1/4 mi) in thundershowers and the runway was wet.

The CRJ was nearing the airport when the controller advised that visibility had decreased to 800 m (1/2 mi), which was below the minimum of 1,200 m (3/4 mi) required to conduct the instrument landing system (ILS) approach to Runway 27, according to the report by the Indian Directorate General of Civil Aviation (DGCA). The crew decided to enter a holding pattern and wait for the visibility to improve. They told the controller that they had sufficient fuel to hold for 20 minutes before they would have to divert the flight to their alternate airport.

The aircraft had been in a holding pattern for nearly 20 minutes when the controller advised that visibility had improved to 1,200 m. The controller cleared the crew to conduct the ILS approach to Runway 27 and advised that there were patches of water on the runway.

Chakeri Airfield is a joint military/civilian airport with one runway, which is 9,000 ft (2,743 m) long. "Since it is an air force airfield, it has arrestor barriers [nets] and a soft-ground area on either side of the runway to stop [an] aircraft in case of an overrun," the report said. The CRJ's quick reference handbook indicated that the aircraft could be landed within about 5,000 ft (1,524 m) on the wet runway.

The commander, the pilot flying, later told investigators that the approach was stabilized and that the copilot made all standard callouts. "Both the cockpit crew stated that they saw the runway at decision altitude and continued for landing," the report said. "The commander further stated that approximately 43 ft [above the runway], he retarded the throttle levers and round-off for landing was initiated."

Recorded flight data indicated that the aircraft's airspeed was 135 kt, or 7 kt above the reference landing speed (V_{REF}), and groundspeed was 146 kt when the commander began the landing flare. The report said that this "implies that at the time of landing the tail wind component was around 11 kt."

The CRJ floated above the runway for about 10 seconds before the commander "had to deliberately put down the aircraft," the report said. Touchdown occurred with about 4,235 ft (1,291 m) of runway remaining. The speed brakes and thrust reversers were deployed, and the commander applied maximum wheel braking. However, "the remaining runway was not enough to stop the aircraft … under the prevailing rainy conditions," the report said.

The aircraft overran the runway at 44 kt and rolled about 200 ft (61 m) before coming to a stop with the landing gear mired in soft ground. The left wing struck the localizer antenna, which tore a 3-in (8-cm) hole in the leading edge. There was no fire, and none of the 55 passengers and four crewmembers was injured.

"After the aircraft came to a complete halt, the commander informed ATC [air traffic control] that they [had] gone off the runway and required assistance," the report said. "The passengers were deplaned normally."

Among recommendations based on the findings of the investigation, the DGCA said that airlines should place more emphasis on wet/contaminated runway landings during recurrent training and proficiency checks, and should publish a nonpunitive go-around policy in training and operations manuals.

'Startle Effect' Cited in Upset

Airbus A340-313. No damage. No injuries.

Investigators said that the flight crew did not have their weather radar and navigation displays adjusted properly to show a small line of cumulus clouds that had built quickly to 38,000 ft over the Atlantic during a flight from Caracas, Venezuela, to Paris the night of July 22, 2011.

"It should be noted that this type of isolated cloud in an inter-tropical zone is beyond forecasting abilities other than immediate or very short-term forecasts," said the report by the French Bureau d'Enquêtes et d'Analyses (BEA).

The A340 was in cruise flight at 0.83 Mach and Flight Level (FL) 350 (approximately 35,000 ft), with the ranges on both navigation displays set to 320 nm (593 km) and the weather radar tilt set between minus 0.5 degree and minus 1.0 degree. The report said that, at the low tilt settings, the radar was scanning a portion of the clouds that consisted primarily of ice crystals, which have very low reflectivity. The report also noted that the recommended display ranges for weather avoidance are 80 nm (148 km) and 160 nm (296 km).

Both pilots told investigators that they saw no areas of precipitation on the navigation displays before the aircraft skirted the edge of the line of clouds and encountered moderate turbulence. A strong wind gust caused airspeed to increase momentarily to 0.87 Mach (maximum operating speed is 0.86 Mach).

The pilots said that they were surprised when the master warning light illuminated and the aural overspeed warning sounded.

The pilots said that they were surprised when the master warning light illuminated and the aural overspeed warning sounded. The copilot, the pilot not flying (PNF), manually disengaged the autopilot by pressing the takeover pushbutton on his sidestick. Moreover, "a pitch-up input on the PNF's sidestick going as far as three-quarters to the stop was recorded for six seconds," the report said. "This input was accompanied by an input to bank to the right then left. The PNF stated that he did not remember these inputs."

