ISASI FORUM

"Air Safety Through Investigation"

APRIL–JUNE 2006

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The Kam Air Flight 904 investigative team performs wreckage documentation at the site of the crash atop 11,000-foot-high Chaperi Ghar Mountain, some 20 miles east-southeast of Kabul International Airport in Kabul, Afghanistan. The most prominent and recognizable piece of wreckage present of the Boeing 737 was the vertical stabilizer as seen here. (Photo courtesy Robert Benzon, NTSB)

iSASi FORUM

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Evolution of Cabin Safety

By Frank Del Gandio, President

(Frank Del Gandio's presentation to the Southern California Safety Institute's Aircraft Cabin Safety Symposium in Oklahoma City on February 14, has been excerpted and adapted for publication.—Editor)

I am here today to discuss one of my life's passions, aviation safety. One of the greatest changes in aviation safety has been the evolution of cabin safety. As you know, safety has always been a real part of the rationale for having cabin attendants.

The very first flight attendant was Ellen Church. Ellen, a registered nurse, was an industrious young woman who loved airplanes and had unique foresight into the future. Back in the days of Boeing Transport, she convinced the company that having a registered nurse on board would be reassuring to passengers who might fall ill while in flight, even to something as simple as airsickness. Thus, she unknowingly created a new occupation for registered nurses. It was called "stewardess."

Unfortunately, as time evolved from the early 1930s, flight attendants were not always recognized as safety professionals and early on came to be looked upon as "sky girls." In the 1950s, the era of jet transportation began to develop and cabin safety kept pace; it was ready to take a giant leap forward, but not without severe growing pains. Many lives were lost during cabin safety's early learning curve.

The FAA's safety database system shows that the agency's very first cabin safety recommendations stemmed from observations of hazards related by airline passengers. For example, often a seat was located directly in front of the overwing window exits. The emergency information cards did not indicate what should be done with the seat in order to open the window in the event of emergencies—nor did flight attendants explain the plight. Another problem involved partitions between the first-class and the tourist compartments that sometimes hid the window exits from view of the tourist compartment. Then there were the overhead exit signs that were sometimes placed in the wrong position.

While we look back at real cabin safety issues in disbelief, it's comforting to know the aviation community and government safety regulators have established a partnership to diligently initiate significant safety improvements. I cannot mark the exact date when the greatest leap in cabin safety may have occurred. I can, however, identify a *single accident* as the catalyst for major changes that we now take for granted.

On June 2, 1983, Air Canada Flight 797, from Dallas to Toronto, made an emergency landing at the Greater Cincinnati Airport, due to an inflight fire that started in one of the aircraft aft lavatories. The crew, using the onboard portable fire extinguishers, could not extinguish the fire that started during flight. As the interior materials of the airplane's cabin continued to burn after landing, black toxic smoke had filled the cabin before touchdown and emergency fire responders had difficulty extinguishing the fire. Of the 46 occupants, 23 people died—*not from fire but from inhaling toxic fumes.* Five crewmembers and 18 passengers evacuated the burning cabin.

I was sent to investigate this accident. Ironically, two weeks before this aircraft fire, I was installing smoke detectors in my home. After the investigation, I realized that the piece of equipment I just installed in my home would have alerted the crew to a fire in the aft lavatory.

For years, aviation accident investigators and safety analysts had recognized that people often survived an accident's impact,

While we look back at real cabin safety issues in disbelief, it's comforting to know the aviation community and government safety regulators have established a partnership to diligently initiate significant safety improvements.

but then succumbed to post-crash fire or smoke. Air safety investigators realized the need to reduce the rate at which fire and toxic smoke spread through an aircraft. The FAA first targeted seat cushions in 1984 by requiring more demanding flammability tests on seat bottoms and back cushions. This led to new seat materials and fire-blocking layers that slow the speed at which fire can spread and reduce the emission of toxic smoke. In 1986, then again in 1988, the FAA enhanced these flammability standards for seats by requiring more demanding flammability tests for all aircraft interiors, such as wall panels, overhead bins, and floors.

The Air Canada accident led to major efforts to improve cabin safety and to give crews and passengers crucial extra seconds to evacuate safely after an accident. Seats also have been strengthened to withstand greater impact forces. All seats on aircraft manufactured after June 16, 1988, must now withstand an impact of 16 Gs, compared to the old standard of 9 Gs. The 9-G seat had performed well, but the 16-G seat established a greater safety margin for passengers.

In December 1984, the FAA took a related step by requiring fire-resistant emergency slides on air transport aircraft and set radiant testing procedures for that purpose. Two years later (Nov. 26, 1986), the FAA required all air transport aircraft to be fitted with emergency floor lighting to lead passengers to emergency exits in an emergency evacuation.

Other efforts to slow the pace at which fire or toxic smoke can spread in an aircraft involved some obvious steps: state-of-the-art fire extinguishers and smoke detectors. The FAA began upgrading those requirements in 1986 and 1987. For example, at least two handheld halon 121 fire extinguishers were required in the cabin of all aircraft as of April 29, 1986. Due to environmental considerations, halon can no longer be produced, but old supplies are still in use.

The Air Canada accident also led to requirements that onboard lavatories have smoke detectors as of Oct. 29, 1986, which is the safety recommendation I made upon completion of my investigation. And as of April 29, 1987, lavatory waste

Now, most people fully recognize that a flight attendant who can organize people during an emergency, who can manage a panicked group of passengers, and who ultimately can get those people out of an airplane quickly and safely is worth his or her weight in gold.

receptacles had to have built-in fire extinguishers. Finally, the FAA required protective breathing equipment, such as smoke hoods, for flight attendants as of July 6, 1989.

These cabin safety improvements were made because of just one accident!

Beginning in 1986, the FAA took action to strengthen fuel tanks and reduce the risk of rupture on impact, and then began work on standards for more heat-resistant liner panels in cargo and baggage compartments, so fires erupting in cargo bays could be better contained. The objective was to replace less heat-resistant aluminum and glass-fiber-reinforced resins with more fire-resistant materials. All subject aircraft had to comply by March 20, 1991.

Other improvements include restrictions on the amount of carry-on luggage to reduce injuries from debris and the danger of tumbling heavy objects during an evacuation (1987). The FAA also established a requirement that a passenger seat could be no more 60 feet from an emergency exit (July 24, 1989) and required an independent power source for public address systems in large aircraft to ensure communication with passengers in an emergency (November 1990).

Protection against cargo compartment fires was strengthened on aircraft with passenger and cargo compartments on the main deck. An airworthiness directive, issued on April 20, 1993, wherein the FAA sought to prevent burn-through fires in palletized cargo areas, required certain operational practices, plus design modifications with fire-resistant fibers. As the ValuJet accident in 1996 illustrated, this change failed to anticipate a self-fed fire, but it was a first step in major improvements.

Though the efforts to improve cabin safety have proven their value, they also offer good examples of how regulatory proposals generate legitimate and politically sensitive differences in perceptions and preferences. Some persons in the industry criticized the FAA for going too far, too fast, on too little definitive evidence. Simultaneously, safety advocates criticized the FAA for not going far enough, fast enough, on what they perceived to be compelling evidence. Any regulator, in any industry, is always caught in the middle of that conflict.

Perhaps a more telling observation is that, after these major improvements, major changes in cabin safety slowed for several years. Yet, these changes in the 1980s and early 1990s paid concrete dividends. In August 1988, just five years after Air Canada, a B-737 was destroyed by fire after an aborted takeoff at Dallas/Fort Worth; 94 of 108 occupants survived the intense fire. The National Transportation Safety Board accident report officially found the 94 survivors were saved by the benefits of the new cabin safety regulations that required fire-blocking seats.

On March 17, 1991, an L-1011 carried 231 passengers and crew on a transatlantic flight. In mid-flight, a fire started beneath the cabin floor. Crewmembers used a halon 1211 extinguisher to fight the fire through the air-return grill. The halon penetrated hidden voids and spaces beneath the floor to extinguish the fire. Those spaces would have been inaccessible with other equipment, and the aircraft would have been lost. Instead of resulting in a catastrophe, the aircraft completed the flight with no injuries among the 231 people on board.

Perhaps the most dramatic event in recent memory occurred at Sioux City in July 1989. A DC-10 lost an engine that severed the aircraft's hydraulic systems, limiting the crew's control to the use of thrust from the remaining engines. During the emergency landing at Sioux City, the aircraft banked before touchdown. The right wing struck the runway, and the aircraft cartwheeled into a ball of fire, which was caught on camera and was replayed around the world for days. Tragically, 111 people died in the accident. Remarkably, 185 people survived what everyone just a few years earlier immediately would have recognized as a non-survivable accident.

The list of heroes in Sioux City should have included safety advocates who had worked to increase seat strength, to reduce the speed at which fire could spread through seat materials, and to reduce toxic emissions from cabin materials.

These three accidents (Sioux City, the L-1011 transatlantic fire, and the 1988 accident in Dallas/Fort Worth) took a total of 125 lives. However, the 510 people who survived those events offer tangible evidence of the benefits that came directly from improvements in cabin safety after the Air Canada accident.

Improvements in cabin safety became more incremental by the mid 1990s, but they have not stopped. Several areas have received close attention. CRM may be the best example. The acronym once meant "cockpit resource management." After Air Canada, Sioux City, and several other accidents in the United States and elsewhere, including British Midlands in 1985 and an Indian Airlines accident in 1988, people recognized that flight attendants, in fact, were very much a part of the onboard safety team. "Cockpit" became "crew" resource management.

With that not-so-little change in nomenclature, flight attendants were encouraged to advise the flight crew of what was going on in the cabin or what they saw from the cabin—was that engine fire still visible from the cabin? How severe is the turbulence in back? Are you hearing sounds that indicate some system failure? In short, flight attendants suddenly were encouraged to assert themselves as equals in the safety system, and pilots were encouraged to recognize the value inherent in such a change.

In the more extreme case of a major accident and impact,
(continued on page 29)

Photo 1

Investigation Challenges in an Active War Zone

Kam Air Flight 904 was reported missing during a flight from Herat to Kabul, Afghanistan, during conditions of extremely low visibility in the area surrounding Kabul International Airport.

By Robert Benzon, U.S. National Transportation Safety Board

(This article was adapted, with permission, from the author's presentation entitled Kam Air Flight 904—Investigation Challenges in Kabul and on Chaperi Ghar *presented at the ISASI 2005 seminar held in Fort Worth, Tex., September 12-15, which carried the theme "Investigating New Frontiers of Safety." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

Experienced accident investigators probably feel that after a while, there is a certain "sameness" to major accident investigation protocols, even though, as we all know, each accident itself is distinctly different. We investigators fly to a location near the accident site, find hotels, rent automobiles, and drive to a central meeting point to join counterparts from industry, other government officials, the press, and the like. Then we hold some sort of organizational meeting, and, finally, we proceed to examine wreckage. The investigation then progresses in an orderly manner, familiar to us all. Accident after accident, these basic steps, with minor variations, seems to always take place.

Not so, my small team and I discovered when we assisted in an aircraft accident investigation in an active war zone.

On Feb. 3, 2005, Kam Air Flight 904 was reported missing during a flight from Herat to Kabul, Afghanistan, during conditions of extremely low visibility in the area surrounding Kabul International Airport. It was subsequently located on the top of Chaperi Ghar, an 11,000-foot mountain about 20 miles east southeast of the airport, 2 days after its disappearance. None of the 104 people on board survived. The aircraft was a 23-year-old Boeing 737, which meant that under the auspices of ICAO Annex 13, the NTSB was obliged to assist the government of Afghanistan in its investigation of this tragedy.

Kam Air is a company in Kyrgyzstan serving Afghanistan air travel, and the airplane was registered in Kyrgyzstan. It was operated by Phoenix Aviation, headquartered in Dubai, United Arab Emirates, and there were citizens from Afghanistan, Italy, Turkey, Canada, Iran, and the United States on board. Many of the victims were associated with various humanitarian aid missions helping to rebuild Afghanistan.

My agency was nominally aware of the difficult political and security situation in Afghanistan, and became acutely aware of

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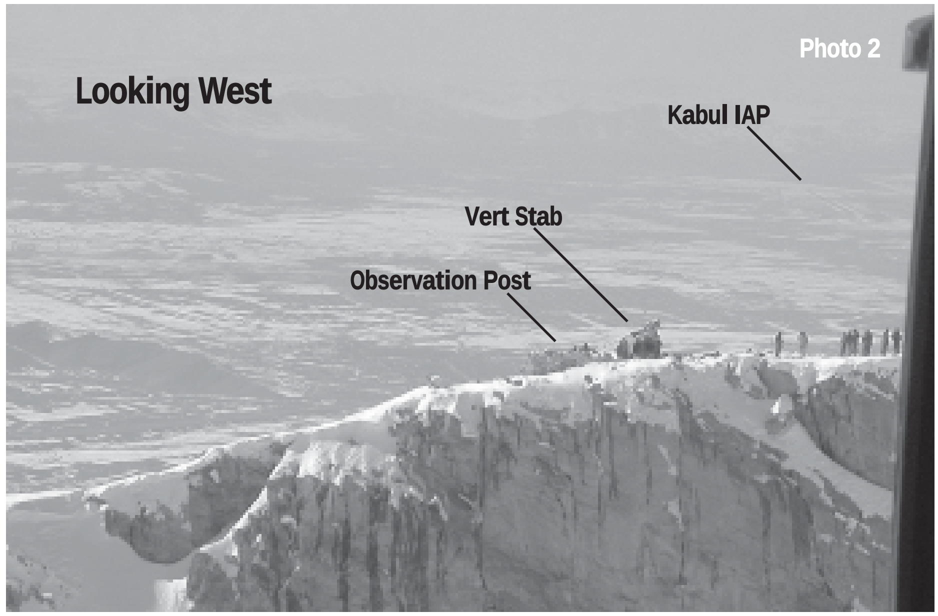
it after lengthy telephone conversations and e-mail exchanges with U.S. Embassy personnel in Kabul following the initial accident notification. We were told that the Embassy compound, where we would be staying, was an armed, walled camp, replete with guard towers, sandbagged revetments, armored vehicles, and the like. We were also told that we would always be accompanied by heavily armed escorts when we left the compound to do our work and that climactic conditions on top of the mountain were very severe. Conditions in Afghanistan did not appear to be conducive to an orderly accident investigation. Because of these difficulties, participation by NTSB investigators became voluntary. It quickly became apparent that this would not be a normal overseas assignment for us.

Although usually eager to do so, the U.S. airframe and engine manufacturers declined to accompany us on this overseas trip. Personal safety concerns were uppermost in their minds, of course. Their expertise would certainly have been put to use, but the reluctance to travel to Afghanistan was completely understandable. So, our team consisted of representatives of the governments of Afghanistan, Kyrgyzstan, Italy, Turkey, the United States, and Kam Air and Phoenix Aviation.



Travel to Kabul

The very task of getting to Kabul proved to be quite difficult. The non-stop flight on Emirates Air from New York City to Dubai was the last routine portion of our trip. Once we arrived in Dubai, we were not exactly sure of how we were actually going to get into Afghanistan. We need not have worried. While checking in at the reception desk at the hotel, I was handed a telephone. On the other end of the line was a U.S. Army colonel who told us to be at a small terminal at 6 o'clock the next morning to board a U.S. Air Force C-130 that would take us to Kabul. Under the mistaken belief that this would be some kind of an interesting clandestine VIP flight, we soon discovered otherwise and found ourselves crammed into the aircraft with about 60 quiet soldiers on their way to the war zone. Several hours into the flight, we were told that the aircraft was refused clearance to overfly Pakistan and would have to return to Dubai. To the credit of the flight crew, they set up an orbit off the Pakistani border and finally secured overflight clearance some time later.

Because the delay that occurred would have caused us to arrive in Kabul after sunset (something no airplanes were allowed to do… Kabul was day VFR only), we were forced to land at Bagram Air Base and spend the night. We went from a 5-star hotel in Dubai to a large uninsulated plywood box at Bagram. The box contained six folding cots, each complete with its own army blanket (no sheets, no mattress, no pillow …just a blanket), a space heater, and a single 40-watt light bulb hanging from the ceiling. After dumping our gear by our "beds," we borrowed a military computer and contacted the Embassy in Kabul via e-mail. We were instructed to be ready to depart in a small, armed convoy at 7 o'clock the next morning for the drive down to Kabul. We found the convoy, were issued flak jackets, and after an hour-long, very speedy ride on a rough road, replete with bomb craters and tanks and trucks destroyed in previous conflicts, we rolled into the U.S. Embassy compound at Kabul.

