Silver Linings

Public pressure forced controversial regulatory changes, but U.S. officials see new risk-reduction benefits.

BY WAYNE ROSENKRANS | FROM ORLANDO

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The 2009 crash of Colgan Air Flight 3407 near Buffalo, New York, U.S., reverberated in April as training and safety specialists debated its effects on initial pilot qualifications, the adequacy of airline pilots' hand-flying skills and adding hours to recurrent flight simulator training. Some predicted during sessions of the World Aviation Training Conference and Tradeshow (WATS 2012) in Orlando, Florida, U.S., that derivative regulatory changes will have unintended consequences. Others credited public pressure on legislators in the United States with breakthrough decisions on air transport safety issues.

"We are focused on fostering the kinds of behaviors that lead to professional conduct," said Michael Huerta, acting administrator of the U.S. Federal Aviation Administration (FAA). Some of the latest industry upheaval has surrounded updates to certification and qualification for airline pilots through a rule proposed in February (*ASW*, 3/12, p. 9), which Huerta termed "the most significant overhaul in crew training in the last 20 years."

"Not only do we want to require [that first officers hold an airline transport pilot (ATP)] certificate, but we propose to greatly increase the training to achieve it," Huerta said. "For example, we believe it is necessary to have both academic and flight training in critical operating skills. [The rules also] would require pilots to demonstrate their skills in real scenarios … rather than have the pilot executing a recovery in a highly choreographed event." A similar philosophy is

Focus on automation in flight training devices and increase manual flying in full flight simulators, presenters said.

being applied to training dispatchers and flight attendants (see "Guaranteed Competence," p. 42).

Corridors of Power

Understanding the continued influence of the Colgan accident on aviation rulemaking requires familiarity with contemporary political dynamics of Washington, said John Allen, director, FAA Flight Standards Service. Government leaders, many in new positions when the accident occurred, and families of the passengers and crewmembers pressed for substantive changes to mitigate risks they perceived in airline industry practices.

The FAA in short order was directed to complete 22 studies and task force reports to Congress, the National Transportation Safety Board and other entities; initiate eight rulemaking processes and create two databases. Again this year, a February congressional reauthorization of funding for the agency included further Colgan-derived rulemaking and study requirements, he said.

'Unintended consequences … are [requiring] quite a bit of effort.'

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"There are some very positive things out of this, even though we are very cautious on legislating safety," Allen said. "But there are unintended consequences that we are trying to work through, and they are [requiring] quite a bit of effort."

Among responses to the changes, the FAA has narrowed its scope of rulemaking for mandating safety management systems (SMS) at major airlines. "If operators have a robust SMS, that means that they have programs for data collection tools, statistics and transparency to show the regulator how well they are managing their safety," Allen said. "They are capturing the risks and the hazards, they are mitigating them, they're getting a positive response, and they're being forthright about it. … FAA inspectors are more efficient and more effective [if] they don't have to waste time [in low-risk areas or] trying to ferret out whether there are unseen risks and hazards."

Adoption of SMS has prompted reconsideration of some deeply ingrained FAA policies. "I'm not sure that our enforcement posture is serving safety very well right now," he said. "We have over 4,000 enforcement actions in the pipeline, over 1,000 of them [more than] three years old. [Having] too many enforcement actions inhibits our attention to the significant ones. We also have a culture [of] inspectors who reflexively — because they don't have guidance to say otherwise — initiate enforcement action [whenever they see a violation of regulations]. We are amending our guidance to provide a mechanism for our inspectors to work in a collaborative fashion to do the right thing for safety … to be judicious in our enforcement [yet apply penalties] when it is appropriate."

Regarding first officer qualifications, the FAA's senior leaders agree with the strong industry and academic view that quality of experience — not just flight hours — establishes "the quality of the pilot," Allen said. "The legislation requiring the ATP is self-enacting, which means that the requirements become effective no later than July 31, 2013, regardless of any rulemaking action by the FAA."

Scheduled completion at the end of July of a notice of proposed rulemaking on professional pilot development, concerning mentoring programs, has been delayed.

Valuing Manual Flight Skills

Aircraft automation has been instrumental to air transport safety gains, said Jacques Drappier, a captain and senior adviser training, Airbus. Therefore, caution should be exercised in drawing conclusions about the causal role of automation in accidents, he said.