The report said that the control inputs likely were reflexive actions that resulted from the "startle effect" produced by the overspeed warning. "Sometimes this effect sparks primal instinctive reaction, instant and inadequate motor responses," the report said. "These basic reflexes may prove to be incorrect and difficult to correct under time pressure and may affect the pilot's decision-making ability."

The continuous sounding of the overspeed warning likely masked the aural alert that was generated when the autopilot was disengaged. The captain, the pilot flying (PF), deployed the speed brakes in reaction to the overspeed warning. "The PF indicated that in the seconds that followed, he switched on the lights and noticed being in IMC [instrument meteorological conditions] and that there was precipitation," the report said. "He also indicated that he turned around to put his meal tray on the seat behind him."

The pilots said that they did not hear the aural altitude alert activate when the aircraft climbed through 35,200 ft at 1,950 fpm. The speed brakes retracted automatically as the aircraft's angle-of-attack exceeded the designed threshold. Pitch attitude increased to 12 degrees as the aircraft climbed through FL 360. "Vertical speed reached a maximum of 5,700 fpm," the report said. "The crew was not aware of this."

The A340 was climbing through 37,950 ft at 0.66 Mach when the captain disengaged the autothrottle and moved the thrust levers to the takeoff/go-around position. "The PF stated that he noted with surprise that altitude was 38,000," the report said.

The aircraft then began to descend with a high nose-up pitch attitude. "The PF then became aware of the disengagement of the AP [autopilot] and made a pitch-down input on his sidestick," the report said. "Pitch attitude began to decrease two seconds later."

The crew returned the aircraft to stable flight at FL 350 and landed without further incident about eight hours later in Paris. None of the 270 passengers and 14 crewmembers had been injured during the upset, and there was no damage to the aircraft.

BEA concluded that "this serious incident was due to inadequate monitoring of the flight parameters, which led to the failure to notice AP disengagement and the level bust [assigned altitude deviation], following a reflex action on the controls." The report noted that if the autopilot had remained engaged, the incident likely would have comprised only the 200-ft altitude deviation.

Engine Vibration Prompts Diversion

Boeing 757-200. No damage. No injuries.

The aircraft was at FL 370, en route with 96 passengers and seven crewmembers from Sierra Leone to London the night of Aug. 25, 2010, when the flight crew noticed an increase in engine vibration levels. In accordance with the quick reference handbook procedure, they activated the engine anti-icing systems, but the vibration levels continued to increase, said the report by the U.K. Air Accidents Investigation Branch.

"The vibration could now be felt through the airframe by both the flight crew and the cabin crew," the report said. "The commander decided to perform the manufacturer's 'Fan Ice Removal' procedure detailed in their OM [operations manual] in an attempt to reduce the vibration."

The OM said that the procedure is to be followed for one engine at a time by quickly moving the thrust lever to idle and waiting five seconds for the engine to stabilize before advancing the lever to attain the desired engine pressure ratio (EPR). The initial rapid reduction of thrust causes the engine fan blades to twist and shed any accumulated ice.

When the crew retarded the left thrust lever, however, the vibration level suddenly and unexpectedly increased to the maximum value. The crew responded by moving the lever forward, without the required five-second pause. The result was that EPR increased only slightly, while exhaust gas temperature (EGT) increased almost to the limit. The lever was retarded again to bring the vibration level and the EGT within limits.

The crew decided to divert the flight to Nouakchott, Mauritania. During the descent, the left engine began again to respond normally to thrust lever movement, and the aircraft was landed in Nouakchott without further incident. "Subsequent examination of both engines on the ground, both externally and internally, did not reveal any damage," the report said.

Investigators determined that the left engine had begun to surge or stall during the interrupted fan ice removal procedure. "The vibration condition was attributed by the engine manufacturer [Rolls-Royce] to an asymmetric ice buildup under the [engine] spinner fairings," the report said.

Rolls-Royce in 2001 had issued a service bulletin, revised in 2006, requiring the installation of seals between the engine spinners and the spinner fairings to prevent moisture from entering the spinner cavities and freezing. The report said that the spinners on the incident aircraft had not been modified according to the service bulletin, which calls for compliance by March 2015.

The left engine had begun to surge or stall during the interrupted fan ice removal procedure.

Oil Tube Fractures on Takeoff

McDonnell Douglas MD-90-30. Substantial damage. No injuries.