Our Embassy contacts did not exaggerate the austerity of conditions there, although it immediately looked better than Bagram to us. The once-beautiful Embassy building was now surrounded by sandbags, festooned with radio antennas, and topped off by four machine gun nests. All available space around the building, once a park-like setting, we were told, now contained dozens of white 20-foot-long steel overseas shipping containers. These containers had been converted into comfortable but somewhat claustrophobic living quarters for the burgeoning Embassy staff, the large U.S. Marine security unit, and now us. The U.S. Ambassador, because of his high rank, lived in several containers hooked together, complete with potted plants by the door.

Our host and handler at the Embassy was a competent young political/economic officer, Robert, whose hobby during his Kabul tour was leading a pick-up rock band of sorts that performed in the mess hall every Friday, the one day off allowed by the Embassy's heavy work schedule. He would change the name of the band every couple of weeks to make Embassy staffers think they would be hearing something new once in a while. The ruse only really worked once, he said. Upon our arrival, Robert smiled and handed us an Embassy procedural guide with this interesting item in it:

"Outside the [Embassy] compound, red [painted] rocks indicate uncleared mines areas while white [painted] rocks are considered mine-free areas. Be advised, however, there remains a 10% chance that unexploded mines remain in the mine-cleared areas. For this reason, during all travel in Kabul or out of the city, travelers should remain on hard-surface roads at all times."

We never saw any painted rocks anywhere, and as one might imagine, staying on hard surface roads did not turn out to be a viable option during our visit.

Our next order of business was to meet our Afghan counterparts in the Ministry of Transport (MOT). This proved to be a sad introduction to the effects of the long period of armed strife in that part of the world. The MOT, and virtually the entire Afghan government, is in the process of reconstituting itself after 20 years of warfare and difficulty in Afghanistan associated with the Soviet occupation, an internal civil war, the times of the Taliban, and our military activity after 9/11. Much of this current governmental reconstitution has to be prioritized, and government agencies such as the Ministry of Defense (MOD), logically, are ahead of agencies such as the MOT in this regard. At the time of the accident, the MOD was being advised by many, many U.S. military personnel and military contingents from other nations. The MOT, on the other hand, was receiving advice from one aviation expert assigned to the U.S. Embassy and perhaps a small handful of transportation advisors from other countries. There were no U.S. Federal Aviation Administration personnel in Afghanistan at the time of the accident.

"Outside the [Embassy] compound, red [painted] rocks indicate uncleared mines areas while white [painted] rocks are considered mine-free areas. Be advised, however, there remains a 10% chance that unexploded mines remain in the mine-cleared areas. For this reason, during all travel in Kabul or out of the city, travelers should remain on hard-surface roads at all times."

—Afghan Embassy procedural guide

Now, one FAA advisor is stationed in Kabul for an extended amount of time. This is good.

At the time of the accident, there was no established intragovernmental agency plan in Afghanistan to deal with a major aircraft crash. Initially, it was proposed that the Ministry of Transportation be responsible for not only the investigation but also human remains identification and recovery and wreckage recovery. When the logic of this concept fell apart because of the small size of the MOT and its almost total lack of resources, these duties were divided among the Ministry of Defense and Ministry of Health (human remains), the Ministry of the Interior (wreckage recovery), and the MOT (the actual accident investigation).

The MOT headquarters building, a two-block, daytime-only, flak-jacketed walk from the Embassy, was very poorly equipped—one or two old photocopiers, no e-mail capability for the staff, intermittent lighting, many manual typewriters in use, old Soviet maps with Cyrillic captions on the walls, and so on. The three gentlemen who served as Afghan investigators for this accident were extremely dedicated, and I admire them. But, they lacked any kind of formal investigative training. To their credit, they were quite familiar with ICAO Annex 13 and are using that document (as general as it is) as their basic investigation guide. Several of them have air traffic control backgrounds. They mentioned ATC training they received in the United States as young men in the late 1960s. Because of these difficulties, the Afghan investigators were extremely receptive to our suggestions on where to begin and how to proceed through the on-scene phase of their investigation. We all then formulated a basic investigation plan, received word that the immediate impact area had been cleared of mines, and would fly to the site the next morning.

On to the mountain crash site

Getting to Kabul was a bit of an adventure, and getting to the accident site from Kabul proved to be equally interesting. Air operations around Kabul are the responsibility of a large NATO peacekeeping subgroup called the International Security Assistance Force (ISAF). ISAF helicopters had discovered the wreckage earlier and had made two previous reconnaissance landings on the mountaintop. They would carry us up to the Chaperi Ghar crash site. This, of course, entailed yet other armed convoys to get us from the Embassy compound to the military side of Kabul International Airport. Once there, we would either board Turkish Army Blackhawks or Spanish Air Force Eurocopter Cougars. The helicopters always flew in two-ship cells, in case one of them became disabled enroute. They also always flew with both doors open and with heavy automatic weapons at the ready. In a sense, these precautions were comforting, but they were yet further indications that this was not a normal investigation.

The flight crews of both nations were very professional, as was the entire ISAF air staff. Full safety briefings led off every preflight, and all the pilots were extremely weather conscious. In that part of the world, at that time of year, flight visibility in the mountains can drop to an unsafe level in mere minutes. On two occasions, we launched and although everyone knew how important getting to the wreckage was, we turned back because of low visibility. Interestingly to me, many of the helicopter door gunners were very capable female soldiers. Besides serving their machine guns, they also made sure we did not fall out of the helicopters.

The landing zone was only big enough for one helicopter at a time. This meant that the helicopters could not shut down and stay with us. If one could not be restarted, for instance, there would be no rapid, practical way to get parts up the mountain to repair it.

Our first trip up the mountain was on one of the Blackhawks. During the "landing" on the only flat spot available, about 200 meters from the main wreckage, the pilot had to maintain a near hover RPM with his main landing gear just touching the surface—otherwise the machine would sink into the snow and possibly strike a rotor blade on nearby rock outcroppings. This, of course, meant that we were immediately exposed to hurricane-force winds and blowing snow and landing zone debris the instant we flopped out the door. The downdraft from the rotor blades on this and subsequent Blackhawk landings bowled us over on a routine basis and we all lost stocking caps, sunglasses, and other equipment down the mountainside during these operations. This, in my mind, was possibly the most dangerous part of our time in Afghanistan. The Cougars, on the other hand, were equipped with skis and could bring rotor speed down to idle during debarkation and embarkation. This made helicopter loading and unloading much easier.

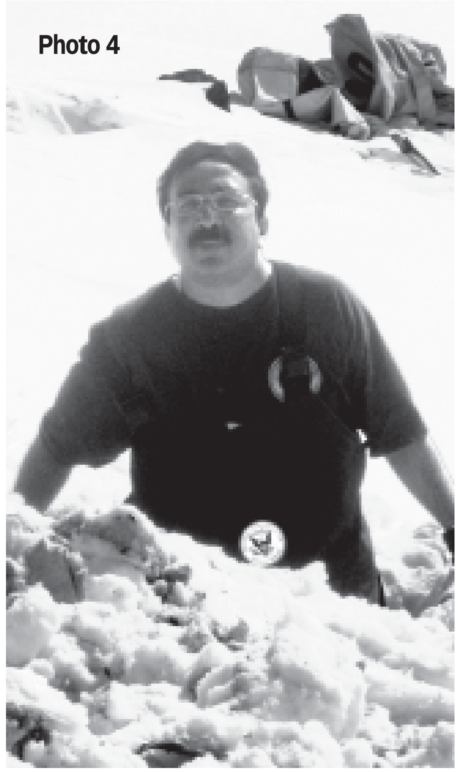
Scheduling of the helicopters soon fell into a routine. This was made simpler for me because the commander of the Turkish ISAF helicopter unit had attended the NTSB accident investigation school several years earlier. He claimed to actually have stayed awake during my lecture, but I believe he was just being polite. In the evening we would relay a list of investigators and volunteer snow diggers to the ISAF helicopter operations office via cell phone or e-mail and would then be told which nation's helicopter ramp to report to the next morning. The most difficult part of this operation turned out to be the actual assembly of the team at the ramp. The U.S. personnel were housed either at the Embassy or in various military installations in the city. Those from other countries were widely scattered around Kabul, and communication among all contingents was extremely difficult. In addition, as mentioned, each group had to always be escorted to and from the airfield by armed military or civilian security personnel. Seemingly small problems like these took up an inordinate amount of time and energy.

Because of the remote and hostile location of the accident site, we had limited time on scene to document the wreckage. The team spent perhaps a total of about 30 hours on top of Chaperi Ghar, broken down into five visits. No investigators stayed overnight on the mountain because of the cold nighttime temperatures, the possibility of being weathered in, and the fact that the wreckage was attracting wild animals at night. Mountain wolves were mentioned and their tracks in the snow were noted in the mornings. The only people who actually remained on the mountain overnight were a squad of very hardy and, I imagine, wide-awake Afghan National Army troops.

Accident site

The accident site itself was compact in a horizontal sense, but not so vertically. See Photograph 1 (page 5), looking east (along the flightpath), and Photograph 2 (page 6), looking west. The Kabul runway can be seen in the central right portion of Photograph 2. The aircraft struck a ridgeline on an easterly heading near the crest of the mountain about 50 feet down from the very top. The final flightpath probably had some amount of upward vector to it, because the fuselage forward of the wing box was propelled, in fragments, over the crest and fell over the cliff side into the valley below.

Photo 4



The actual wreckage documentation during five site visits was difficult because most of the parts were either buried under several feet of snow and inaccessible, outside the mine-free cordon and inaccessible, or down the cliffside and, therefore, also inaccessible to all without mountain climbing training. Fortunately, the Italian investigator brought two Italian Army officers with him with such training, and some photographic documentation of the cockpit area was done by these individuals. In addition, a very sturdy Russian, a Phoenix airline captain, worked his way down the cliff side to assist in this effort. The most prominent and recognizable piece of wreckage present on the top of the hill was the vertical stabilizer and a small portion of the rear fuselage. (See photograph 3, page 7.)

Most of the visible wreckage was located between two stacked-stone, roofless structures that were observation posts used by Mujahadeen fighters to monitor Soviet troop movements in the Kabul valley during the 1980s. Within a 200-foot circle, after a lot of arduous snow removal, we identified portions of both engines, both wings, the left main landing gear assembly, many aft galley components, the horizontal stabilizer, human remains and personal effects, and much miscellaneous debris. Some material, such as an escape slide and some right engine components, were located outside the landmine-free area. These items were "documented" with binoculars and digital camera zoom features.

The flight data recorder was found almost immediately, although as of this writing, the cockpit voice recorder (CVR) had not been located. We did locate the mounting bracket for the CVR. It was very frustrating to locate this item and not the CVR itself. We spent a good deal of time digging blind holes in the snow in the immediate vicinity of where this bracket was found, and also forward of that location, to no avail. (See Photograph 4.) Unfortunately, the FDR eventually yielded no useful data. As near as could be determined, the external flight data acquisition unit had not been providing valid signals to this device for a long time.

Our physical well-being during the wreckage documentation was of concern to me. Except for the Afghans, I was the oldest person on the team and I used my age (55) and my lack of any formal physical exercise regimen as a benchmark of sorts for onsite strenuous activity. In other words, when I got tired, that would seem to be a conservative time to wind down activity on the mountain for the day. This canary-in-a-coal-mine approach probably was not the best way to deal with this issue. To wit…the Afghan investigators were all in their late 50s and early 60s, one of our Embassy volunteers was overweight, and even some of the U.S. military personnel who volunteered to assist us were not in the best physical condition.

The 11,000-foot altitude, the strenuous debarkation from the helicopter, and the snow caused the Embassy employee to spend his single session with us on the mountain sitting down. One U.S. officer became quite winded during the early part of her site visit but acclimated quickly. Ironically, the Afghan investigators, my main worry, faired the best of all. They are very tough individuals. Fortunately, the information about severe weather on the mountaintop turned out to not be true. It was quite cold when the sun was not shining and the wind was blowing. However, on one occasion, during sunny weather, we were working in shirtsleeves.

I was less worried about landmines on

Chaperi Ghar, but should have been more worried, in hindsight. We had been warned in a general way about the dangers of mines in Afghanistan, as noted earlier. In spite of this, we felt confident in our safety because we had been assured by one U.S. government source and two Afghan military officers that the area where the wreckage was located was clear of mines. We were still wary, though.

On the second trip to the site, one of the Turkish investigators found what he thought was a mine, or at least something very suspicious with wires coming out of it, wedged between two of the flat stones that made up one of the old Mujahadeen observation posts. He called several of us over to take a look, and like fools, we did so. We at least had the presence of mind not to touch the object. A moment later an Afghan National Army sergeant arrived, and after several minutes of peering at the device and a short conversation with several other soldiers, he cleared the area of people and then gently removed it. The "mine" turned out to be an electrical connector assembly from Kam Air 904, jammed into the rocks by the force of the aircraft impact. Frowns turned to looks of relief and we went about our business.

An important point must be made here. Landmines, with all their varied colors, shapes, and sizes, often resemble aircraft parts. Unlike other places where mines may be found in war zones, crash sites force investigators and rescuers to stay in a mined area for a very long time. An investigator's job is to examine everything at a site, turn over every piece of wreckage, look under every rock, and so on. This could be a recipe for disaster, as one might imagine. Mines and aircraft crash sites mix only too well. My advice on this subject would be to trust what your mine advisors tell you, but verify, verify, verify to the best of your ability. Sadly, a week after we returned to the United States, an Afghan National Army soldier helping with the human remains recovery operation at Chaperi Ghar stepped on a landmine at the site and was killed. Another soldier was seriously injured in the same explosion. The accident site had supposedly been cleared of mines, but the experts missed at least one.

Having said that, we had been told that the site was completely inaccessible via land routes in the winter because of the heavy snowfall, no roads, and, again, the ever-present landmines. However, on our third visit to the site, an ANA soldier with binoculars spotted a party of five individuals making their way slowly on foot up the western slope of the mountain. They arrived at the site about an hour-and-a-half later. Although everyone was initially suspicious of these people, it turned out that they were representatives from the nearest local village, located many miles away, and had climbed the mountain simply to see what was going on and to extend greetings. They heard about the accident on a transistor radio. After meeting them, we somehow did not feel quite so heroic. (See Photograph 5.)


Photo 5

As the investigation work progressed both on the mountain and down below in Kabul, it became apparent to all that there was room for improvement concerning certain aspects of civilian air operations in Afghanistan. Recommendations, of course, are the most important aspect of any aircraft accident investigation. The Afghan MOT had no formal mechanism for forwarding specific safety recommendations to entities within the country (both domestic and foreign), so our solution was to distribute a simple informal "white paper" of safety suggestions to several government ministries, the U.S. Embassy aviation advisor, the ISAF military air staff, and others—a shotgun approach, so to speak. We handed a copy of the white paper to anyone in authority who seemed even remotely interested. These suggestions ranged from the acquisition of mobile radar for then-radarless Kabul International Airport to the importance of rebuilding a previously blown up ILS array to the consolidation and tightening up of visual flight rules operations in Kabul airspace.

I believe the white paper, although unofficial and a bit unorthodox, proved effective and many of the suggestions are being acted upon at this time. In addition, the Afghan Investigator-in-Charge asked us to compose a letter for his internal use containing ideas about how the safety staff of the Ministry of Transportation itself could increase its effectiveness.

The U.S. members of the team traveled back to the United States in three groups. The FAA representative and our operations specialist went back after one week on a convoluted, difficult routing with the flight data recorder. Our systems and structure specialists left a week later via a United Nations contract flight to Dubai. I remained one further week to finalize our on-scene assistance to the Afghans.

The Afghan investigation into the tragic loss of Kam Air Flight 904 is still open, and may remain so for some time. The Investigator-in-Charge hopes to be able to recover the cockpit voice recorder in the near future, but in a nation with many other priorities, this may take a while, or, in fact, prove to be impossible. A final report following ICAO Annex 13 guidelines is the goal. I believe that the effort put forth so far on this investigation is an excellent example of cooperation between many groups —the government investigators from Afghanistan, Italy, Turkey, and Kyrgyzstan, the military flight crews and flight planners in ISAF, the NTSB, the U.S. Armed Forces, the U.S. State Department, and the Kam Air and Phoenix Aviation participants.

