



All the right moves

Boeing Aviation Safety develops a software tool to better understand how flight-deck crews respond to non-normal events

By Jeff Wood and photos by Bob Ferguson

As the jetliner cruises at 34,000 feet (10,360 meters) above the North Pacific with autopilot on, the engine thrust levers begin creeping forward. The first officer notices this and glances at the airspeed indicators, which show that airspeed is dropping—yet the sound of air rushing past the windshield is getting louder. Training and experience tell the first officer that these are conflicting indications. What to do?

How the flight crew responds to a “non-normal” event like this can be crucial to continuing safe flight. Thanks to a two-year collaboration spanning two continents, Boeing safety experts have developed a better way to assess how reliably flight crews would react to the problem: It’s called CREW, short for Cockpit operations Reliability Evaluation Worksheet.

“CREW is an excellent example of how Boeing employees work continuously to make flying even safer,” said Corky Townsend, director of Aviation Safety, Commercial Airplanes. “It also reflects how safety efforts are evolving in the aviation industry. Today we can use real-world data to identify emerging patterns or potential conditions before accidents occur.”

After a non-normal event, Aviation Safety experts use the CREW tool to guide pilots through about 120 detailed yes-no questions designed to pinpoint areas of vulnerability in the flight crew’s response. Were the alerting indications too subtle? Was there clear guidance on what actions were most pressing? How easy was it for the flight crew to understand the nature of the problem?

By covering a full range of issues in minute detail, aviation safety analysts can locate and address potential vulnerabilities.

By definition, non-normal events are unexpected, but they do happen. Boeing flight and operations manuals often provide guidance, but exactly how crews respond depends on a complex interaction of factors such as their training and experience, operational procedures, and indications they receive from both the airplane and the environment. These can include messages, lights, sounds, wind noise or even the smell of smoke.

“As part of Boeing’s Continued Airworthiness program, we monitor problems that airplanes experience in operation,” including non-Boeing airplanes, said Randy Mumaw, human factors expert and Associate Technical Fellow in Aviation Safety, Commercial Airplanes.

When an incident occurs—from a system fault that affects the airplane’s capability to an emergency situation such as a damaging bird strike—the team assesses the information and indications that the crew would receive on Boeing airplanes.

“Then we determine which indications help and which hinder the flight crew in restoring the airplane to a safe operating state,” Mumaw explained.

Frank Santoni, Boeing Test & Evaluation chief pilot for commercial airplanes, said one of the challenges in assessing airplane design and operational issues

PHOTO: Cab operations technician Robert “Corky” Corcoran (foreground) is at the controls as (from left) Frank Santoni, Boeing Test & Evaluation chief pilot for commercial airplanes, discusses a non-normal scenario with Commercial Airplanes Aviation Safety Associate Technical Fellows Randy Mumaw and Roger Nicholson.

has been trying to account for the human response—"what the pilots would do."

Traditionally, Aviation Safety experts have interviewed pilots using open-ended questions that require pilots to make judgments about how flight crews from different airlines and countries would perform.

"Answers can vary from pilot to pilot," said Roger Nicholson, systems safety expert and Associate Technical Fellow, Aviation Safety. "We recognized that we needed a more objective way to evaluate crew performance."

Mumaw and Nicholson teamed with Lars Fucke at Boeing Research & Technology-Europe in Madrid to develop CREW, which is a form of human reliability analysis.

"We use a flight simulator to understand how the non-normal event develops," Fucke said. "Then we step through the scenario with the pilot, using CREW to assess whether the information coming from the instruments and controls helps or hinders execution of the right actions."

Safety experts then can put together a comprehensive view of how flight crews process the information from the various airplane and environmental indications.

"We want the flight crew to recognize when there is a problem, establish the right priority of remedial actions, choose the procedure associated with the root cause, then perform the actions specified in the procedure," Mumaw said. "The CREW tool identifies any potential hurdles to the desired response at each step."

With each case, CREW is proving its value.

"I can't tell you how many times in my career," said Santoni, "I've been asked, 'How would the pilot react?' or 'How many times out of 100 would a pilot take this action?' CREW is our best tool yet for gathering the subjective human input and quantifying it into a form we can then use in engineering analysis."

Next, the team will revise the tool to guide flight-deck enhancements and support crew training for future airplane designs. The effort demonstrates the benefits of working together as one global company.

"Our collaboration erased the distance and removed organizational barriers between Commercial Airplanes and BR&T-Europe in Madrid," Nicholson said.

"Together we built a tool that is immediately useful to our people as we work to improve aviation safety even further." ■

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For more information about aviation safety at Boeing, visit www.boeing.com/commercial/safety/index.html.

PHOTO: From left, Boeing Test & Evaluation chief pilot for commercial airplanes Frank Santoni and Commercial Airplanes Aviation Safety Associate Technical Fellows Randy Mumaw and Roger Nicholson.

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