# ISASI FORUM

"Air Safety Through Investigation"

JANUARY–MARCH 2010

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## ABOUT THE COVER

A very typical excursion accident: i.e., unstable approach, land long and fast, then engine issues happen. Narrative: Boeing 747-F-GITA operated Flight AF072, Paris-Los Angeles-Tahiti. Weather on Sept. 12, 1993, was good when the flight approached Tahiti, French Polynesia, at night. The aircraft positioned for a Runway 22 VOR-DME approach. At 21:05 the aircraft touched down at a speed of 168 knots. Two seconds later, No. 1 engine power increased to 107% N1. Because of this, the spoilers did not deploy and the automatic brake disarmed. Reverse thrust was used on all remaining engines. Because of difficulties due to thrust asymmetry, the No. 4 engine thrust reverser was cancelled. The aircraft overran the runway and ended up in a lagoon.


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"Air Safety Through Investigation"

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AIR SAFETY INVESTIGATORS
INCORPORATED AUGUST 31, 1964

# Looking Back and Ahead

By Frank Del Gandio, ISASI President

On this page of the January–March 2000 issue of the *Forum,* I wrote of what "we might face in the coming decade." Today, I look back at some of those thoughts and let you judge their germaneness. Also, I pen a few thoughts on our Society's present status and its future well-being.

"A new millennium," I wrote, "tempts us to speak of unimaginable levels of aviation safety…[but] accidents will not become a thing of the past." I noted that we, as investigators, would encounter new as well as some of the usual suspects: "…controlled aircraft flying into high terrain or into level ground, approach and landing accidents, poor communication between crewmembers or between pilots and ATC, judgment mistakes by pilots, maintenance issues, and small errors of omission or commission that invite other small errors and eventually the crew is behind the airplane and never catches up."

I also noted, "We also will face new challenges or issues that, at most, are only emerging today. For example, as aircraft become ever more automated and integrated, intellectually there is a loss in the understanding of how all systems in an aircraft interact…. Other challenges…include the need to strike a balance with the rapid advances in media technology that speeds reporting…. We need a working understanding with the press.…Yet, we must ensure the continued integrity of complete and thorough investigations…."

Lastly, I wrote "We can also expect more direct and instant involvement by national political officials in many countries…. The political pressures that news media coverage creates for visible public officials suggest that the political complexity of air safety investigation may accelerate even faster than the technical and organizational complexity."

Now let me turn to Society matters of today and the future. We have become a much more viable professional society in the past 10 years. Our international Reachout Workshop program has instructed more than 2,010 persons in 22 countries. We have become a voice in ICAO's AIG meetings. Our Kapustin Memorial Scholarship program has been highly successful. We have placed all our historical library records into a digital library managed by Embry-Riddle Aeronautical University, and most recently, we published and placed on our website a 30-page booklet titled *ISASI Guidelines for Investigation of Human Factors in Accidents or Incidents,* developed in concert with the Transport Safety Board of Canada. The booklet is designed as an aid for accident investigators-in-charge specifically on the subject of human factors. These advancements are but a few of the Society's accomplishments.

In the past decade, the Society placed itself on a firm membership and financial footing. At the close of 1999, our final fund balance (net worth) was $31,205. At the close of 2008, it was $168,512. The increase is greatly owed to the purchase of and mortgage pay off of the ISASI office condominium and to the great successes of the annual international seminars conducted by the Society.

However, not every year or every seminar is a financial success. The recent seminar in Orlando, Fla., is a case in point. It was, from the prospective of the delegates, highly successful. The papers presented were the best to date. This was attested to me by at least a half dozen delegates. The keynote speeches given by the Honorable Deborah Hersman, Chairman of the National Transportation Safety Board, and Paul-Louis Arslanian, Director of BEA, were well received and very appropriate. Disney's Coronado Springs Resort met all our needs, including lodging and food. Of course, almost everyone got to visit the main attraction, Disney World. ISASI was supplied with passes for the delegates to use at night. I received numerous accolades regarding the tutorials, which were attended by 135 delegates. The companion's tours were memorable, exciting, and informative and well-received by the attendees.