"Without automation … reduced vertical separation minimum and required navigation performance approaches would just be impossible," Drappier said. "Continued efforts from all aviation manufacturers to further enhance the safety and economy of flight will bring more automation. But nothing is perfect, [and] maybe there have also been some side effects. One could be the loss of manual flying skill, and one may be an overreliance on automation."

Some avenues for further scientific research into the question include measuring the effects of practice and the causes of skill erosion, poor quality ab initio training and level of experience before promotion of first officers to captains. "Hand-flying, in most cases nowadays and especially in the long hauls, is limited to one minute after takeoff and about two or three minutes in approach," Drappier said. "But in some respects, automated aircraft may require a higher standard of basic stick-and-rudder skills [because they are not practiced often]. These skills are still necessary today when, at certain moments, there are abnormal situations or extreme weather conditions. The transition between smooth autopilot [flight] and a hair-raising situation can be very abrupt in modern cockpits."

Loss of control–in flight and runway excursion events cannot be assumed to be attributable to flight crews' use of automation. "Are we really looking at … erosion of our manual flying skills, or are we looking at an issue of airmanship?" he said. "When [Airbus] looked at cases where flying skill was blamed, often the real cause of the accident was a lack of situational awareness, lack of airmanship or disregard of rules. … It is too easy to blame automation."

Anecdotal evidence at Airbus, however, does not support the assertion that significant numbers of active airline pilots have "lost" these skills. "What we see in our training centers is a few pilots who are a little bit rough on the edges, but the majority are still very capable and are doing a fine job in hand flying," Drappier said.

Flight training adhering to U.S. or European evidence-based training principles does not necessarily address manual handling proficiency for abnormal or difficult situations such as upset prevention and recovery or crosswind landings. "We need dedicated sessions," he said, citing a decision by Emirates to introduce four hours of additional simulator sessions per pilot in 2012 dedicated to manual flying proficiency. "Every three months or every six months, their pilots are back in the simulator to do flight director-off, autothrust-off [sessions such as] manual flying of patterns," Drappier said. "I am sure that, if we take this problem seriously, [other airlines] will come to the same conclusion: [Pilots] need more [of this flying] time."

Airbus suggests that even pilots with a solid foundation of hand-flying proficiency from earlier training should have manual handling skills developed or refreshed during type rating training. "We believe that at least two sessions' worth of manual flying are needed during a type conversion," he said. "We must use time in the full flight simulator to do handling, and push the automation exercises into flight simulation training devices. We also need to put more effort into the recurrent [hand-flying experience], where in recent years we've seen a reduction in overall time spent in the simulator."

Memorization Overdose

Mike Carriker, a captain, aeronautical engineer and chief pilot, new airplane product development, Boeing Commercial Airplanes, told attendees that time spent designing airplanes has made him wary of persistent-but-obsolete pilot training practices.

The first reform should be to stop requiring rote memorization from books, Carriker said. "No place — in 50,000 hours of analysis of failures in the 787 — was there anything [to suggest, for example,] a better outcome if a crewmember had recalled that the airplane has a 15-kVA electrical system."

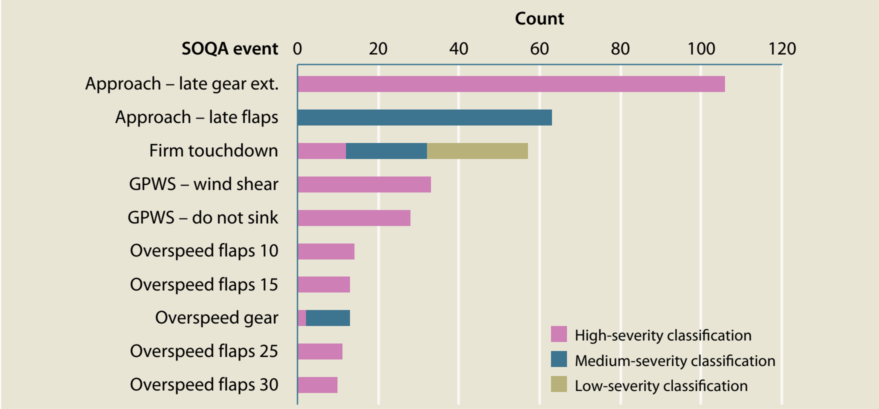
Far more important than conserving a tradition of memorization is accelerating advances in airline pilot training and adapting to the learning strengths/preferences of multiple generations, he said. This includes "turning the airplane loose," that is, taking full advantage of the latest technology for precise flight paths.