From tragedy we draw knowledge to improve the safety of us all. ◆

Flight Data Analysis: A New Approach

Research is under way allowing pilots to do their own flight data analysis. Advantage? Pilots can add crucial information such as threats, threat management, error, and error management to the flight data. The system is intended to complement present flight data monitoring (FDM) programs.

By Dieter Reisinger, Austrian Airlines; Simone Sporer, FH Joanneum-University of Applied Sciences, Graz, Austria; and Gernot Knoll, FH Joanneum-University of Applied Sciences, Graz, Austria

(This article was adapted, with permission, from the authors' presentation entitled Flight Data Analysis—A New Approach *presented at the ISASI 2005 seminar held in Fort Worth, Tex., Sept. 12-15, 2005, which carried the theme "Investigating New Frontiers of Safety." The full presentation including cited references index is on the ISASI website at www.isasi.org.—Editor)*

Flight Operations Data Analysis (FODA), the method of retrieving data from an aircraft data recorder and performing a post-flight analysis for the purposes of detecting operational parameters that are exceeded or to detect unfavorable engineering data, celebrated its 30-year anniversary not too long ago. TAP, with the introduction of the Sud Aviation "Caravelle," British Airways, Air France, and Lufthansa are among the first that used the FODA method, which comes under different names: Sometimes the term FDM (Flight Data Monitoring) or FOQA (Flight Operations Quality Assurance) is used, although the latter term implies more then just flight data analysis.

The International Civil Aviation Organization (ICAO), under its standards and recommended practices (SARPs), has issued a recommendation that suggests aircraft with a maximum takeoff weight (MTOW) greater than 20 tons (44,100 pounds) be part of a flight data monitoring program. Effective January 2005, under Annex 6, Part 1, ICAO now intends to make the recommendation a standard, applicable to aircraft with a MTOW greater than 27 tons (59,535 pounds). The recommendation would still apply to aircraft weighing between 20 and 27 tons.

Among safety experts, FODA is a well-accepted method and is one cornerstone in an airline safety management program. Despite such acceptance, today's FODA, in the opinion of the authors, has some significant disadvantages. The goal of this article is to point out these disadvantages and present an idea on how the system could be improved with the aim to make a contribution to safety statistics, by giving the data to the pilots and letting them analyze their flights.

Present-day drawbacks

One of the drawbacks of today's FODA is that any analysis depends on what has happened in the past: An operational exceedance has to have occurred before it can show up in a statistics. Therefore, strictly speaking, FODA is not a proactive way of enhancing safety. However, there is no doubt the method is much more proactive than the traditional "kick-the-tin" approach that dominated the early days of accident investigation. Still, it would be nice to have a truly proactive tool (see Figure 1 and Figure 2). In Figure 1, a typical FODA process is shown; in Figure 2 the modified FODA process is shown.

A second drawback is that in many cases there is no information on threats, threat management, errors, and error management as done by the crew. Only undesired aircraft states are captured. Basically, this is because in most airlines, due to union constraints, the data are deidentified. The safety department in many airlines cannot establish a direct line of communication with the crew that experienced the exceedance. The authors recognize that in some airlines the union itself does the analysis and will approach pilots individually to ask specific questions, but even if that line can be established, valuable information is not fresh in memory as time is wasted. Klinect et al took data from operational safety audits and came to the following interesting conclusions: The highest percentage (39%) of external threats was in the descent/approach/landing phase of flight; 22% of the external threats occurred before the aircraft left the ground in the preflight/taxi phase of flight (see Table 1). Furthermore, at least 72% of flight segments had at least one external threat. The distribution of flight crew errors by phase of flight (see Table 2) shows that the most flight crew errors also occur in the descent/approach/landing phase of flight.

A third drawback is that the reported statistics typically do not take into account the individual pilot's weak spots. In other words, because the data cannot be customized, a training program cannot be tailored to the specific needs of a pilot. This needs some further

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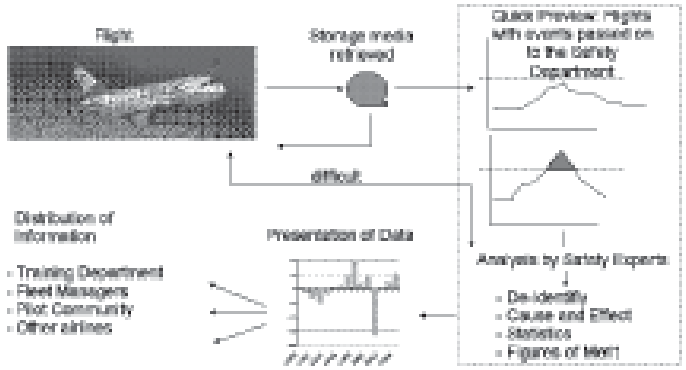

Figure 1. Typical FODA process. After quick preview, files with exceedances are passed to the Flight Safety Department for detail analysis. Deidentified data are then distributed.

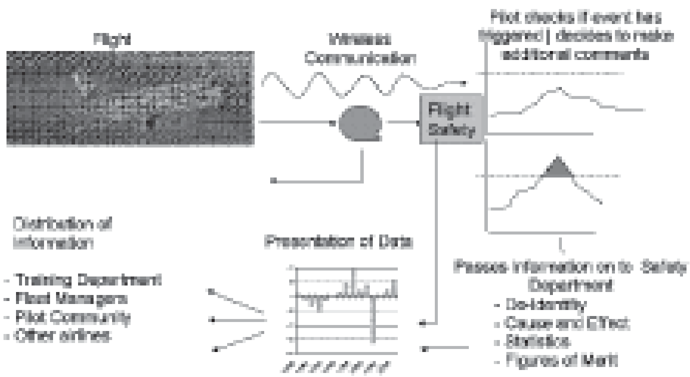

Figure 2. Modified FODA process. The pilot adds data before they are deidentified and passed on to Flight Safety Department. The pilot keeps his personal statistics.

explanation: A typical process of how the data are handled through the airline departments is depicted in Figure 1. A line maintenance engineer typically retrieves the data storage media (optical disk, PCMCIA card, etc.) at a prescribed interval, e.g., after arrival at the home base. Then the data are fed into a server and a scan is performed for operational exceedances. Those data sets containing exceedances are passed on to the safety department, where a number of specialists, typically with the involvement of type-rated pilots, look at the event, classify it, and run statistics. The results are then in most cases either passed on for use in internal safety magazines, as a guideline for those who design simulator sessions in flight training departments, or in some cases shared among other airlines. All this is valuable.

But, this process takes time, which leads to the fourth drawback: Today's FODA process, from the occurrence to the point where the end-user (the pilot) receives results, is lengthy.

The new approach

As of today, more and more airlines equip their pilots with modern laptop computers for obvious reasons: performance calculation, information sharing, electronic library (see Figure 3, page 12). These powerful machines could easily handle the post-flight data analysis of one's specific flight. The idea is to give the pilots the data directly after the flight, let them do the analysis, and rely on their self-evaluation capability. The pilots could add information

Table 1. External Threats by Phase of Flight (Klinect et al, 1999)

Phase of Flight	*Percentage of External Threats*
Preflight/Taxi	22%
Takeoff/Climb	28%
Cruise	10%
Descent/Approach/Land	39%
Taxi/Park	1%

Table 2. Distribution of Flight Crew Errors by Phase of Flight (Klinect et al, 1999)

Phase of Flight	*Percentage of Errors*	*Percentage that Were Consequential*
Preflight/Taxi	23%	7%
Takeoff/Climb	24%	12%
Cruise	12%	12%
Descent/Approach/Land	39%	21%
Taxi/Park	2%	Insufficient data

such as threats, threat management, errors, and error management. Further, they could run their personal statistics and see if unfavorable trends on their part develop. This could then further lead into "custom tailored" simulator sessions.

Ability for self-evaluation

Most pilots we have met try to do a perfect job. They have a passion for their profession and strive for no less than a perfect flight. It seems intrinsic to a pilot's nature to attempt to ever enhance his/her skills. If something goes wrong, not an accident, but rather a minor imperfection, a lapse or slip, an operational exceedance, or anything that in sum could lead to an incident, pilots tend to know very accurately why things went wrong and what they could have done better. A good example is the debriefing of a simulator session: when asked by the instructor, a pilot will typically recall most situations, recall how he/she managed the situations, the mistakes he/she made etc., even over a 4-hour simulator session. A pilot will typically be inclined to see his or her performance worse than an outside observer would. There is evidence from research that pilots, as a collective with high skill levels in particular tasks, are able to self-evaluate their own performance very accurately, especially in high-workload situations. A study with F/A-18 pilots in the RAAF showed that the participants achieved a high level of agreement with outside observers when recalling and self-reporting their own behavioral performance across a series of non-technical behavioral categories. The pilots' self-reports were even more highly correlated in high-workload conditions.

Flight experience issue

In general, experience in terms of total flight hours is a key figure. Pilots with more total hours are generally regarded to be more competent compared to those with fewer hours. So what, if any, is the value of letting a very experienced pilot do a self-analysis?

We know in a general sense that even very experienced pilots are not immune to mistakes, to bad decisions, to disregarding aircraft limitations, etc. They might at times even have difficulty with the handling of the aircraft. Certainly, even among experienced pilots unfavorable trends can develop, such as a tendency for landing long in an attempt to land soft, flying approaches to the limits, etc. These tendencies will go undetected: With typically only two to four simulator sessions a year and only one annual line check, it is highly unlikely that an outsider, such as a check pilot, picks up an unfavorable trend on these rare occasions.

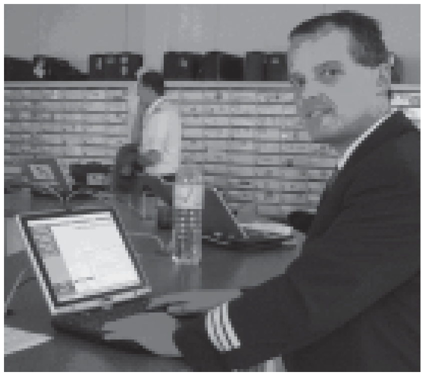

Figure 3. Typical electronic information exchange. First officer is checking latest information with his laptop during preflight preparation.

Crews are composed of ever-different combinations of first officers and captains, so even a peer will not be able to detect an unfavorable trend and let the other pilot know (apart from the fact that very likely a first officer would not debrief a captain in most airline cultures on these issues, unless the captain asked for feedback). One person who for sure can tell whether unfavorable trends develop, provided the person has the right tool, is the individual pilot. So in summary, it seems that giving the flight data to pilots, from the student pilot to the experienced pilot, will have its merits.

Threat and errors

Why is it essential to feed FODA data with threats and errors? This is best highlighted by some real-life examples, where today's FODA program would very likely give a wrong clue or insufficient background information, unless the pilot is brought into the loop.

- **Example 1**—The pilot accepts a short line up by air traffic control (ATC). The option would be a delaying vector due to heavy inbound traffic. Due to high energy, the approach is unstabilized. *(Note: FODA will only show an unstabilized approach and the fact that the aircraft turned in early at exceedingly high energy; it will not tell that the short line up was offered by ATC and that it was accepted because the pilot wanted to avoid undue track miles with subsequent higher flight time [commercial pressure].)*
- **Example 2**—Late landing configuration (300 ft above aerodrome level [AAL]) during instrument landing system (ILS) approach—the pilot flying (PF) thought that the DME distance (distance measuring equipment) is reading to the threshold when in fact the station was 2 miles behind the runway. PF started configuration change too late. Initial crosswind turned into a tailwind, increasing during descent. *(Note: FODA will only show late configuration/unstabilized approach but will not be able to detect the wrong mental picture of where the DME is located.)*
- **Example 3**—The aircraft lands over weight. *(Note: FODA will show the overweight landing. It will not show that the pilot decided prior to departure to tanker fuel for economic reasons and overlooked that he would have less fuel burn with ATC shortcuts.)*
- **Example 4**—The VOR-DME approach was flown to the left of the inbound radial, with the aircraft generally too high and too fast, with a high sink rate almost until touchdown. (*Note: FODA will show all of the above. It will not, however, reveal that the pilots, after reading the preflight checklists, decided to clean their windscreens. In doing so, the window heat was turned off and was never turned back on. During descent, the window fogged up. Also, in the approach there was a discussion with ATC about what the correct inbound radial should be [the approach chart was in error]. Thirdly, with a major shortcut, the aircraft started high. The discussion with ATC led to late configuration and resulted in a slightly higher altitude over the initial approach fix, which—together with the partly fogged up windshield—caused the less-than-perfect approach.)*

These real-life examples show that when FODA data are enhanced with pilot information not only will the statistics still be produced, but the enhanced data will also be useful in decision-making courses, typically part of a captain's course.

Additional advantages

With self-evaluation, a true proactive approach to risk reduction can be taken.

Examples:

- **Example 5**—A pilot approaches the company limit for the bank angle and is made aware of the high bank angle by the other crewmember.
- **Example 6**—A pilot lowers the nose after departure in 1,000 ft AAL in an attempt to accelerate and retract the flaps. However, clean speed would have been much too high for the subsequent tight turn in the mountainous terrain and obstacle clearance would have been compromised. An exceedance was avoided by the callout of the pilot monitoring (PM) not to accelerate yet. *(Note: FODA will not pick up either event because there were no exceedances yet.)*

With today's FODA, the great benefit of standard operating procedures (SOPs) cannot be proved, simply because a FODA will only show the exceedance but not the approach to an exceedance: Giving the data to the pilot (and assuming that the pilot would make use of the tool) would enable us to mark out those phases of flight (and add comments) where such SOPs were helpful.

A further advantage lies in the fact that we do not have to worry so much about proprietary data and confidentiality. The pilot produces the data; therefore, why shouldn't he own it?

Challenges to face

The pilot flying (PF)—pilot monitoring (PM) issue

Surely, one would not like if other pilots had access to data that show your own mistakes. So the question arises, whether the crew, the PF, or the PM should have access to the flight data on a specific leg. Technically, the easiest thing would be to give both pilots the same data set and not have to worry about how to separate that data. The logic behind this is that whenever something goes wrong, be it minor, it is the crew who act together and do the self-evaluation to the best of their knowledge together. Very likely this will be up to the individual airline and part of the negotiations with the unions. Clearly, it has to be ensured with high confidence levels that data of previous flights are not accessible to later crews.

The data transfer issue

Owning a laptop and having installed a flight data acquisition unit, an optical disc recorder, etc., on the aircraft is one thing, retrieving the data efficiently and timely is another. Wireless transfer seems to be the ideal method, and in some airlines a global system for mobile communication (GSM) solution is already in place (however, this is a transfer between aircraft and the safety department,

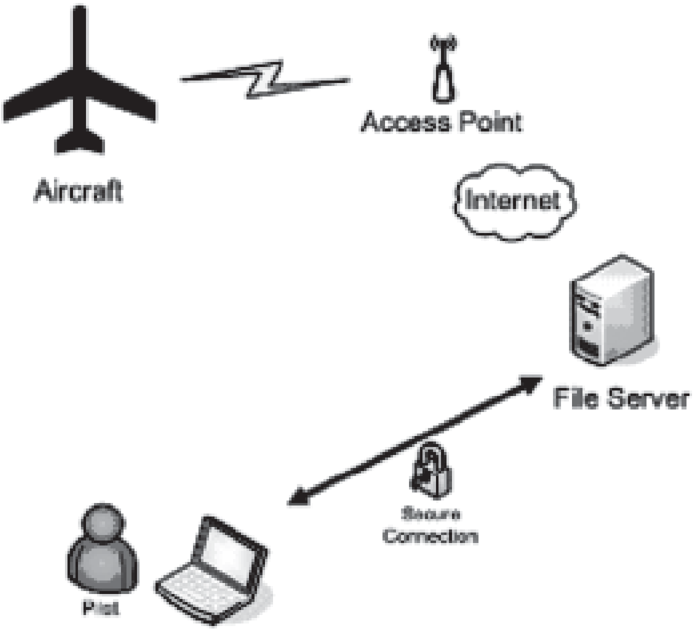

Figure 4. Data transfer via WLAN access point at the airport.

not the individual pilot). Because of its importance, the issue is dealt with in more detail below.