**As your president, I want you to know that your Society is financially solvent and that you, as a member, will not see any reduction in services or benefits.**

However, the financial aspects did not work out as well. Traditionally ISASI seminars generate funds in excess of expenses. It is this overage of funds that helps keep ISASI financially solvent. The Orlando seminar resulted in a loss of approximately $39,000. There were many contributing factors to this loss. The main factor was the economy. When the contract for the hotel was signed in March 2006, the economy was very robust and the anticipated attendance was higher than actually realized. The loss resulted from rooms not utilized and, of course, the food associated with the missing attendees.

That said, I want to assure you that ISASI will never be confronted with this situation again. We have taken initiatives to revise the seminar manual and other associated policies. Room guarantees will be realistic and reduced to levels below the anticipated attendees. The ISASI Executive Council has implemented a number of cost-saving measures to reduce our overall expenses for the next year. Additionally, I encourage each of you to assist in the recruitment and retention of potential and current corporate and individual members.

As your president, I want you to know that your Society is financially solvent and that you, as a member, will not see any reduction in services or benefits. My best wishes to you and yours for a very fruitful New Year. ◆

During the past 14, years the number of runway excursion accidents is more than 40 times the number

# Reducing the Risk of

By Jim Burin, Director of Technical Programs, Flight Safety Foundation.

*(This article is adapted with permission from the author's paper entitled* Reducing the Risk of Runway Excursions *presented at the ISASI 2009 seminar held in Orlando, Fla., Sept. 14-18, 2009, which carried the theme "Accident Prevention Beyond Investigations." The full presentation, including cited references to support the points made, can be found on the ISASI website at www.isasi.org.—Editor)*

The Flight Safety Foundation, at the request of several international aviation organizations, initiated the Runway Safety Initiative (RSI) project to address the challenge of runway safety. This was an international effort with participants representing the full spectrum of stakeholders from the aviation community. The effort initially reviewed the three areas of runway safety: runway incursions, runway confusion, and runway excursions. Ultimately, the RSI Group determined that it would be most effective to focus its efforts on reducing the risk of runway excursions. All data used in this document are taken from the RSI report *Flight Safety Foundation Reducing the Risk of Runway Excursions* (May 2009).

RSI defined a runway excursion as when an aircraft on the runway surface departs the end or the side of the runway surface. Runway excursions can occur on takeoff or on landing. They consist of two types of events: 1. A veer-off is a runway excursion in which an aircraft departs the side of a runway. 2. An overrun is a runway excursion in which an aircraft departs the end of a runway.

During the 14-year period from 1995-2008, commercial transport aircraft experienced a total of 1,429 accidents involving major or substantial damage (see Table 1). Of those, 431 accidents (30%) were runway related. The specific RSI focus on excursion accidents was driven by the fact that of the 431 runway-related accidents, 417, or 97%, were runway excursions.

The number of runway *excursion* accidents is more than 40 times the number of runway *incursion* accidents, and more than 100 times the number of runway *confusion* accidents (see Table 2). During the past 14 years, there has been an average of almost 30 runway excursion accidents per year for commercial aircraft, while runway incursion and confusion accidents combined have averaged one accident per year.

| Aircraft Type | Turbojet | | Turboprop | |
|---|---|---|---|---|
| Damage | Major | Substantial | Major | Substantial |
| | 286 | 372 | 528 | 243 |
| Total | 658 | | 771 | |
| 1,429 Total Accidents | | | | |

Western- and Eastern-built Turbojet and Turboprop Aircraft

**Table 1. Total Commercial Transport Accidents, 1995-2008**

| Accident Type | Number of Accidents | Average Annual Rate | % of Total Accidents |
|---|---|---|---|
| Incursion | 10 | 0.7 | 0.6% |
| Confusion | 4 | 0.3 | 0.3% |
| Excursion | 417 | 29.8 | 29.0% |

**Table 2. Runway-Related Accidents for Commercial Turbojet and Turboprop Aircraft**

Figure 1 shows that the largest portion of runway-related accidents is, by far, excursion accidents.

Forty-one of the 431 runway accidents involved fatalities. Excursion accidents accounted for 34 of those 41 fatal accidents, or 83% of all fatal runway-related

**Only a small percentage of runway excursion accidents are fatal. However, since the overall number of runway excursion accidents is so high, that small percentage accounts for a large number of fatalities.**

*__Jim Burin__ has 33 years of experience in the aviation safety field. He holds an MS degree in systems analysis and is a 30-year career retired U.S. Navy captain who has commanded an attack squadron and a carrier air wing. Prior to joining the Flight Safety Foundation, he was the director of the School of Aviation Safety in Monterey, Calif., where he was responsible for the safety training of 650 Navy, Marine, Coast Guard, and international safety officers each year. As the FSF director of technical programs, he organizes and oversees safety committees and manages safety-related conferences and research. He is also the chairman of the Foundation's international ALAR (approach and landing accident reduction) effort.*

of runway incursion accidents, and more than 100 times the number of runway confusion accidents.