The MD-90, with 111 people aboard, was on initial climb when ATC told the flight crew that white smoke had been observed from the right engine as the aircraft was rolling for takeoff from Sendai (Japan) Airport the afternoon of Aug. 15, 2010. The captain, the pilot monitoring, noticed an indication of low oil pressure and received clearance from ATC to stop the climb at 6,000 ft and proceed to an area south of the airport, where the problem could be diagnosed.

The aircraft was climbing through 5,500 ft shortly thereafter when the engine fire warning activated, said the report by the Japan Transport Safety Board (JTSB). The captain declared an emergency and assumed control of the aircraft. The crew then shut down the right engine, activated the fire-extinguishing system and returned to the airport, where a single-engine landing was completed without further incident.

Investigators found that the no. 4 bearing scavenge tube had fractured, spraying oil that ignited on contact with the engine's hot section. The tube, located inside the engine case, returns oil used to lubricate and cool the aft bearing on the high-pressure rotor shaft to the oil tank. The report said that stresses imposed by temperature and pressure changes inside the tube likely had caused a fatigue crack to form at a bend in the tube.

The report noted that a heat shield precludes a visual check of the tube during maintenance inspections. As a result of the investigation, the JTSB recommended that the U.S. Federal Aviation Administration require the engine manufacturer, International Aero Engines (IAE), to review the tube design and inspection procedures.

The report, issued in June, noted that IAE believes the fracture was caused partly by assembly stresses and has revised the installation procedures.

Stall on Go-Around

Hawker Beechcraft 390. Substantial damage. Two serious injuries.

Special ATC procedures were in effect for a high volume of traffic at a major air show in Oshkosh, Wisconsin, U.S., the afternoon of July 27, 2010. Arrivals and departures were being handled by different controllers on different radio frequencies. An arrivals controller had cleared the pilot of the Premier 1A to turn onto a base leg about the same time that a departures controller cleared the pilot of a Piper Cub, which was holding on the runway, for an immediate takeoff and to make an "angled departure" — that is a slight left turn after liftoff to clear the runway for the light jet.

The Premier pilot was not aware that the Cub was going to make an angled departure, and he became concerned about a potential conflict with the smaller airplane, said the report by the U.S. National Transportation Safety Board (NTSB).

The report said that as the light jet made a continuous left turn from downwind to short final, the bank angle varied between 32 and 43 degrees. The enhanced ground-proximity warning system aboard the Premier generated five "bank angle" warnings.

The pilot "stated that he overshot the runway centerline during his turn from base to final and, when he completed the turn, his airplane was offset to the right of the runway," the report said. The Premier was 37 ft above the ground when the pilot radioed that he was going around.

"The pilot reported that he initiated a go-around, increasing engine power slightly but not to takeoff power as he looked for additional traffic to avoid," the report said. "He estimated that he advanced the throttle levers 'probably a third of the way to the stop' and, as he looked for traffic, the stall warning stick-shaker and stick-pusher systems activated almost simultaneously as the right wing stalled."

The airplane was in a nose-down and right-wing-low attitude when it struck a grass drainage ditch about 4,300 ft (1,311 m) north of the departure end of the runway. The pilot and his passenger were seriously injured, but no one on the ground was hurt.

TURBOPROPS

Prop Overspeed Causes Control Loss

Bombardier DHC-8-103. Substantial damage. No injuries.

The flight crew had turned on the seat belt sign, expecting turbulence during the descent over mountainous terrain to Sørkjosen (Norway) Airport the night of Feb. 21, 2006. When the aircraft encountered "heavy" turbulence at about 9,000 ft, the commander moved the power levers toward flight idle, intending to decrease airspeed from 225 kt to 180 kt, the maximum speed for flying in turbulence.

However, the commander inadvertently lifted the tabs beneath the power lever knobs that release the locks that prevent the levers from being moved past the flight idle gate and into the beta range, said the report issued by the Accident Investigation Board Norway in June 2012.

"Unintentionally, both power levers ended up aft of the flight idle gate," the report said. "As a result, both propellers overspeeded." Possibly because the right power lever was moved farther into beta than the left power lever, the right propeller entered an uncontrollably high rotation speed and caused severe internal engine damage.

The drag produced by the right propeller caused a momentary loss of control. The Dash 8 pitched 20 degrees nose-down, entered a 58-degree right bank and descended about 1,000 ft before the crew was able to level the aircraft, feather the propeller using the alternate feathering system and shut down the engine. None of the 17 passengers or three crewmembers was injured. The crew decided to return to Tromsø, where a single-engine landing was conducted without further incident.