• ***Data transfer***—In most airlines, the standard flight data transfer is done by staff. After landing, typically at the home base, a maintenance technician or, in some cases, flight safety personnel change the storage media and deliver it to a central data acquisition office. This process is fairly typical for optical disks or PCMCIA cards, which then need to be administered.

One company (Teledyne Controls) supplies WQARs (wireless quick access recorders). The system is called Wireless GroundLink©. It includes four to eight cell phones for data transfer and is already in use with some airlines. With such units, the transfer of data can be completed in 10-15 minutes after the aircraft has landed. The drawbacks of today's GSM are high cost and slow data transfer. Another transfer method is via wireless local area network (WLAN) interface from the aircraft to an access point on the airport. Avionica (www.avionica.com) supplies a WLAN QAR for transfer data over 802.11b (IEEE WLAN wireless local area network standard). The system offers a secure link from aircraft to company server (see Figure 4).

• ***Data safety and encryption***—Systems that enable efficient encryption of the data transfer between QAR and a server at this stage are still expensive. Public key (RSA-encryption) or a universal serial bus (USB) hardware key could be used for access control once the data are on the server so that only the individual pilot gains access to his flight data. A typical general process for handling data after landing could be

—Sort data—allocated data with flight number (select data that are relevant to pilots).

—Encrypt data—pilot has the key on his laptop.

—Access by pilot via Internet.

—Data analysis by pilot (comments, threat and error management, deidentify, etc.).

—Analyzed data transferred back to server for use at the Flight Safety Department.

Figure 5. Research simulator at FH Joanneum/University of Applied Sciences, Graz, Austria.

Outlier data

Pilots will only accept the tool if exceedances are for real and not spurious nuisance-events caused by, e.g., faulty sensors. Quite often, spikes due to faulty transducers will appear as operational exceedances. Clearly, such "ghost events" must be reduced to avoid frustration among those doing the analysis.

Rapid input of comments

If pilots enjoyed writing lengthy text, they would have chosen to be authors. In general, pilots do not like to spend much time in debriefings. So how should the data be retrieved, be analyzed for exceedances, information be added, and personal statistics be kept all within short time? One way would be to limit the need for free text and rather offer standard solutions for threats, threat management, errors, and error management. Klinect et al have developed a list of typical threats that flight crews face for the LOSA (Line Operation Safety Audit) program that they developed. This could be useful.

• ***Pattern of evaluation***—The pilot's task is to comment on the exceedances after the flight in a standardized way. In addition, a pattern of evaluation has to be provided. With this pattern of evaluation, the causes of exceedances can be received. The already-mentioned threats and errors are considered as causes for parameter deviations.

Presently, it is not possible to identify all kinds of threats that influence the flight progress, e.g., wind conditions can be analyzed on the basis of the technical data; however, risky ATC requests cannot be detected in the flight data. Commenting the parameter exceedances with consideration of the time axis (temporal process and exceedance in agreement) makes it possible to specify the time when countermeasures are initiated—the concrete kind of countermeasure, threats, or errors that almost lead to an exceedance (a deviation that is not yet classified as an exceedance).

The development of the pattern of evaluation: A possibility exists to provide a pure listing of possible causes (threats, errors) that, however, do not provide us with information about the recovery action that was taken and the sequence between deviation and recovery, i.e., a causal integration is not possible. Therefore, we chose an alternative approach. Commenting is done over a time axis. By the representation of temporal operational sequence it

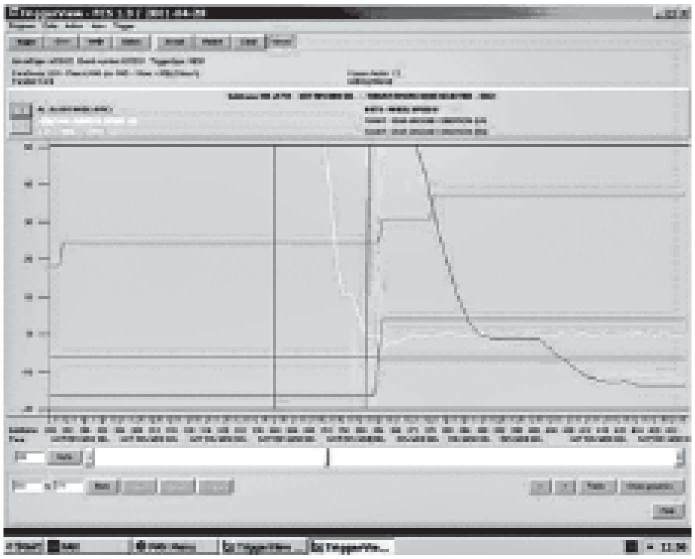

Figure 6. Typical FODA print—multiple parameters on y-axis running along time.

will be possible to receive the additional information specified above. Thus the cause for an exceedance is better analyzed. The disadvantage is that no exhaustive categorization can be made at this point. Therefore, in the test phase increased free text inputs are necessary. They will extend the predefined categories to a final standardized pattern of evaluation. After the end of the test phase, the free text inputs should only capture a small part besides the standardized pattern of evaluation.

• ***Flight simulation study***—A flight simulation study at FH Joanneum is in progress to describe an event-time-diagram as the basis for the design of the pattern of evaluation (see Figure 5). This implies that the event-time-diagram will be the base for the creation of category formation as well as for the software's structure. Scenarios have been developed that can reproduce as far as possible a realistic flight progress. Different threats are integrated in the scenarios, e.g., unfavorable radar vectors, adverse weather. To lead pilots to errors is more difficult. Some threats are presented in a way that they can provoke errors, e.g., minimum decision altitude at ceiling. In this particular study, two methods are applied that supplement each other—behavior observation and interview. To achieve the goals regarding the event-time-diagram and category formation, different background questions have to be answered.

Since human data processing is subject to all actions and reactions, our research is based on the model of human information processing of Wickens and Hollands. The model provides a general framework for analyzing human performance.

One point consists of whether the flight crew perceives threats and errors during the flight and when they perceive them. Perception means to decode the meaning from raw sensory data, e.g., the deflection of the CDI (course deviation indicator) is not only a deviation of a coefficient, but conveys the meaningful message: "Danger, you are leaving the primary area!"

Another topic is how threats and errors are appraised. Is a threat always perceived as a threat right away? Perhaps some threats for some of the pilots are not threatening—they are just like routine operations. Some reactions (in our case threat management) are carried out almost automatically. For definitions in skill and rule-based and knowledge-based behavior, the reader is referred to Rasmussen (1983, 1986).

Even if threats are perceived correctly, there is likelihood that a pilot happily accepts the threat in order to show his skills. In other words, he might be well aware of the situation and even without an obvious benefit (e.g., accepting a shortcut although the flight arrives early) takes up the challenge. In a classification, it would be necessary to look into the motivating factors.

Another question deals with the reaction that is shown regarding a threat or an error, as well as consideration of the background. The understanding of a situation, achieved through perception and augmented by cognitive transformations, triggers the selection of a response.

A last point is the general issue of whether the pilots were aware of the situation. "Situation awareness is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future." Situation awareness involves a correct appreciation of many conditions. The most relevant aspects in aviation are three-dimensional spatial awareness, system (mode) awareness, and task awareness.

• *Usability of the user interface*—So that time-saving commentating of exceedances is possible, apart from a standardized pattern of evaluation, a user friendly graphical user interface also is required in which the pattern of evaluation is embedded.

The user interface will be examined and reviewed, to what extent it agrees with certain usability principles. An example of these principles is the following list of heuristics of Molich and Nielsen:

- Simple and natural dialogue.
- Speak the user's language.
- Minimize the user's memory load.
- Consistency.
- Feedback.
- Clearly marked exits.
- Shortcuts.
- Precise and constructive error messages.
- Prevent errors.
- Help and documentation.

Visualization

FODA data are typically presented in x-y-plots, with time running along the x-axis. It takes a good deal of expertise to analyze graphs with multiple parameters shown on the y-axis (see Figure 6). In order to make things easier for the pilot who does a self-evaluation, a visual presentation of the instrument panel seems to be the preferred method of presenting data.

This concludes our description of a new method of proactive data collection and analysis. The idea is to give the pilot access to his flight data and let him enter threat- and error-specific information with the aim of gaining a deeper insight into why certain decisions were made. Rather than just running statistics across an entire fleet, a pilot runs his personal statistics with the aim of tailoring his training. ◆

Acknowledgement

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(ISASI Life/Fellow Member Ludwig Benner [WO2202] was interviewed by R. Schnepp for the development of this article, which first appeared in and is reprinted from DomPrep Journal *at www. domesticpreparedness. com. —Editor)*

LUDWIG BENNER:

The Father of Modern Hazmat Thinking?

By Rob Schnepp

During the late 1960s and into the 1970s, the nation's fire departments were suffering between 20 and 50 firefighter deaths and injuries per year due to hazardous materials incidents. "That statistic bothered me," commented Ludwig Benner, then a hazardous materials specialist with the National Transportation Safety Board (NTSB). "I looked at the numbers of firefighters getting hurt at hazardous materials incidents and figured out they were many, many times more likely to suffer a hazardous-materials-related injury than the second-ranked classification of workers injured in the hazmat field—transportation employees.

"The problem really became evident," Benner continued, "in 1971. I investigated a hazmat accident in Houston where a guy got killed and several other employees were injured. Ironically, the fatality was the hazmat training officer, and, as it turns out, he and the rest of the firefighters were following the emergency response instructions they were taught.

"During that investigation a question occurred to me: If these guys were doing what they were trained to do, how did they get themselves wiped out? It had to be the training. After the investigation, I was prompted by a friend and colleague to offer some alternative solutions in terms of hazmat training and agreed to develop and teach a class on hazardous materials at Montgomery College [in Maryland]."

Essentially, that was the beginning of what might be called the age of enlightenment for hazmat response in the nation's fire-service community. For the next 10 years, Benner, along with other significant players in the fire-service hazmat-response arena—working in conjunction with the International Association of Fire Chiefs, Chemical Manufacturers Association, the American Association of Railroads, and other national organizations—led a campaign to improve the ways in which firefighters respond to and, of greater importance, *think their way through* a hazardous-materials emergency.

HAZWOPER, CHEMTREC advances

Indirectly, their work (along with several significant hazmat incidents that occurred at the time) laid the foundation for such advances as the formulation of hazardous waste operations and emergency response regulations, found in the Code of Federal Regulations. These regulations, commonly referred to as HAZWOPER, are under the jurisdiction of OSHA, the Occupational Safety and Health Administration.

Another major step forward was the formation of CHEMTREC, an emergency-response resource for chemical information, funded by the Chemical Manufacturers Association. There were a number of other significant changes and developments along the way that collectively improved the abilities of firefighters across the country to handle hazardous-material emergencies. The net result was a huge reduction in the hazmat-related deaths and disabling injuries that were so common among firefighters in the 1960s and 1970s.

"Back then," Benner pointed out, "firefighters received hazmat training pretty much the same way, following the prevalent fire-service paradigm at the time: attack and extinguish.

"I wanted to change that paradigm by teaching firefighters the importance of *thinking* their way through an incident rather than jumping into the middle of something they didn't really understand. I wanted to show them how to look at a situation, interpret the visual cues, and predict what was going to happen next.

"Additionally," he continued, "my training program illustrated how critical it is to start out with a game plan, even if it's pretty basic. If the situation isn't going to create a problem, maybe you don't have to do anything. On the other hand, if it's going to hurt somebody, you have to figure out *how* it's going to hurt them and decide whether or not you can do anything about that."

Decisive and innovative change

To help firefighters think through a hazmat situation, Benner developed an innovative decision-making process, appropriately named DECIDE.

- **D**etect HM Presence
- **E**stimate Likely Harm Without Intervention
- **C**hoose Response Objectives
- **I**dentify Action Options
- **D**o Best Option
- **E**valuate Progress

The DECIDE acronym represents key decision-making points that occur during a typical hazmat emergency. "The intent of the DECIDE process," according to Benner, "is to help the responder get 'ahead of the curve' during the hazmat incident.

"The goal," he emphasizes, is "to constantly update the predictions of what's going to happen next, in order to see how the actions are changing the outcome. With a hazmat incident, you have to focus on the outcome. The beauty of the DECIDE process is this: If you can't make a prediction about what will happen next, you can pinpoint the data gaps that will ultimately allow you to make a predication."

Now many years removed from his days of teaching hazmat, but still interested in the health and well-being of firefighters, Benner offers this perspective in closing: "I had the very distinct advantage of hindsight when I was investigating accidents for the NTSB, and *(continued on page 30)*

Practical Human Factors in the Investigation of 'Daily Events'

Testing concluded that the ability to track successes, not just error/failure, was critical in learning about events. Indeed, recording successes is a *need,* not a want, in setting successful programs.

By Paul Jansonius, Standards Pilot, Human Factors Training, WestJet Airlines, and Elaine Parker, Operations Manager, North Cariboo Air

(This article was adapted, with permission, from the authors' presentation entitled Practical Human Factors in the Investigation of 'Daily Events' *presented at the ISASI 2005 seminar held in Fort Worth, Tex., Sept. 12-15, 2005, which carried the theme "Investigating New Frontiers of Safety." The full presentation including cited references index is on the ISASI website at www.isasi. org.—Editor)*

In 2001, the companies that would become Air Canada Jazz were in the process of merging, and at that time the two authors of this article worked for this newly "birthing" company.

The safety and human factors team in the "soon-to-be Air Canada Jazz" company was tasked to look at bringing human factors (HF) components formally into the incident database system. In this tasking, the following items were considered critical:

- Make sure the data being gathered can be used (don't just collect it because we can).
- Plan the feedback and utilization into the working system.
- Make the process as simple as possible so that the company will keep on doing it.

As a team, we examined the human factors models that were in use in external database programs and found most of them to be fairly complex. We then examined the current model of human factors (the HF "toolbox") that was being taught in the company's current company resource management (CRM) program.

We tested the model using a real company event where a detailed investigation and good crew information was available and the crew was still willing to discuss the event. When utilizing the model on this test, we concluded that the ability to track ***successes***, not just error/failure, was critical in learning about events. Very few, if any, of the models encountered were able to do this, and after the initial test this capability (recording successes) was considered a ***need,*** not a want, in determining the program.

The ultimate model that was chosen was an adaptation of the human factors toolbox the company was using in the CRM program (the adaptation being recording the successes). A template was built into the computer program for use. However, due to the complexities of merging four regional carriers and competing priorities, the project languished for a while.

Revitalized development

In the spring of 2004, WestJet and Jazz revitalized the concept of bringing the training in human factors (under CRM) into the investigation of incidents through the safety department. Jazz had a draft of human factors in its database from the preliminary work done in 2001. WestJet did not have anything in place. Jazz determined there was no benefit to changing models, although there were disadvantages to the one they had (there are disadvantages to all of them).

As WestJet did not have a model in place, it was more able to select/design its own. However, WestJet was looking at the database for its incident management, and the human factors "built in" components needed to be considered. The built-in components were all fairly complex and were ruled out for that reason. In 2004, WestJet built its model; in 2005 it begun to test the model and the system.

In the summer of 2004, Jazz commenced "testing" its system by investigating and entering human factors in a percentage of the files. In January 2005, based upon this testing, Air Canada Jazz began to "go live" and require the human factors analysis on specific files.

Basic definition

In developing their models, the two teams agreed to the criticality of the *observable act*—All items recorded as HF must either be

Paul Jansonius *has been involved with human factors training since 1991 when he started providing CRM training for the crews at Time Air (now Air Canada Jazz). He currently holds the position of Standards Pilot, HF Training, at WestJet and shares his time among desk, classroom, and on the line as a captain on the 737NG.*

Elaine Parker *in her 30 years as an aviation safety professional has served in senior management positions in operations, marketing, safety, security, and training, both in the public and private sector. In 2001 the Canadian Minister of Transport honored her with the "2001 Canadian Aviation Safety Award." She is an ISASI member and has been on the Executive of the Canadian Society since 1994. She maintains her airline transport license as a captain on Dash 8 aircraft, is the Operations Manager for North Cariboo Air, and is President of Beyond Risk Management, Ltd., a safety and security consulting business.*

something that was an action or inaction (the individual did or did not do a thing that was observable) or a stated perception of the individuals themselves that could not be refuted by other facts in the investigation.