"[A current Boeing] airplane possesses the capability to [utilize] billions of dollars worth of satellites and a multimillion-dollar, multisensor, integrated FMS [flight management system that provides] up/down, left/right guidance to the end of every runway in the world — with indication of deviation from the path and warning for excessive

Carriker (top) and Huerta

Wayne Rosenkrans

Simulator Operations Quality Assurance: Top 10 Events



DoD = U.S. Department of Defense; SOQA = simulator operations quality assurance; GPWS = ground-proximity warning system; ext. = extension

Note: A full flight simulator, designed for military versions of the Boeing 737, was used in a CAE SOQA-feasibility study for the DoD. Each event represents a deviation by the flight crew from a standard operating procedure. During 115 of 246 simulator flights, 416 SOQA events (ranked as high, medium or low severity) were detected, captured and analyzed. These flights included 135 takeoffs, 111 landings, 27 wind shear exercises and 29 engine-out exercises. "Top 10 events" is a standard report from the SOQA capture and analysis station connected to the simulator.

Source: CAE

Figure 1

deviation," he said. "The airline industry has to turn that [technology] on."

Simulator Operations Quality Assurance

Flight data–driven flight training has been demonstrated recently in feasibility research for the U.S. Department of Defense (DoD) involving a Boeing 737 full flight simulator and military versions of this aircraft type, said Lou Németh, chief safety officer, CAE. The inspiration is flight operational quality assurance (FOQA) programs, typically collecting 1,500 variables (also called *parameters*) 11 times a second during routine flights for subsequent analysis.

"We use computer algorithms to see if the pilots are performing as they were trained, and to see if the aircraft is performing the way it was engineered and maintained to fly," Németh said. "The simulator operations quality assurance [(SOQA) research now addresses the questions] 'Is there value in SOQA data to look the training system as a whole, to see if it's performing as it should?'; 'Do SOQA data match the realities that we are seeing from FOQA data?' and 'Is there a correlation between FOQA and SOQA data?'"

SOQA basically comprises a full flight simulator, a data capture station, automated reports, analyses transmitted to the training manager, and data visualization/animation capability. "We're monitoring the system, not necessarily the individual pilot performance," he said.

Nevertheless, one simulator session during the SOQA feasibility research underscored the system's ability to clarify risks when a pilot and/or an instructor is ambivalent about the seriousness of errors — or possibly even denies that errors in the simulator would have had serious safety consequences during a real flight.

A simulator-flown approach northbound into Colorado Springs, Colorado, U.S., specified a right turn in the published missed approach procedure to avoid the Rocky Mountains. In one observed event, however, with the simulator's crash-inhibit function selected for unrelated reasons, miscommunication between the pilots led the pilot flying to turn left toward charted terrain, and the error was not detected until audible terrain alerts activated.

Shortly after this session, the crew and instructor told Németh that their error had been resolved. "The crew said, 'We got pretty close, but we saved the day at the last moment, and we did not [strike] the terrain,'" he recalled. "I said, 'Oh, really?' In actuality, as seen from the animation, they 'flew through' a mountain." The SOQA data replay with animation and data visualization showed controlled flight into terrain. "The visualization tool made it very clear to the instructor, and the students came away with entirely new behaviors because they could [relive] the problem from the outside looking in," Németh added.

One common deviation, for example, involved violations of the procedure for setting approach flaps. Most frequent was late extension of landing gear during approach and landing (Figure 1). "We also wanted to see pilots land the airplane [with touchdown] just above 1 g [that is, one times standard gravitational acceleration], but the data showed a number of landings at 2 g to 3 g and one at about 5 g to 6 g," he said.

As in an actual hard landing, the touchdown may not be perceived by pilots or instructors as a significant exceedance. "We don't know [which hard landings] should require retraining unless we have the analytical basis to decide. [The SOQA] system will give us that information. The student and client benefit from a more precise indication of performance — and know they're going to be treated impartially."

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