The report noted that the aircraft had not received a service bulletin modification preventing the power levers from being moved into beta unless the weight-on-wheels sensing system is activated.

Icing, Turbulence Trigger Upset

Beech King Air A100. Substantial damage. No injuries.

The airplane was on a positioning flight from Bridgewater, Virginia, U.S., to Wichita, Kansas, the afternoon of June 15, 2011. The pilots said that the ride in IMC at FL 200 over Tennessee was smooth, but the weather radar system showed a large area of moderate to extreme precipitation about 30 nm (56 km) northwest.

"Meteorological and radar data revealed that the airplane entered an area of rapidly intensifying convective activity [that] developed along the airplane's flight path," the NTSB report said.

The King Air encountered moderate turbulence and severe icing conditions, and the pilot altered course 40 degrees south. "However, the turbulence increased, and the airplane entered an uncommanded left roll and dive," the report said. "The autopilot disengaged, and the pilot's electrically driven attitude indicator tumbled. The flight crew reduced the engine power levers to idle and were able to recover utilizing the copilot's vacuum-driven attitude indicator. The airplane was returned to straight-and-level flight at an altitude of 8,000 ft; however, flight control instability persisted."

The crew diverted the flight to Blountville, Tennessee, and landed the King Air without further incident. Examination of the airplane revealed that the outboard one-third of the left elevator had separated in flight and the outboard section of the right elevator was bent downward. "In addition, the horizontal stabilizer bulkhead frame was fractured, and the aft portion of the airframe sustained several areas of deformation," the report said.

Examination of the airplane revealed that the outboard one-third of the left elevator had separated in flight.

Takeoff Rejected Too Late

Cessna 208B. Destroyed. One fatality, eight minor injuries.

The pilot was familiar with the airport in Pukatawagan, Manitoba, Canada, and, having conducted two scheduled flights there earlier in the day on July 4, 2011, likely was aware of several soft spots caused by recent rainfall on the 3,000-ft (914-m) gravel runway. With eight passengers, baggage and 900 lb (408 kg) of fuel aboard, the Caravan was about 1,000 lb (454 kg) below its maximum takeoff weight, and the center of gravity was within limits, said the report by the Transportation Safety Board of Canada.

The pilot began the takeoff from the approach end of Runway 33, with 20 degrees of flaps per the company's standard operating procedure. Groundspeed stagnated when the aircraft encountered soft spots about halfway down the runway. "One or both of the main landing gear wheels lifted off the ground momentarily, but the aircraft was unable to fly away," the report said. "This indicates that either the aircraft was rotated too early or a significant degree of rotation occurred before liftoff speed was attained."

The report said that the aircraft's takeoff performance might have been affected by an unexpected wind shift or wind shear. The surface winds were estimated as from 280 degrees at 12 kt, gusting to 22 kt.

The pilot rejected the takeoff with about 600 ft (183 m) of runway remaining, which was insufficient to stop the aircraft, the report said. The Caravan overran the runway, rolled down a steep 20-ft (6-m) slope into a ravine and caught fire. One passenger, who was not wearing a shoulder harness, was rendered unconscious by severe head wounds. The pilot and another passenger tried to extricate the unconscious passenger but were forced away from the aircraft by the increasing heat and smoke. The passenger died of smoke inhalation.

PISTON AIRPLANES

Split-Flap Condition

Cessna 421B. Minor damage. No Injuries.

The airplane was about 1,000 ft above the designated pattern altitude when it entered the downwind leg at Truckee-Tahoe (California, U.S.) Airport during an emergency medical services positioning flight the afternoon of May 2, 2011. When the pilot extended the landing gear and flaps to facilitate a descent, he heard a "popping sound," and the 421 banked 80 degrees right, the NTSB report said.

The pilot attempted to retract the flaps, but the left flap remained fully extended, and the pilot had to use full left aileron control and trim to keep the wings level. He circled the airport and cycled the flap selector several times, but the split-flap condition persisted.

"He was able to accomplish left turns with about 5 degrees of bank, and although right turns could be performed, recovery to wings-level was slower than normal," the report said. "Due to terrain and wind concerns, he decided to divert back to [Sacramento, California]. For the remaining 35 minutes of flight, the pilot employed the assistance of a medical crewmember to help with maintaining left aileron control deflection."