Jazz model—The regional safety officer investigates all safety-related events from both a technical and human factors perspective. The safety officer writes a third-party narrative for general release that gives the step-by-step detail of the event. Actions taken after the event are recorded as are preventative measures taken. These fields in the database are common access. In a "behind-the-scenes" page, the human factors components are recorded.

After the investigation, the human factors team meets to review the event. There must be a minimum of three people on the review team: the safety officer who investigated, a member of the company resource management development and training group, and an employee representative from the pilot association. Air Canada Jazz found this "tripartied" group to work exceptionally well, with the different perspectives assisting in better analysis and better feedback to the investigator to improve subsequent investigations.

Observable acts are described and then assigned to a "crew," which may be the flightdeck crew, the cabin crew, the maintenance crew, the airports crew, the dispatch crew, the management crew, or "other" for outside agencies. Once the observable act is described and the crew defined, the analysis team determines the human factor "code" to assign and determines if it was a positive or a negative contributor. The possible codes are

1. External—expected
2. External—unexpected
3. External—latent
4. Crew—communications
5. Crew—intentional non-compliance
6. Crew—proficiency
7. Crew—procedural
8. Crew—operational decision

For example, on a landing gear failing to indicate down event, here are two of the observable events as recorded on the Human Factors Analysis Page:

(1) Crew Defined: Flight deck

Description of Specific Threat/Error or Condition/Action: The crew confirmed the gear was extended and locked using the alternate lights.

***Code*:** +7 (positive 7, crew—procedural)

***(2) Crew Defined*:** Flight deck

***Description of Specific Threat/Error or Condition/Action*:** The crew changed the burnt out light bulb while in flight; this procedure is not in keeping with the elementary maintenance training they had received.

Code: -7 (negative 7, crew—procedural)

WestJet model—This model is based on the experience and lessons learned from the Jazz model, and from work done at WestJet both in our HF training and in the implementation of HF assessment in LOFT (Line-Oriented Flight Training) and simulator training. Considerations for determining the HF elements to assess were accessibility and simplicity. A primary concern was that the information collected would be useful to the different departments when the information was passed on for corrective action.

As with the Jazz process, the WestJet HF classification team consists of at least three members to test assumptions and ensure that any questions have been, or will be, clarified by the author of the safety report. This ensures that we are assessing the incident as it was experienced by the participants, and not through the assumptions of the investigators. Currently the classification team consists of the Director of Corporate Safety, the associated departments' Safety Officer, and the Standards Pilot HF Training. As the week's companywide safety reports are all addressed in the same meeting, there are usually safety officers from different departments present, who provide a beneficial difference of perspective to the analysis.

Following is an outline of the HF elements as they appear on our HF assessment form along with the short description included to help the investigator test his/her assessment *(italic)*.

Human Factors Classes

1. Skill based

1A Absentminded, automatic

Slip of habit, recognition failure, lose track of past actions, memory block.

1B Technique

Unable or difficulties in performing a particular task.

If unable, due to lack of training or information, this would be a technical issue, not HF related. Cases where the individual has been trained but is unable to properly perform the task would be HF technique.

One of the fundamental concepts promoted in our HF training is that of the relationship between skill and error. The stronger or better developed a skill, the greater the potential that a habit pattern, or muscle memory, will result in an action that may be completely inappropriate for a given situation. These errors are most likely to occur when a repetitive or structured task (checklist, SOP) is misapplied or omitted altogether. Opposite of this would be an error that results from the lack of a skill—a proficiency issue or misunderstanding the application of a procedure. The desire and intent to comply may exist, but the capabilities do not.

2. *Intentional non-compliance*

Deviation from procedure, regulation, or written policy. Cutting corners.

May be a norm in the operation, tolerated by supervisors, maybe even sanctioned.

This category is applied exclusively to those occasions where a crew is aware of, and understands, a given procedure but elects not to follow it.

3. *Operational decision* *(No intentional non-compliance)*
Where the decision-makers find themselves in uncharted waters and must use a slow and effort-filled reasoning processes that may be affected by insufficient time or faulty logic. Decisions that result from deliberate, conscious thought. Was the choice a good or a bad one? Risk management.

3A Threat/error management
A situation that is unique, for which there is no procedure or policy. Error recovery is not a normal part of the written procedure. If the crew recognizes, "traps" an error, the decisions made regarding the recovery would be an "operational decision."
Similarly, any identified threats not managed by procedures or policy would require, and fall under, an "operational decision."
*A decision to deviate from the standard, or written, procedure would be considered "intentional non-compliance, **NOT** "operational decision."*

3B No decision made
No decision where one should have been made (failure to see/understand/identify threat). (See chart above.)

Another key concept in our HF and simulator training is that of threat error management. The WestJet TEM model promotes SOPs as a first defense to avoid and trap threats and errors. The need exists to identify threats and manage expected, unexpected, or latent threats before they can result in an outcome. Managing the undesired states that can result from unidentified threats or errors is necessary.

Within the context of threat/error management, the category "operational decision" relates to the crew's ability to identify and manage threats that arise in the operation. Given that no SOP can identify all contingencies or circumstance that a crew may encounter, this category allows us to examine the caliber and success of the decisions the crew makes operationally. Where a "decision" is made to deviate from a standard operating procedure, the act would be categorized as "intentional non-compliance." The only exception would be if it was understood the deviation was made to manage a threat not considered or managed by the SOP—again, a situation that, through the interview, considers the crew's thought process rather than the assumptions and perspective of the investigator.

4. *Communication*

4A Utilization of other resources
Were other group people contacted or utilized?

4B Quality of communication
Was the communication used clear, unambiguous, and understood?
Was there clear acknowledgement? If trail balloons were used, was the meaning clearly understood or clarified, if required?

Again, in our HF training, we discuss the use of "trial balloons" or the "hint and hope" style of indirect communication used in our polite society and as a technique used by less-senior crew to communicate through higher levels of rank. Was a critical communication not understood, clarified, or received? If there was no acknowledgement garnered by the sender resulting in missed communication, it would be categorized as "quality of communication."

The other consideration is whether the crew made use of other resources in determining its course of action. That might be other members of the crew/group, ATC, or OCC/Dispatch.

5. *Physiological*

5A Adverse mental states
Complacency, stress, distraction, task saturation.

5B Adverse physiological states
Fatigue, illness, effects of medication, motion sickness.

5C Physical or mental limitations
Visual limitations, overload, reaction time.

5D Personal readiness
Rest, self-medication, diet.

5E Physical environment
Temperature, noise, lighting, equipment interface.

Initially the category "physiological" was dismissed from the form. However, as we began testing the process, it became apparent that workload, fatigue, and (especially in areas other than flight operations) physical environment were being cited as contributors by interviewees. This category was also of interest to the flight safety group as the airline has started operating longer flights, often with multiple crossings of up to four time zones. (This entire physiological section was taken directly from the work of Dr. Scott Shappell and Dr. Doug Wiegmann. Refer to their paper from the ISASI 2004 seminar in Australia.)

Human Factors Analysis

Crew Defined	Description of Specific Threat/Error or Condition/Action in this Event	Code
O	The smoke warning light for the cargo compartment illuminated in the climb-out phase of flight.	-2
F	The captain was the non-flying pilot and contacted the flight attendant and stated that there was an "indication of fire in the back."	-4
I	The flight attendant believed that the fire was in the "back" of the engine and checked the back of both engines.	-4
F	The flight deck crew declared an emergency and returned for landing.	+8
F	The flightdeck crew did not follow the Quick Reference Handbook for the general smoke procedures or for the smoke warning light.	-7
I	The flight attendant reported to the flight deck that she was "unable to see fire but that it was difficult to tell since the aircraft was in cloud and it was difficult to see."	+4
F	The first officer took the call from the flight attendant and noted that her comment regarding being in cloud was odd, but the first officer did not pass that information to the captain nor did he ask for clarification from the flight attendant.	-4
F	The flight deck did not brief the flight attendant about the type of landing.	-7
F	Once the aircraft stopped, the flightdeck crew did not utilize the flight attendant to check the cargo hold, rather the first officer went to the hold himself without discussing or involving the flight attendant and returned to the flight deck without discussion or involving the flight attendant.	-6

6. *Other*

The category "other" was included to allow for the eventuality that an issue might arise that does not match any of the other criteria. Should this category find frequent use, it would then bring into consideration a new category to track any recurring issues.

Example situation using the Jazz model

After a normal takeoff at between 1,300 and 1,500 ft in the initial climb, the crew received a cargo hold smoke detector indication. The first officer was the flying pilot. The captain contacted the flight attendant and stated that there was indication of a fire in the back. The flight attendant understood the concern to be the aircraft engines and went into the cabin and checked out the windows looking at the rear of the engines. The captain then declared an emergency with air traffic control (ATC) and actions for returning to the departure airport were taken.

As the captain was talking with ATC passing the fuel and passenger loads, the flight attendant called the flight deck. The first officer took the call from the flight attendant, who informed the first officer that there was no smoke or flames visible, but it was difficult to be sure because of the aircraft being in cloud. Though the first officer thought the comment was odd, it was not questioned. After completion of the transmission to air traffic control, the captain was advised by the first officer that the flight attendant said there was no sign of smoke. The flightdeck crew agreed it was unlikely there was a fire but planned to land and confirm. The captain then made an announcement to the passengers advising them of the return to the departure airport and that further information would be given upon landing. The flight attendant resumed her seat for what she perceived to be an abnormal landing.

The landing was completed without difficulty and the flightdeck crew advised air traffic control that they would proceed onto the taxiway to confirm the situation. The engines were left running while the first officer left the flight deck and proceeded to the cargo hold to check conditions. While the first officer was checking the cargo hold, the fire department outside the aircraft asked for the engines to be feathered while they checked the exterior of the tail and opened the cargo hold to check. Everything was normal, and the first officer returned to the flight deck and the aircraft was taxied back to the terminal. (See table.)

Example situation using the WestJet model

This example involves a crew that was faced with a runway change during taxi for takeoff in a busy airport. The process we use for entering takeoff data to the FMS (Flight Management System) is through an ACARS (Aircraft Communications Addressing and Reporting System) uplink, which is initiated by an ACARS request for data on up to three different runways. As the crew was having difficulty receiving the ACARS uplink (technique), it elected to revert to the manual method, using the data provided in the flight release. This process was performed by the first officer and monitored by the captain as he taxied ahead in the line up for takeoff. In the process, the first officer made an error and derived speeds using their zero fuel weight rather than the GTW, a difference of 20,000 pounds. The captain (FP) missed the error during the data entry, but trapped it on takeoff when he recognized the abnormal performance on rotation and maintained a 10-degree pitch attitude till the aircraft flew away.

The ACARS takeoff data system is still in its first 6 months of operational use and as such is still quite new to the crews. There is an SOP bulletin regarding using the system and common errors and includes guidance on managing a runway change. It states:

"The optimum time and place for a runway change is at the gate with the park brake set. This allows for the uninterrupted attention of both pilots through this crucial process. If it becomes necessary to perform a runway change after engine start or pushback, the crew should delay the FMC entries associated with the runway change until the aircraft can be stopped. This will allow for the uninterrupted attention of both pilots during the confirma-

Department/ Involved Parties	Observable Act	Human Factors Class	Impact (+/-)
Flt Deck	Did not stop to reprogram the FMS when runway changed (possible norm at this airport).	2 or 3A	-
Flt Deck	Manual T/O data entered without verification.	2	-
Flt Deck	Manual T/O data entered without verification.	5A	-
Flt Deck	Runway change reprogramming not done as per SOP.	1B	-
Flt Deck	Wrong data from TLR entered into FMS.	1A	-
Flt Deck	General contributing factor—fatigue (circadian shift, loss of sleep, YHZ 0530 check in).	5B	-
Flt Deck	Maintained maximum 10-degree pitch on T/O.	3A	+
Flt Deck	Pilots consulted F/As regarding abnormal T/O indications (i.e., tail strike).	3A	+
Flt Deck	Pilots consulted F/As regarding abnormal T/O indications (i.e., tail strike).	4A	+
Flt Deck	Adjusted target V2 bug to V2 + 15 after T/O.	3A	+

tion/verification process as well as mitigate the risk of taxiway/runway incursion."

The use of the word "should" rather than "shall" in the guidance regarding stopping to make the data entry required further interview with the crew to understand if they were in "non-compliance" or making an "operational decision" to continue taxi during the process.

Department/Involved Parties

- Flight deck
- Airports customer service
- Dispatch
- Maintenance
- Inflight crew
- Airports ops
- Other

WestJet Human Factors Assessment Tool

Assessors:

____

____

____

(See table above.)

Difficulties, results, and surprises

The companies have found little difficulty in the tripartied assessment group agreeing on the observable acts or on coding the acts; however, there was a great deal of difficulty on the extent to which single observable acts should be noted. For example, if a procedure with seven steps was done correctly for six but incorrectly on one, should each and every step be recorded or just "significant" steps. (This is still being resolved.)

Another difficulty is when an observable act falls in more than one human factors code area. Should it be listed twice—for example, the communication of information and the procedure to communicate. (This is still being resolved.)

In both of these difficulties, the inclination to solve the problem by increasing the amount of data recorded has to be balanced against the original requirements to keep the system as labor UNintensive as possible and to record only information that can reasonably be used by the operational and training departments.

As expected, the companies found the following results by adding human factors analysis to the database for events:

- Improved technical investigation.
- Greater interaction with the crews.
- Improved feedback to crews.
- Better data to support changes.
- Labor-intensive and resource-needy process.

Although the examples in this paper were flight operational in nature, the process works well in all areas of the safety management system (maintenance, ground operations, etc.). Though not really a "surprise," the companies also found

- little or "minor" events are more data rich as people will talk about the bad things when they are small easier than the *big* bad things (the higher profile the event, the more discomfort in talking about why something was done the way it was).
- proof of the effectiveness of major event training (consistent excellent handling of engine failure procedures, etc.).
- proof of the small events hiding much bigger problems than they first appear to be.

The flightpath ahead

Air Canada Jazz and WestJet proved that two *highly competitive* airlines can work together productively on safety issues despite all the commercial pressures. They have shared information with one another and with other organizations.

Air Canada Jazz has entrenched the human factors analysis in its safety management system and will continue to improve the process and glean useful information to enhance safety. Air Canada Jazz proposes to look at the abnormal (non-serious) events in more detail as it has found those to be richest in information (example, two engine go-arounds, minor or inconclusive indication problems immediately after takeoff).

WestJet continues to test and gain experience using its HF analysis tool through sharing and analyzing safety reports brought forward by different members of the team. The system will not be a fully integrated part of the investigation process, though, until a new database has been selected and is brought on line as part of the safety management system at WestJet.

North Cariboo Air will be building on the results of these two companies and implementing the human factors analysis into its new safety management system and event investigation and follow-up program.

All three companies are open to sharing their knowledge and learning from other operators. ◆

ISASI 2006 Begins Registration

By Seminar Committee and *Forum* Staff

Registration has opened for ISASI 2006, announced Barbara Dunn, ISASI 2006 chairperson. The 37th annual international seminar is being held in Cancun, Mexico, from September 11-14 at the Fiesta Americana Grand Coral Beach Hotel. A detailed and easy-to-manage website has been established and can be accessed only through the ISASI home website, www. isasi.org. A link on the home website's page will take a user directly into the ISASI 2006 menu. From there, all areas of interest are easily accessed.

Of immediate importance to those planning to attend is that the hotel registration form must be printed from the website, completed, and returned to the hotel via fax transmission. The seminar registration form must also be printed and is to be returned to the ISASI home office, Attn: Ann Schull, either by postal mail or fax transmission. Telephone registrations will not be accepted for the seminar or the hotel.

The seminar program registration fee is as follows: member $520, student member $200, nonmember $565. If registration is made after August 15, the fees are $570, $225, and $605, respectively. Day pass fee for any of the 3 days is $200 by August 15 and $250 after August 15.

The fee for either of the two tutorials set for September 11 is $125 by August 15 and $150 after that date. The companion fee is $320 by August 15 and $350 after that date. The fee for the day-long post-seminar function conducted on September 16 is $100. A copy of the seminar registration form is reprinted on page 23. It may be completed, clipped out, and forwarded to ISASI headquarters to complete the registration.

Accommodation registration

The Fiesta Americana Grand Coral Beach Hotel is one of only four AAA Five Star Diamond Resorts throughout the entire Caribbean. It is providing seminar registrants a special rate of US$133 per night based on single or double occupancy, no meals included, plus 10% VAT and 2% city occupancy tax. A charge of $35 is made for the third party in a room, and no quad occupancy is permitted. Forms of payment may be credit card (American Express, Visa, MasterCard) and bank wire transfer (account address is on the registration form). The rates are good for September 8-18. The registration form on page 25 should be forwarded by fax transmission to +52 (998) 881 3273. The reservation deadline is August 11, after which no guarantee for room or rate is made. For information not found on the registration form, e-mail the hotel reservation department at reslfacb@posadas.com.

This all-suite luxury resort offers 602 beautifully appointed oceanfront suites featuring front balconies or terraces and a sunken sitting area. Each room is equipped with a 27-inch color satellite television, in-room movie and music channels, refrigerated mini bar, electronic safety deposit box, scales, makeup mirror, hair dryer, iron and ironing board, in-room coffee makers, individual A/C control, two-line telephones, one wireless telephone with personal voice mail, and a data port for computers. Year-round weather is mild with easterly trade winds sweeping across the peninsula. The temperature range between day and night is usually between 10 and 15 degrees, and the average temperature for the month of September is 89 degrees Fahrenheit.

Technical program

"Incidents to Accidents: Breaking the Chain" is the theme for the seminar. ISASI will present a 3-day technical program, which has proven to be an invaluable experience over many years for all attendees, who include air safety investigators, aviation safety managers, and other professionals in the aviation community who must deal

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with improving aviation safety in civil aviation or the military.

Jim Stewart, technical program chairman, says, "We plan to present both individual papers and panel discussions on current incident and accident investigation experience, techniques, and lessons learned with particular emphasis on international investigation challenges. A major feature each day of the technical program will be a full hour session on recent, high-profile investigations presented by senior investigators or investigators-in-charge. One commitment has been made by the Transportation Safety Board of Canada, which will present on two accidents, the Air France landing accident in 2005 at Toronto and the MK Airlines B-747 takeoff accident at Halifax in 2004. As well, we are accepting some extended papers of one hour each for our afternoon sessions, featuring new technical developments in incident and accident investigation as well as investigation management."

Keynote speakers have been scheduled for each day to set the tone for the day. The Director General Civil Aviation, Mexico, Capt. Gilberto Lopez Meyer, will open the seminar and provide the keynote address on Tuesday, Latin American Day. Bill Voss, Director of the Air Navigation Bureau of ICAO, will open Wednesday's session on International Aviation, and Ken Smart, recently retired Chief Inspector of Accidents for the U.K., will open Thursday, the Investigator's Day, with a "Reflections of an Investigator," looking back on his experience as one of our senior investigators and ISASI members.

Further details regarding the speakers and scheduling aspects of the technical program will be found on the website as they become available.

As previously reported, the tutorial program will take place on Monday, September 11. Two tutorials will be offered. They will start at 9:00 am and conclude at 5:00 pm. Included in the tutorial price is the continental breakfast, lunch, and all handout material. One tutorial will be conducted jointly by the AAIB of the U.K. and Cranfield University. Designed as a workshop on investigation management, participants will be taken through a simulated investigation during which they will have to deal with and respond to the normal challenges an investigator faces. The second tutorial will include senior ISASI members and airline and government representatives and will focus on the development and maintenance of an effective corporate safety management system with a particular emphasis on event investigation, risk assessment, and system performance monitoring.

Stewart adds, "The tutorials provide a unique opportunity for seminar delegates to receive the most up-to-date training material at a very reasonable cost on subjects considered important for improving skills of accident investigators and prevention specialists. They have been a huge success in past years and should not be missed."

Companion's program

Joann Matley and Toni Ketchell are planning the companion's program that will feature two full-day events, including a trip to the impressive cliff-top archaeological site of Tulum, 86 miles south of Cancun, which commands a spectacular view of the Quintana Roo coast. The guest speaker of the day, an expert in the world of the Mayas, will regale attendees with stories of the Mayan existence for 2,000 years before mysteriously disappearing. In their day, they created a near perfect calendar by observing the stars and the planets, well before any such calendar existed in early Europe. Companions will see firsthand the impressive temples, pyramids, and observatories, all erected without horses, carts, or even the wheel.

At Xel-Ha, located 15 minutes away from Tulum, the aquatic-minded visitor will see how fresh water from stream mixes with ocean salt to create placid waters in which many tropical fish take refuge among incredible caves, inlets, and lagoons. And if so inclined, snorkel gear may be donned so one can mingle with the multicolored, brilliant fish. The park also offers all modern amenities and services.

The second day the group moves away from history and into the main avenues of the city to mingle, lunch, and bargain hunt. First comes pampering at a gala lunch at La Casa de las Margaritas. The restaurant surrounds the visitor with the sights, sounds, aromas, tastes, and laughter so characteristic of festive Mexico. Following lunch, a fashion show will allow the participants to experience a part of the Mexican identity viewed through its national folk costumes. Closing out the day comes the bargain hunting as the group moves with an exceptional guided shopping tour of Cancun, to experience a fantastic world of folk art—a joyful expression of Mexico's rich cultural arts.

Seminar sponsorship

Seminar sponsorships are still available in the following categories: Wright Brothers Sponsor, $100-2,500; Bronze Sponsor, $2,500; Silver Sponsor $5,000; Gold $7,500; and Platinum/Co-host $20,000. Organizations wishing to become sponsors may contact Ron Schleede, Sponsorship chair, at 703-455-3766 or e-mail: ronschleede@cox.net or ronscheelde@aol.com. ISASI is an IRS 501(c)(3)(US) qualified entry. Full details regarding sponsorship opportunities are also available on the seminar website.

Optional day tour

It is customary to celebrate the end of the 3-day seminar with an optional full-day tour that allows the program attendees some time to relieve the rigors of sitting and listening as they have during their attendance. For 2006, seminar planners have selected a tour that will take visitors to the most vis-

ISASI 2006

"Incidents to Accidents: Breaking the Chain"

Sept. 11–14, 2006 • Cancun, Mexico

REGISTRATION FORM

Please complete this registration form (one for each delegate). Please type or print clearly.

☐Mr. ☐Mrs. ☐Ms. Member Number ____________________

First Name ____________ Middle Initial ____________ Last Name ____________

Badge Name ____________ Title ____________

Mailing Address ____________

Address ____________

City ____________ State or Province ____________

Zip/Postal Code ____________ Country ____________

Telephone: Residential ____________ Business ____________ Fax ____________

Cell ____________ E-mail ____________

Companion's Name ____________ E-mail ____________

PLEASE NOTE ALL FEES ARE TO BE PAID IN U.S. DOLLARS

Full Seminar and Function Program—Please Check All Appropriate Boxes	**Before August 15**	**After August 15**
☐ISASI Member	$520	$570
☐Non-Member	$565	$605
☐ISASI Student Member	$200	$225
☐Day Pass ☐Tuesday ☐Wednesday ☐Thursday	$200	$250
☐Tutorial Student	$ 75	$100
☐Tutorial	$125	$150
☐Companion Program (Per Person)	$320	$350
☐Tuesday Fun Night Only (Included in Full Registration)	$100	
☐Banquet Only (Included in Full Registration)	$100	
Will You Be Attending the Banquet on Thursday: ☐Yes ☐No		
☐Optional Friday Tour (Per Person)	$100	
☐Special Meal Request **TOTAL AMOUNT REMITTED $**____________		

☐Tutorial #1 Safety Management System: The Investigative Challenge
☐Tutorial #2 Technical Investigation—AAIB U.K.

PAYMENT OPTIONS—PLEASE CHECK ONE

☐**Credit Card:** ☐Visa ☐MasterCard ☐American Express Name as it appears on card ____________

Card Number ____________

Card Code (three-digit number on back of Visa/MasterCard, on front of American Express card)____________

Expiration Date____________ ☐Corporate ☐Individual

☐**Check/Money Order**—Mail to: ISASI, 107 E. Holly Avenue, Sterling, VA 20164, USA

☐**Wire Transfer** (funds must arrive two weeks before seminar begins)*

☐**Invoice** (funds must arrive two weeks before seminar begins)*

*Contact Ann Schull: Business Telephone 1 (703) 430-9668; Fax 1 (703) 430-4970; E-mail isasi@erols.com

Cancellations made before July 15, 2006, will incur a $10 fee. Cancellations made between July 16, 2006, to Aug. 15, 2006, will incur a $75 fee. There will be no refunds for cancellations after Aug. 16, 2006. Registrations are transferable.

ISASI 2006 Begins Registration

ited archaeological site in the peninsula of Yucatan, Chichen Itza. Known for its extraordinary architectural beauty, Chichen Itza was founded in 514 AD. When the Spaniards arrived to Chichen Itza, it had been abandoned as a consequence of the civil war fought with Mayapan.

The city is divided into two areas—Old Chichen, built between 600-900 AD, and New Chichen, constructed in the 10th century. The largest and most important element of the city is a pyramid-like structure called “El Castillo,” the Castle, with stairs ending in two large serpent heads. During the spring and fall equinox (March 21 and September 22), the sun casts shadows on the steps that create the illusion of a snake slithering down the face of the pyramid. Also very important are the observatory, the Temples of the Warriors, the Thousand-Columns, the Tzompantli, the Akab Dzib, and the jaguar.

Those persons taking advantage of the tour will move in air-conditioned vehicles, with beverages and snacks on board. The group will have official tourism guides speaking both English and Spanish. Lunch will be served at the Palapa at Xay-Beh Hacienda, where typical regional dances will be performed.

About Cancun

Cancun, Mexico, a Caribbean resort community, is one of the leading premier tourist destinations worldwide with white sand beaches, beautiful turquoise Caribbean waters, and the remains of the ancient and mystifying Mayan culture.

Cancun’s International Airport is the second busiest airport in Mexico and was recently expanded on both the land and air sides to create an international air hub, serving regional, national, and international commercial and charter flights.

Visitors must present a completed immigration form (as distributed on the aircraft prior to landing), one for each passenger. The Immigration officer will provide a copy that must be kept as it has to be returned upon leaving the country. U.S. visitors must present an original ID with photograph with an original birth certificate or a valid passport. During the flight, visitors will also receive and need to fill out a Customs form (one per family). Following Immigration, passengers may retrieve their luggage and proceed to Customs to hand the form to the Customs agent. Inspection is lottery based with passengers pressing a button on the “traffic light,” which flashes a red or green light: green means “go,” red means “inspection.” Officials perform quick, courteous inspections.

Odds and ends

Semitropical temperatures in spring and summer range from 84° to 97°F with humidity of 80 to 100%. During winter, the temperature drops into low 80s daytime and high/mid 60s at night with low humidity. The highest temperatures occur during May, June, July, and August, and the rainy season takes place in September and October.

Official currency is the Mexican peso, although U.S. dollars are accepted everywhere. One dollar is approximately 11 Mexican pesos, with some variation according to the daily exchange rate. Money can be exchanged at the airport, hotels, banks, and exchange houses. Hotels generally exchange from dollars to pesos, not the other way around. ATM machines offer easy access to cash in pesos and menus are in both Spanish and English.

Buses and taxis are plentiful throughout the beaches and boulevards. Bus stops are sprinkled throughout the downtown and the hotel zone. Taxis fares are fixed. In the hotel zone, it depends on which zone you are traveling between, so ask the driver for the fare. Within the downtown area, the standard fare is 15 pesos.

International access **code** to Cancun is 52 (country code) 998 (area code). International access code to the Riviera Maya is 52 (country code) 984 (area code). When dialing from the U.S., please add 011 before dialing the international access code; for calls within Mexico add 01 and the area code.

Gratuities for good service at restaurants, hotels, attractions, etc., will be appreciated. For restaurant services, a 15% tip on top of the F&B consumption bill is customary; for the rest of the services, use your discretion.

Time zone in Cancun operates on a summer schedule (April to October) and another for the winter (November to March). According to the international time zones, Cancun is located -6 hours of the Greenwich Meridian Time. Domestic electric current is 110 volts, the same as in all of Mexico.

Most businesses and shops are open from 9:00 am to 10:00 pm, some close for lunch from 2:00 to 4:00 pm. Spanish is the official language in Mexico. The local people in the area also speak Maya. English is spoken almost everywhere, while other languages are also spoken, especially in the large hotels.

Cotton clothing and comfortable shoes are the choice of dress, as dress in Cancun are casual (jeans, Bermuda shorts, and sandals are accepted almost everywhere)—but there are some formal dining restaurants and chic nightspots that will require dressing up (no need for jacket or tie). However, seminar planners state that casual business attire is suitable for the seminar programs, jeans and shorts are not. ◆

VAT Exemption

Mexican law provides for a tax exemption for non-Mexican seminar organizers and attendees. In order to qualify for this 0% VAT on individual hotel rooms, all non-Mexican seminar attendees are required to pay for their hotel rooms with a credit card issued by a non-Mexican bank. It is also a requirement for all non-Mexican attendees to be able to provide proof of their visitor status. In order to do this, we ask that all non-Mexican attendees bring their passports—or other forms of official identification—with them to Mexico. When you check in, the hotel will take a photocopy of your ID as well as your Immigration document, and it will be kept in the hotel safe for inspection by government officials. If this is not done, ISASI will loose its tax-exempt status and each individual attendee will be charged 10% VAT on rooms. ISASI will also be charged 10% VAT on all food and beverages served during the seminar. We would appreciate your full cooperation with this hotel policy/procedure. ◆

REGISTRATION FORM
FIESTA AMERICANA GRAND CORAL BEACH, CANCUN
ISASI 2006 • SEPT. 11–15, 2006

NAME: ____________________

COMPANY: ____________________

ADDRESS: ____________________

____________________ **CITY/COUNTRY:** ____________________

TELEPHONE NUMBER: ____________________ **FAX NUMBER:** ____________________

E-MAIL ADDRESS: ____________________

ARRIVAL DATE AND TIME: ____________________

DEPARTURE DATE AND TIME: ____________________

NUMBER OF ROOMS: ____________________ **NUMBER OF PERSONS:** ____________________

Please send this registration form no later than Aug. 11, 2006, otherwise your reservation will be subject to availability.

ROOM RATE: Junior Suite Single or Double: $133—This rate includes a charge of $3 per day for housekeeping. There will also be a one-time charge of $5 for the bell staff added to your final bill, per person.

Above rate is in U.S. dollars, per room, per night, based on single or double occupancy, European plan (no meals included), plus 10% VAT tax and 2% city occupancy tax. There will be an additional US$35 charge for a third person in a room. Quad occupancy is not allowed.

FORM OF PAYMENT TO GUARANTEE ROOM: ☐CREDIT CARD ☐BANK TRANSFER

CREDIT CARD INFORMATION: ____________________

CREDIT CARD NUMBER: ____________________ **EXPIRATION DATE:** ____________________

BANK NAME: ____________________ **DATE OF ISSUE:** ____________________

Bank Account Under: **Promotora Caribe Cancun, S.Z. de C.V.**
Bank: BANAMEX
Account No. 9002954
Suc./Branch: 657
CABLE: 002691065790029549
Plaza Terramar Loc. 37 y 45 Hotel Zone, CP 77500
Cancun, Q. Roo, Mexico

Policies for Credit Card Payment:

Please include with your Registration Form a copy of your credit card and ID, both sides.
We accept only the following credit cards: American Express, Visa, MasterCard.

Policies for Bank Transfer:

Please include with your Registration Form a copy of your Bank Transfer or Deposit Slip.

Policies to Guarantee your Reservation:

This Reservation Form authorizes us to charge one night plus applicable taxes, upon receiving the form in order to guarantee the reservation as well as any cancellation or no-show charge plus any applicable taxes.

Cancellation Policies:

Cancellations made up to 8 days prior to arrival date will not have any penalty charges.
Rooms cancelled 7 days to 72 hours prior to arrival day will be charged two (2) nights plus any applicable taxes.
Cancellations after 72 hours prior to arrival will be charged for the entire stay plus any applicable taxes.
This amount will be applied directly to your credit card.

No-Show Policy:

In case of No Show, you will be charged for the entire stay plus any applicable taxes.
This amount will be applied directly to your credit card.