After the airplane was landed in Sacramento, investigators found that the right wing flap extension cable had failed where it contacts a pulley — a cable section that cannot be inspected for damage unless the cable is removed, the report said. The cable was installed when the airplane was manufactured in 1975 and had accumulated over 4,830 flight hours.

Brake Failure Leads to Ramp Overrun

Lockheed P2V-5 Neptune. Substantial damage. No injuries.

The air tanker was returning to its base in Broomfield, Colorado, U.S., the afternoon of June 26, 2010, when the flight crew discovered that the main hydraulic system had failed — a fault later attributed to a ruptured hydraulic line. The copilot used emergency systems to extend the landing gear. However, she inadvertently returned the emergency nose gear selector to the "bypass" position, rather than to the "normal" position, which isolated emergency hydraulic system pressure from the emergency brakes.

There was enough residual accumulator pressure to engage the brakes during landing, and the captain exited the runway on a high-speed turn-off onto a taxiway leading to the tanker ramp. However, when he tried to stop the airplane on the ramp, the brakes did not respond. The P2V crossed the ramp, rolled through the airport perimeter fence and down an embankment, and came to a stop on a road.

The report noted that the airplane flight manual procedure for a hydraulic failure is to stop and shut down the airplane on the runway after landing, pin the landing gear and have the airplane towed to parking.

Multiple Modifications Blur V_{MCA}

Beech 58 Baron. Substantial damage. Two fatalities.

The pilot had recently purchased the airplane, which had been modified according to a supplemental type certificate (STC) with vortex generators that decreased the minimum single-engine control speed (V_{MCA}) from 81 kt to 74 kt and under another STC with more powerful engines and different propellers. The STC for the latter modification specified a V_{MCA} of 87 kt.

Because no flight testing had been performed to determine the interrelationship of the two STCs, which had been obtained by different companies, "the actual performance data for the airplane, including the V_{MCA}, were unknown," the NTSB report said. "However, the V_{MCA} … likely was higher than the 74-knot V_{MCA} marked on the airspeed indicator."

The pilot was receiving an instrument competency check the morning of Aug. 7, 2010, when the airplane stalled, entered a spin and struck a house in Saltsburg, Pennsylvania. The pilot and flight instructor were killed, but no one on the ground was hurt.

Investigators determined that the pilot likely lost control of the Baron during a V_{MCA} demonstration. "Because the airplane was equipped with only a throw-over control yoke, the [flight instructor] had limited ability to assist in the recovery of the airplane," the report said.

HELICOPTERS

Clipboard Strikes Tail Rotor

Hiller UH-12E. Substantial damage. Three fatalities.

The pilot stowed most of the passengers' equipment and personal effects in the helicopter's external racks before departing from Clarkston, Washington, U.S., for a wildlife-survey flight the morning of Aug. 31, 2010.

About 40 minutes later, the pilot radioed that he was diverting the flight to Kamiah, Idaho, which was about 35 nm (65 km) short of the planned destination, but gave no reason for the diversion. "No further transmissions were received from the helicopter," the NTSB report said. "Several witnesses … heard unusual noises emanating from the helicopter and observed objects separating or falling from it. [They] reported that it was rotating as it descended."

The Hiller crashed out of control on a driveway in a residential area near Kamiah. Investigators determined that a metal clipboard belonging to one of the passengers had struck and destroyed the tail rotor. "The original location of the clipboard and how it became free could not be determined," the report said.

Rotor Stalls on Approach

Robinson R22 Beta. Destroyed. Two fatalities.

The pilot was returning to a helipad in Yamaga, Japan, after a route-familiarization flight the afternoon of Aug. 1, 2010. A witness saw the R22 cross utility lines and then enter a steep, descending right turn. Both occupants were killed when the helicopter crashed in a paddy about 160 m (525 ft) from the helipad.

The JTSB report said that the helicopter likely had been descending with a relatively high approach speed and a low main rotor speed when the pilot increased collective control to stay above the power lines. Main rotor speed continued to decrease until the rotor blades stalled, resulting in the loss of control, according to the report.

Bent Pneumatic Line Fractures

Hughes 500D. Minor damage. No injuries.

The helicopter was descending to land at McGrath, Alaska, U.S., during a charter flight the evening of July 4, 2011, when the engine noise abruptly changed and the aural and visual engine failure warnings activated. The pilot initiated autorotative flight and conducted an emergency landing on uneven tundra. The main rotor blades were damaged when they struck several small trees during the emergency landing, but the pilot and her two passengers escaped injury.

"A post-accident inspection revealed a fatigue fracture in the engine Pc line that provides compressed air to operate the engine governor and fuel control units," the NTSB report said. "The Pc line met the metallurgical material specifications, but there was a bend in a normally straight portion of the line." The bend, which was of unknown origin, created material stress and fatigue that eventually caused the line to fracture.

Preliminary Reports, June 2012

Date	Location	Aircraft Type	Aircraft Damage	Injuries
June 1	Pontianak, Indonesia	Boeing 737-400	substantial	163 minor/none
Visibility was 600 m (3/8 mi) in heavy rain, and surface winds were from 230 degrees at 22 kt when the 737 veered off the left side of Runway 15 while landing.				
June 2	Accra, Ghana	Boeing 727-200F	destroyed	12 fatal, 4 minor/none
A thunderstorm was overhead when the 727 overran the 3,400-m (11,155-ft) runway during a night landing, rolled through the airport perimeter fence and struck two vehicles on a road. Twelve people on the ground were killed.				
June 3	Lagos, Nigeria	McDonnell Douglas MD-83	destroyed	163 fatal
The MD-83 was 11 nm (20 km) from the airport when the flight crew declared an emergency because of a loss of power from both engines. The aircraft then struck a power line and crashed in a residential area. All 153 people aboard the aircraft and 10 people on the ground were killed.				
June 3	Modena, Utah, U.S.	Lockheed P2V-7 Neptune	substantial	2 fatal
The air tanker struck terrain while turning onto final approach to drop retardant on a forest fire at the bottom of a narrow valley.				
June 4	Indiantown, Florida, U.S.	Bell 427	substantial	5 minor
The helicopter was in cruise flight at 800 ft when several large birds struck the main rotor head. The pilot said that the 427 began to shake violently and became difficult to control. The helicopter rolled over after striking the ground hard during the emergency landing. Recovered bird remains were sent to the Smithsonian Institution for identification.				
June 6	Rio de la Plata, Uruguay	Swearingen Metro III	(missing)	NA
The Metro is presumed to have crashed, and the four crewmembers killed, shortly after departing from Montevideo, Uruguay, for a cargo flight to Buenos Aires, Argentina.				
June 7	Lake Wales, Florida, U.S.	Pilatus PC-12/47	destroyed	6 fatal
The airplane was in instrument meteorological conditions, climbing through 25,000 ft and deviating from course to avoid an area of moderate to extreme precipitation, when it departed from controlled flight and broke up. Witnesses saw the PC-12 emerge from the clouds in a spin.				
June 9	Prague, Czech Republic	ATR 42-500	destroyed	1 NA
A mechanic was injured when an explosion occurred and the ATR 42 caught fire inside a maintenance hangar.				
June 9	Teisendorf, Germany	Robinson R44	destroyed	4 fatal
Visual meteorological conditions (VMC) prevailed when the R44 struck mountainous terrain during a flight from Worms, Germany, to Salzburg, Austria.				
June 10	Kiev, Ukraine	Let 410UVP	destroyed	5 fatal, 15 minor/none
The skydiving aircraft was returning to the airport because of an approaching rainstorm when it crashed in a field.				
June 18	Atlanta, Georgia, U.S.	Beech 400A Beechjet	substantial	2 serious, 2 minor
Witnesses said that the Beechjet touched down at DeKalb-Peachtree Airport with about 3,000 ft (914 m) of the 4,800-ft (1,463-m) runway remaining. The airplane overran the runway and rolled down an embankment.				
June 19	Ceduna, South Australia, Australia	Eurocopter AS 350-BA	destroyed	2 none
The pilot conducted a precautionary landing after detecting fuel fumes. The helicopter caught fire after the landing.				
June 20	Pweto, Democratic Republic of Congo	Grumman Gulfstream 1	destroyed	5 minor/none
The Gulfstream touched down hard, bounced 20 ft and overran the runway onto a rocky embankment.				
June 20	Tokyo, Japan	Boeing 767-300	substantial	193 none
Winds were from 220 at 14 kt, gusting to 27 kt, when the 767 touched down hard on Narita's Runway 16R and bounced twice.				
June 22	Morgantown, West Virginia, U.S.	Beech King Air C90GT	substantial	1 fatal
The King Air struck a communications tower and crashed about 7.5 nm (14 km) from the airport during a positioning flight in VMC.				

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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