RESERVATION DEADLINE: Aug. 11, 2006

SIGNATURE: ____________________

NAME: ____________________

DATE: ____________________

Fiesta Americana Grand Coral Beach
Reservations Department
Tel: +52 (998) 881 3235
Fax: +52 (998) 881 3273
E-mail: res1facb@posadas.com

For any additional information about SPA, hotel restaurants, and amenities for any special occassion, etc., please contact our "Guest Recognition Coordinator" who will be more than glad to assist you at: gh1facb@posadas.com.

Election Nominations Closed April 1

The ISASI Nomination Committee has announced that the Call for Nominations for the Executive officers and councillor positions for the years 2007-2008 has closed. The positions to be filled are president, vice-president, secretary, treasurer, U.S. councillor, and international councillor.

All incumbents, except Keith Hagy, secretary, have expressed a willingness to serve another term and have been nominated. Other nominations include for secretary, Chris Baum, Manager of the Engineering and Air Safety Department, Air Line Pilots Association.

Present plans call for voting to be done through a computer on-line process. Details are being completed, and full instructions will be posted on the ISASI website. If members do not have access to a computer, they may request a paper ballot to be forwarded to them, and if they have not paid their membership dues as of April 30, 2006, they will not be able to participate in the ISASI 2006 election. ◆

NZSASI Learns about Composite Materials

The New Zealand Society conducted a very successful educational day on the use of composite materials in aviation, at Auckland on March 4. More than 60 persons attended the event, which began with excellent presentations by Air New Zealand Engineering Services (ANZES) design staff on composite fundamentals, damage assessment and repair technology, and some research results on damage mechanisms.

Dr. Roland Thevenin of Airbus Industrie and Dr. Dave Polland of Boeing Commercial Aircraft gave presentations on the evolution of composite material use, from secondary structure such as fairings through to present use in primary structure such as wings and fuselage. The day finished with a look at the development of local expertise for scientific support to the New Zealand Defence Force.

The day was a useful, cooperative exercise with ANZES and provided investigators with information on site safety at an accident involving composite materials and guidance on what to look for among the damage and what technical assistance can be given to investigations. ◆

Lederer Nominations Deadline June 30

The ISASI Awards Committee reminds readers that the nomination period for the 2006 Jerome F. Lederer Award is open until June 30.

The Society's Jerome F. Lederer Award recognizes outstanding contributions to technical excellence in accident investigation and is presented each year during the annual seminar in recognition of positive advancements in the art and science of air safety investigation.

Committee Chairman Gale Braden urges members to nominate a person (or persons) who "you believe deserves consideration for this Award."

The nomination process allows any member of ISASI to submit a nomination. The nominee may be an individual, a group of individuals, or an organization. The nominee is not required to be an ISASI member. The nomination may be for a single event, a series of events, or a lifetime of achievement. The ISASI Awards Committee considers such traits as duration and persistence, standing among peers, manner and techniques of operating, and, of course, achievements. Once nominated, a nominee is considered for the next 3 years and then dropped. After an intervening year, the candidate may be nominated for another 3-year period. The nomination letter for the Lederer Award should be limited to a single page.

This Award is one of the most significant honors an accident investigator can receive; therefore, considerable care is given in determining the recipient. ISASI members should thoughtfully review their association with professional investigators and submit a nomination when they identify someone who has been outstanding in increasing the technical quality of accident investigation.

Nominations should be mailed to the ISASI office or directly to the Awards Committee Chairman, Gale Braden, 2413 Brixton Road, Edmond, OK 73034 USA or e-mailed to galebraden@cox.net. ◆

In Memorium

ISASI Life Member, Capt. Robert A. Patterson (LM0668), passed away in January 2006 after a long-term illness. He was extremely active in Society work and was the long-time ISASI librarian, instituting new methods of maintaining what was then a voluminous library of accident case files, statistical data, safety journals, and ISASI-produced safety reports and products. The ISASI Council honored him by naming the library in his name and adorning its door with a bronze plaque that proclaimed it the ISASI Robert A. Patterson Library. It was dedicated on April 27, 2001, and still fills a place of honor on the wall of ISASI headquarters.

He began his flying career with Capital Airlines in 1953, eventually attaining his captaincy with United Airlines, from which he retired. He joined ISASI in December 1973 and was granted Life Membership in 1996. He is survived by his wife of 58 years, Kathryn Elizabeth (Tepe) Patterson. ◆

2005 Annual Seminar Proceedings Now Available

Active members in good standing and corporate members may acquire, on a no-fee basis, a copy of the *Proceedings of the 36th International Semina*r, held in Fort Worth, Tex., Sept. 12-15, 2005, by downloading the information from the appropriate section of the ISASI web page at http://www.isasi.org. The seminar papers can be found in the "Members" section. Alternatively, active members may purchase the *Proceedings* on a CD-ROM for the nominal fee of US$15, which covers postage and handling. Non-ISASI members may acquire the CD-ROM for a US$75 fee. A limited number of paper copies of *Proceedings 2005* are available at a cost of US$150. Checks should accompany the request and be made payable to ISASI. Mail to ISASI, 107 E. Holly Ave., Suite 11, Sterling, VA USA 20164-5405.

Speakers and Technical Papers Presented at ISASI 2005

(Listing is in order of presentation, by paper title and author.)

TUESDAY—*Topic: Recent Investigations*

Kam Air Flight 904—Investigation Challenges in Kabul and on Chaperi Ghar *By Robert Benzon, Investigator-in-Charge, U.S. NTSB*

Accident, Serious Incident, and Incident Investigations: Different Approaches, the Same Objective *By Stéphane Corcos and Pierre Jouniaux, BEA, France*

Removing Pilot Errors Beyond Reason! Turning Probable Causes into Plausible Solutions *By Dr. Robert O. Besco, President, PPI; Capt. (Ret.), American Airlines*

Performance and Flight Dynamics Analysis of the Flight in Ice Accretion *Presented by Wen-Lin Guan, Aviation Safety Council, Taiwan, R.O.C.*

Are the ACAS/TCAS Safety Improvements Sufficient? *By Johann Reuss, Federal Bureau of Aircraft Accidents Investigation, Germany*

***Panel 1: Industry Flight Safety Information Sharing Activities** *Jim Ballough, AFS-1, U.S. FAA; Michelle Harper, University of Texas; Capt. Terry McVenes, Executive Central Air Safety Chairman, ALPA; Dr. Steve Predmore, JetBlue Airlines; Tom O'Kane, FRAeS; Jill Sladen-Pilon, IATA*

WEDNESDAY—*Topic: Data Analysis*

Flight Data Analysis—A New Approach *By Dieter Reisinger, Quality Manager Flight Operations, Austrian Airlines, Vienna, Austria; Simone Sporer, Psychologist, FH Joanneum/University of Applied Sciences, Department of Aviation, Graz, Austria; and Gernot Knoll, Electronic and Communication Engineer, FH Joanneum/University of Applied Sciences, Department of Aviation, Graz, Austria*

A Case-Based Reasoning (CBR) Approach for Accident Scenario Knowledge Management *By James T. Luxhøj and Ahmet Oztekin, Department of Industrial and Systems Engineering, Rutgers, the State University of New Jersey*

Airline Flight Data Analysis (FDA)—The Next Generation *By Michael R. Poole, P. Eng., Managing Partner, Flightscape, and David Mawdsley, CEng, FRAeS, Director-Safety, Safety, Operations and Infrastructure, IATA*

Investigation of Causes of Engine Surge Based on Data in Flight Operations Quality Assurance Program *By C. Edward Lan, University of Kansas, and Capt. Samson Y.C. Yeh, Vice-President, Safety, Security, and Compliance Division, China Airlines*

Practical Human Factors in the Investigation of 'Daily Events' *By Paul Jansonious, Standards Pilot, West Jet, and Elaine Parker, North Cariboo Air, Canada*

Safety Incident Classification Systems—Made Redundant by Text Mining Tools? *By Tom O'Kane, FRAeS, Aviation Safety Advisor*

Update: Finding Wreckage Under Water *By John Fish, American Underwater Search and Survey, and John Purvis, Safety Service International*

Similarities and Differences in the Characteristics of Fatal General Aviation Accidents in Several Countries *By Robert Matthews, Ph.D., U.S. FAA*

Wet (?) Runway Operations *By A. Ranganathan, Capt., SpiceJet, India*

Turbulence Forecasting, Detection, and Reporting Technologies: Safety and Operational Benefits *By Christian Amaral, Delta Air Lines*

***Panel 2—Post-Accident/Incident Stress Management Guidance for the Investigator** *Brenda Tillman, Readiness Group International, and Mary Cotter, Air Accident Investigation Unit, Ireland*

THURSDAY—*Topic: Human Factors and Safety* Management/Investigative Techniques

Total Safety Management for Aircraft Maintenance Using Total Quality Management Approach *By Derrick Tang, Advent Management Consulting, Singapore*

Maintenance Error Prediction Modeling *By Howard Leach, MRAeS, British Airways, England*

System Identification Techniques Applied to Aircraft Accident Investigation *Presented by Donizeti de Andrade, Ph.D., ITA, Brasil*

Runway Awareness and Advisory System (RAAS) *By Jody M. Todd, Capt., Honeywell Aerospace Electronic Systems*

Rotor Seizure Effects *By Al Weaver, Senior Fellow Emeritus, Gas Turbine Investigations*

3-D Photogrammetric Reconstruction in Aircraft Accident Investigation *By Michiel Schuurman, Investigator, Dutch Safety Board, the Netherlands*

Do You Smell Smoke? Issues in the Design and Content of Checklists for Smoke, Fire, and Fumes *By Barbara Burian, Ph.D., SJSUF, NASA Ames*

Selecting the Next Generation of Investigators *By Keith McGuire, U.S. NTSB*

Applying Human Performance Lessons to Smaller Operators *By Kathy Abbott, Ph.D., FRAeS, Chief Scientific and Technical Advisor, U.S. FAA*

Bringing Proactive Safety Methods and Tools to Smaller Operators *By John Cox, Capt., FRAeS, Safety Operating Systems*

The Use of Operational Risk Management in the Royal Netherlands Air Force Applied to Apache Helicopter Operations in Afghanistan *By Rombout Wever, NLR, the Netherlands*

The Unified Field Theory *By Michael Huhn, ALPA, and Mark Solper, Chairman, ALPA Accident Investigation Board*

GAIN Contribution to an Airline Safety Management System *By Mohammed Aziz, Ph.D., Advisor to Chairman, Middle Eastern Airlines*

An Analysis of Flight Crew Response to System Failures *By A.L.C. Roelen, and Rombout Wever, National Aerospace Laboratory NLR, the Netherlands*

Boeing Runway Track Analysis *By Mark Smith, Boeing*

AZSASI June Seminar Registration Still Open

The 2006 annual seminar of the Australian and New Zealand Societies of Air Safety Investigators to be held June 2-4 at the Hilton on the Park Hotel, Melbourne, Australia, is still open. This seminar will be an educational event with emphasis on contemporary regional issues in aircraft accident investigation and prevention. The Asia-Pacific Cabin Safety Working Group is expected to meet on Friday, June 2, and there will be a visit to the Defence Science and Technology Organization at Fishermen's Bend on the Friday afternoon.

Registration for the seminar can be made by completing the registration form found at http://www.asasi.org. Full seminar details may also be obtained at the seminar website. ◆

Rudy Kapustin Scholarship Recipient Seeks Tips

Noelle Brunelle (ST1941), ISASI's 2003 Rudy Kapustin Scholarship recipient, is seeking "tinkicker" tips in the form of teaching tales and published short articles that will be compiled and used in a "student" program that will be conducted during ISASI 2006 in Cancun, Mexico.

Brunelle is gainfully employed, participating in crew station and cabin design for a rotary-wing manufacturer. She explains her reasons for becoming involved in a "teaching" role: "A turning point for me on my journey to this career was winning the scholarship and attending the ISASI seminar. I met many great people who took the time to both share their experiences with me and encourage me when I needed it. In gratitude for the opportunities ISASI provided me, I would like to begin to give something back.

"This year, I have volunteered to coordinate a student program for the seminar in Cancun. The goal is not to provide separate activities for the students, but rather to incorporate aspects of what I received on a one-to-one basis into the overall student experience. One aspect that I found invaluable was similar to the 'hangar flying' I received during flight training. Investigators would share tales from the field to help me better understand the craft. [Students can take classes or study books on techniques and read the final reports, but often there is little information on what really happens at the accident site.] *Flying* magazine has a series called 'I Learned About Flying From That.' In these articles, pilots teach tales to other pilots, pointing out potential traps, or offering helpful techniques. I and other students have often wished there was something similar for accident investigation."

So, this year she plans to offer students at the seminar a compilation of short articles and teaching tales from the field. She asks, "If you have a story to share, or would be interested in helping me with this project, please contact me at (386) 383-0953 or brunnoe@earthlink.net." ◆

New Members

CORPORATE

Accident Investigation & Prevention Bureau, CP0240
- Mr. Angus I. Ozoka
- Mr. Remi Faminu

Alitalia Airlines-Flight Safety Dept., CP0244
- Capt. Ledda Angelo

Colegio De Pilotos Aviadores De Mexico, A. C., CP0241
- Mr. Salvador Lizana
- Mr. Eric Mayett

Directorate of Aircraft Accident Investigations-Namibia, CP0236
- Mr. Mwangi C. wa Kamau
- Mr. Ananias N. Shivute

European Aviation Safety Agency, CP0238
- Mr. John W. Vincent
- Mr. Alain Leroy

Flight Attendant Training Institute at Melville College, CP0237
- Mr. Dennis E. Adonis
- Mr. ODell S. Patterson

Hellenic Air Accident Investigation & Aviation Safety Board, CP0239
- Mr. Akrivos D. Tsolakis
- Dr. Nikos S. Pouliezos

Qwila Air (Pty) Ltd., CP0243
- Mr. Bernie Robertson
- Ms. Bianca Lovell

Skyservice Airlines Ltd., CP0242
- Mr. Savik Ramkey
- Mr. J. Jeffrey Oliver

INDIVIDUAL

Abraham, Abe, M., FO5220, London, UK
Adams, Pamela, M., FO5249, Cromwell, New Zealand
Alber, Joshua, B., ST5181, Daytona Beach, FL, USA
Anderson, Kent, H., FO5205, Apple Valley, CA, USA
Armstrong, Robert, C., MO5190, Ocean Reef, WA, Australia
Avgoustis, Jimmy, AO5178, Laval, QC, CANADA
Bledsoe, Ruth Ann, FO5174, Eagle River, AK, USA
Boss, Molly, C., AO5238, Oshkosh, WI, USA
Boucher, Brian, G., MO5224, Port Orange, FL, USA
Brown, Jr., Edward, B., MO5241, Hanscom AFB, MA, USA
Carter, Harold, E., AO5230, Wellington, New Zealand
Choinski, Pawel, ST5215, Brooklyn, NY, USA
Coppin, Allan, O5165, O'Connor, ACT, Australia
Costa, Marcus, A., MO5172, Montreal, QC, Canada
Cunningham, Lindsay, B., AO5207, Arlington, TX, USA
David, Ron, M., FO5223, Thunder Bay, ON, Canada
DeLashmutt, Morgan, ST5244, Ormond Beach, FL, USA
Dozier, Bud, AO5169, Richmond Heights, OH, USA
Dukes, Jason, B., ST5195, Lexington, SC, USA
Egeler, Jonathan, A., AO5183, Elizabethton, TN, USA
Faminu, Remi, MO5170, Ikeja, Nigeria
Feller, Herb, J., MO5222, Toronto, ON, Canada
Fetter, Stanley, B., FO5242, Accokeek, MD, USA
Fidler, James, E., MO5243, Melbourne, FL, USA
Fitzpatrick, Mark, B., AO5191, Cobourg, ON, Canada
Frank, Keith, N., ST5213, Prescott, AZ, USA
Frias-Almonte, Pablo, A., ST5198, Port Orange, FL, USA
Gregoire, Joan, M., ST5196, Prescott, AZ, USA
Grenier, Marc, MO5201, Blainville, QC, Canada
Harding, MBBS, Noel, P., FO5180, Brisbane, OLD, Australia
Hawkins, Stuart, J., MO5216, Salisbury, UK
Hernandez, Becca, R., ST5212, Fontana, CA, USA
Jones, Gregory, W., MO5254, Seattle, WA, USA
Keck, Derek, J., MO5253, Altus, OK, USA
Keenan, David, O., MO5177, Manassas, VA, USA
Kim, Hamish, J., AO5247, RDI Rangiora, New Zealand
Kim, Hyun-Ji, ST5229, Daytona Beach, FL, USA
Kim, Kahyun, S., ST5257, Daytona Beach, FL, USA
King, James, D., MO5228, Newnan, GA, USA
Kirker, Peter, J., AO5250, Wellington, New Zealand
Kittel, Edward, C., MO5227, Washington, DC, USA
Kluk, Joseph, R., MO5168, Albuquerque, NM, USA
Lai, Benjamin Yat Kam, ST5262, Carlingford, NSW, Australia
Laska, Lewis, L., FO5226, Nashville, TN, USA
Lee, Pil Moon, MO5248, Seoul, KOREA
Leech, Pauline, FO5234, Greytown, New Zealand
Lemay, Michael, T., ST5225, Verdun, QUE, Canada
Li, Wen-Chin, ST5233, Cranfield, UK
Liarakos, Thanos, N., FO5232, Mt. Sterling, OH, USA
Liddy, Graham, J., MO5251, Dublin 15, Ireland
Martinez, Rodney, M., ST5204, Daytona Beach, FL, USA
Meikle, Douglas, A., ST5237, Kirtland AFB, NM, USA
Mohelnitzky, Mark, J., AO5235, Kerikeri, BOI, New Zealand
Morey, Douglas, G., AO5211, Nairobi, Kenya
Muzio, David, S., MO5166, Ashburn, VA, USA
Naja, Walid, ST5240, Beirut, Lebanon
Naphas, Jay, T., ST5245, Prescott Valley, AZ, USA
Navaratnam, Suresh, MO5202, Singapore, Singapore
Negroni, Christine, FO5208, Old Greenwich, CT, USA
Nielsen, Flemming, B., MO5209, DK-4600 Koege, Denmark
Nikou, Lambros, FO5188, Athens, Greece
Olmsted, Fred, S., AO5189, Germantown, TN, USA
Ozoka, Angus, I., MO5171, Garki Abuja, Nigeria
Palcho, Kris, A., MO5210, Kent, OH, USA
Paluszak, Douglas, J., ST5182, Lancaster, NY, USA
Pennetta, Vincenzo, MO5218, Rome, Italy
Perin, Jeffrey, S., ST5193, Bloomington, IN, USA
Quevedo, Rodolfo, J., AO5192, New Milford, NJ, USA
Randell, Douglas, C., AO5179, Salisbury South, SA, Australia
Reilman, Robert , F., AO5175, USAFA, CO, USA
Ringuet, Francois, MO5256, Montreal, Canada
Ross, Nick, J., ST5231, Leicester, England
Russell, John, D., AO5261, Helena, MT, USA
Saini, Kelly, AO5186, Athens, Greece
Salivia, Rick, AO5176, The Woodlands, TX, USA
Santos, Alfredo, A., MO5258, Charneca Da Caparica, Portugal
Schneidmiller, Gene, D., MO5219, Calgary, AB, Canada
Seykora, Dorothy, V., ST5185, Arlington, TX, USA
Shepherd, Roger, ST5239, Rotorua, New Zealand
Slane, Jean, H., MO5217, Colorado Springs, CO, USA
Sleight, Philip, A., MO5252, Woking, Surrey, UK
Smith, Mark, H., MO5167, Vashon Island, WA, USA
Smyth, Niall, T5255, Birr, Ireland
Soukeras, Dimitrios, V., AO5187, Athens, Greece
Stillson, Christopher, M., ST5199, Prescott, AZ, USA
Straker, Darren, AO5246, 31707 Blagnac Cedex, France
Stuart, Brian, R., FO5173, Lawton, OK, USA
Sydiongco, Jim, MO5194, Alabang, Muntinlupa, Philippines
Teixeira, Matthew, A., ST5260, Prescott, AZ, USA
Teplik, Thomas, J., MO5200, Wichita, KS, USA
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A380 Evacuation Test Is Approved

European and U.S. air safety authorities have approved the March 26 evacuation test of the Airbus A380 super-jumbo. Approval from the European Aviation and Safety Agency and the U.S. Federal Aviation Administration confirms the plane's maximum 853-person capacity.

During the A380's evacuation test in Germany, one man broke his leg and another 32 people had minor injuries. To date, 159 of the twin-deck planes have been ordered by 16 airlines. Under the evacuation test, 853 volunteer "passengers" and 20 crewmembers left the aircraft within 78 seconds. The evacuation drill required that

- 853 passengers and 20 crew take part,
- lights were out in the cabin,
- debris was strewn across the cabin,
- half of the exits were closed,
- passengers were not told which exits were in use,
- passengers had to wear their seat belts,
- evacuation took 80 seconds, and
- drill had to feature at least 40% women and 35% people over 50.

According to the set regulations, the test was performed in complete darkness, using only half of the 16 exists on the A380. Charles Champion, head of the A380 program at Airbus, said the approval of the test was a "major milestone" on the plane's way to gaining its certification for public use.

To make the drill as realistic as possible, the volunteers represented a broad cross-section of the population in terms of age and sex. About 40% of those taking part were women, while 35% had to be over the age of 50. Three life-size dolls were carried on board to represent children under 2 years old.

Discovery Channel has created an episode in which the *MythBusters* explore the quirks of a general aviation accident that left a Piper Seminole with a uniquely shredded fuselage.

The first A380s are due to go into service with Singapore Airlines at the end of this year. ◆

HK Develops Pioneering Air Safety System

The Hong Kong Observatory reports that it has developed the world's first LIDAR windshear alert system to scan runway flightpaths and provide minute-to-minute warnings to aircraft landing and taking off.

The observatory's Assistant Director Wai Hon-Gor said it is the world's first operational system applying laser technology in airport windshear detection. The observatory is one of the world's leading pioneers in the application of remote sensing technology to windshear alerting at airports.

A LIDAR measures the wind by transmitting infrared light pulses and receiving the reflected light from dust particles in the air. The alerting system scans the landing and takeoff flightpaths with a laser beam to measure the winds ahead of the aircraft. When it detects windshear, it sends radio transmission alerts to pilots. ◆

MythBusters Tackle Strange Airplane Accident

The television show *MythBusters*, an Australian-American production for the Discovery Channel, has created an episode in which the *MythBusters* explore the quirks of a general aviation accident that left a Piper Seminole with a uniquely shredded fuselage.

ISASI Forum first covered the accident by placing a picture of the wreckage (above) on the cover of the July-September 2003 issue. Accompanying the picture was a request for readers to submit information regarding the then-mysterious accident.

According to responses by ISASI members David Adkins (MO4479), Andrew Simmonds (AO4893), and Jack Parnell (LM2680) and by *Forum* readers John Griffiths, Philip Smith, and Norman Hogwood, the accident began when the owner of a Piper Saratoga attempted to hand start his aircraft after discovering the plane's battery was dead. Once started, the pilotless aircraft taxied freely until impacting and shredding the fuselage of the now-famous Piper Seminole.

ISASI member Joe Rakow (AO4926) of Exponent Failure Analysis Associates appears on the *MythBusters* episode, entitled "Shredded Airplane," which will be rerun throughout the year. Check the *MythBusters* website, http://dsc.discovery. com/fansites/mythbusters/mythbusters. html, and your local listings for show times. ◆

President's View *(from page 4)*

flight attendants now can be expected to assert themselves and take charge in the cabin. Yes, that was always true to a degree in the past, but the degree has changed. By now, most people fully recognize that a flight attendant who can organize people during an emergency, who can manage a panicked group of passengers, and who ultimately can get those people out of an airplane quickly and safely is worth his or her weight in gold.

Still other changes are under way. Today, most investigations of major accidents include formal cabin safety teams. That would have been unheard of not so long ago. The International Society of Air Safety Investigators (ISASI) now has a Cabin Safety Working Group, which recently developed a first-class set of guidelines for on-scene investigators participating in cabin safety teams. Such participation would have been beyond the realm of reality just 10 or 15 years ago.

Over the past several years, through the Commercial Aviation Safety Team (CAST), the FAA, and the entire aviation industry—including flight attendant unions, pilot unions, manufacturers, U.S. airlines, foreign airlines and foreign civil aviation authorities—jointly analyzed nearly 200 turbulence accidents and incidents. Unlike most such studies, the sponsoring organizations agreed in advance to develop implementation plans for recommendations that met with consensus, and then to jointly establish a system to monitor implementation.

The study found that more than 95 percent of all serious injuries in turbulence could be avoided if people were simply seated and properly belted. All but a handful of passengers who were seriously hurt over an 18-year study period were found to be out of their seats or seated, but not secured. Many passenger injuries, in fact, involved people who simply ignored warnings to be seated. Instead they insisted on waiting in line to use a toilet or insisted on simply remaining out of their seats for no particularly good reason. That no longer is tolerated, as it once was.

The study also found that flight attendants accounted for a hugely disproportionate share of serious injuries in turbulence; they, too, needed to be seated and secured. For example, the data at that time indicated that flight attendants accounted for just 4 percent of people on board, but accounted for over half of all serious injuries in turbulence. Clearly, the nature of cabin attendants' duties put them at inherently more risk, but the nature of the job did not explain this huge disparity.

Instead, the study found that the failure to follow procedures and the absence of procedures in many cases were the most common causes of turbulence injuries. Since this study was completed, numerous airlines have implemented relatively simple and inexpensive changes that have proven effective in reducing injuries. These changes include clearly stated warnings from the cockpit when turbulence was anticipated, clear statements to cabin crew when they needed to be seated, emphasis on the need for cabin crew to ensure their own safety and to get themselves seated and secured, clear statements to cabin crew when the risk appeared to be over.

The team also provided more evidence of additional safety benefits to improving onboard weather, the need to focus on galley designs, and the need to educate both flight crews and cabin crews on the risks that turbulence poses. For example, in aircraft with engines hung from the tail, conditions might seem just fine in the cockpit while the tail section of the aircraft is getting hammered in turbulence.

Most pilots did not recognize this. Some pilots also still needed to be educated on the risk of turbulence when flying around but near active weather cells. Similarly, some flight attendants needed to be educated on the risks they assume when moving about the cabin even in very low-G turbulence events. Finally, some airlines had to be educated on just how much turbulence was costing them in sick days due to minor injuries, plus indirect costs such as delayed or cancelled flights.

The FAA followed this study with a public awareness effort, via radio and print, and issued an advisory circular to identify best practices. Some of the recommendations of the team and of the advisory circular have yet to be formally endorsed, but most, in fact, have been implemented.

In short, I think the FAA can rightly claim that it takes cabin safety seriously, whether it involves turbulence or other issues. I think, too, that the FAA can rightly claim that it has been among the most active regulatory authorities to ensure improvements in cabin safety.

Broader behavioral changes also have occurred. If 9-11 made no other point to passengers, they now understand that flight attendants are important to their own personal safety. They also understand that extreme misbehavior by other passengers should not be tolerated. Things have changed!

What does all this really mean?

Have we seen the latest significant paybacks of these safety enhancements? A recent accident involving an Airbus 340 in Montreal can best describe the results of years of safety improvements. This aircraft had the latest safety improvements installed. Despite the aircraft skidding off the end of the runway and bursting into flames, 297 passengers and 12 crewmembers escaped with no life-threatening injuries. Without the safety improvements and a professional, well-trained, and qualified cabin crew, I have no doubt that fatalities would have resulted.

Yet, as I suggested earlier, I recognize all too well that we still have some way to go in cabin safety. At the ISASI seminar in Alaska in 1997, the Cabin Safety Working Group identified a need for an accident investigation class for cabin safety people. Approximately a year later the FAA initiated the class through the Transportation Safety Institute at Oklahoma City.

As time goes on, new issues will emerge in cabin safety. Consider the challenges in evacuating an A380 during an emergency. In fact, Airbus and the DGAC of France are conducting evacuation tests next month in Toulouse. [The evacuation test was conducted on March 27].

Cabin attendants deserve much of the credit for these positive changes that have become much more active and more visible in public debate about aviation safety issues. Today, cabin safety is understood to be a discrete safety discipline that demands technical skills and professional respect. ◆

Ludwig Brenner *(from page 15)*

once you start to understand why people are doing things, you start to see what's going wrong. Back then, firefighters were using the same paradigm for hazmat incidents as they were for structural firefighting, and it wasn't working. All I did was show them how to look at the situation a little differently [by using the DECIDE model] and appreciate the differences between a firefighting mindset and a hazmat mindset. Hazmat incidents can't be handled with a cookbook approach, and I'm not a believer of teaching cookbook-type hazmat training—you have to use your head." ◆

(The full source document on the DECIDE process, and many other writings by Ludwig Benner, can be found on the web at http://members.cox.net/lbjr99/papershm/DECIDE.htm.)

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AeroVeritas—Facilitating the Highest Standards of Aviation Safety

(Who's Who is a brief profile of, and prepared by, the represented corporate member organization to enable a more thorough understanding of the organization's role and function.—Editor)

AeroVeritas is proud and honored to join the distinguished ranks of ISASI corporate membership. Based in the Bay of Islands, New Zealand, AeroVeritas is an independent aviation consulting organization that draws on the training and experience of its President, Mark Mohelnitzky, a former Federal Aviation Administration Principal Airworthiness Inspector.

AeroVeritas provides aviation safety consultation, advisement, and investigative support services, concentrating on regulatory requirements for aircraft airworthiness, maintenance, engineering, and repair. Within the aircraft airworthiness field, AeroVeritas specializes in FAA repair station certification, quality assurance auditing/evaluation, manual and procedural development, independent accident investigation, litigation support, and regulatory training services.

Mark Mohelnitzky provides AeroVeritas clients a unique combination of extensive industry knowledge, FAA inspector experience, and supervisory training. After 25 years, Mark's aviation background is as diverse as it is well-rounded. He began his aviation career maintaining various general aviation aircraft at repair stations in Phoenix, Ariz., U.S.A. He then advanced to hold senior maintenance and program management positions with U.S. air carrier America West Airlines. While employed by America West, his diverse and expanded responsibilities consisted of senior maintenance technician, technical training instructor (B-737, B-757, B-747), maintenance program developer/technical writer, and manager of the air carrier's Boeing and Airbus minimum equipment list (MEL) program department.

He also represented America West in such organizations as the Air Transport Association (ATA) and the FAA Flight Operations Evaluation Boards (FOEBs), as well as an assignment to a combined human factors research project with Boeing, NASA, and Sandia Laboratories as participants. This early research assisted in developing modern human factors tools for aviation maintenance.

AeroVeritas clients benefit from Mark Mohelnitzky's training and experience as

AeroVeritas

a Principal Airworthiness Inspector for the FAA Flight Standards Service. While serving in the FAA Scottsdale, Ariz., Flight Standards District Office, he was responsible for certification, surveillance, inspection, and enforcement activities.

As a graduate of the FAA's Scottsdale Flight Standards District Office Supervisor Development Program, he contributes his personnel management skills as well as his understanding of the FAA's management philosophy to AeroVeritas customers. In addition, his experience in airline maintenance made him a logical choice for assignment to the office's large (heavy maintenance) repair station certificate holders, including key assignments to the Phoenix, Ariz., FAA Certificate Management Office (CMO) in support of FAR Part 121 air carrier operations.

AeroVeritas investigative services are based on Mark Mohelnitzky's experience within the FAA Scottsdale office's busy district where he served as the Investigator-in-Charge (IIC) for all types of incidents and accidents involving private, commercial, aerial application, and flight training operations.

Following one such investigation in 2000 related to the inflight wing separation of an Air Tractor AT-502, Mark was responsible for the issuance of an emergency airworthiness directive (AD) for an apparent defect in wing center section design. He was subsequently presented the FAA's Aviation Safety Award for his "outstanding contribution to aviation safety" through the Safety Recommendation Program. The Award was presented in person by the current ISASI President and FAA Manager Frank Del Gandio.

Competency in coordinating and advising technical groups, managing complex regulatory projects, and providing investigative support are the strengths behind AeroVeritas capabilities. To meet the needs of a worldwide clientele, AeroVeritas is achieving its goal of promoting and facilitating the highest possible standards of aviation safety.

Further information may be obtained by contacting AeroVeritas, Aviation Safety Consulting Limited, P.O. Box 474, Kerikeri, Bay of Islands, New Zealand or by e-mail at aeroveritas@xtra.co.nz or at website www.aeroveritas.com. ◆

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