# Runway Excursions

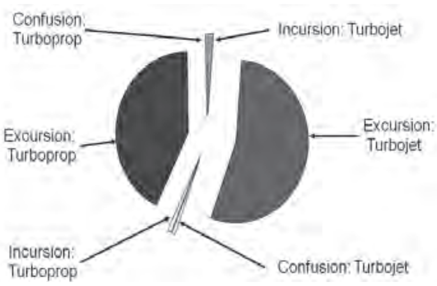


**Figure 1. Proportions of Runway-Related Accidents for Commercial Turbojet and Turboprop Aircraft**

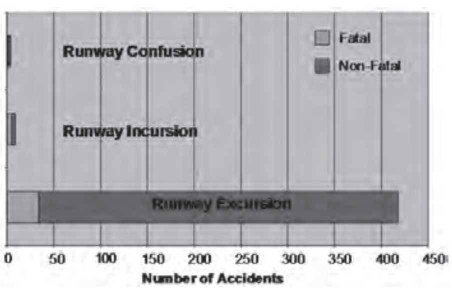


**Figure 2. Proportions of Fatal and Non-Fatal Runway Accidents**

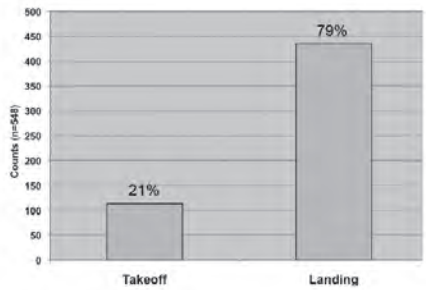


**Figure 3. Runway Excursions, By Type**

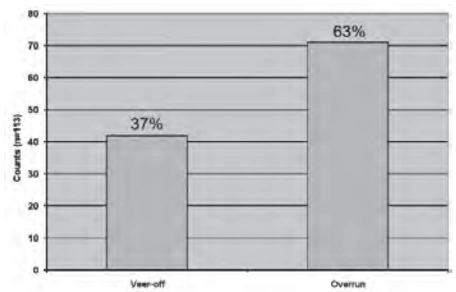


**Figure 4. Takeoff Excursions, By Type**

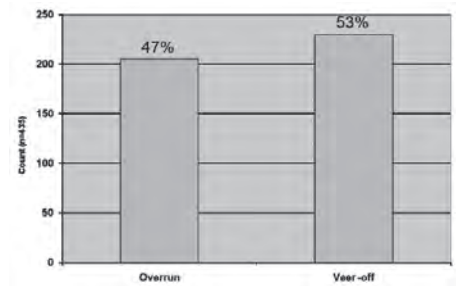


**Figure 5. Landing Excursions, By Type**

accidents. In general, the likelihood of fatalities in a runway-related accident is greater in incursion and confusion accidents. However, the much greater number of runway excursion accidents results in a substantially greater number of fatal excursion accidents (see Figure 2).

Only a small percentage of runway excursion accidents are fatal. However, since the overall number of runway excursion accidents is so high, that small percentage accounts for a large number of fatalities. During the 14-year period, 712 people died in runway excursion accidents, while runway incursions accounted for 129 fatalities and runway confusion accidents accounted for 132 fatalities.

## Who is responsible?

Who is responsible to address the challenge of runway excursions? The answer is everyone aircraft manufacturers, operators (both aircrews and management), airports, air traffic control, and regulators.

The manufacturers do a great job providing the operators with safe and reliable aircraft. They also provide data and procedures that the crews will need in most day-to-day operations. However, without good data on how the aircraft will perform under all runway conditions, some landings have the potential of becoming physics experiments. Operators must have and monitor stabilized approach criteria, since the data clearly show that unstabilized approaches are a primary risk factor in landing excursions. Operators also need to have a true no-fault go-around policy because the leading risk factor in landing excursions is failure to go around when warranted.

Airports have many issues to address in the runway excursion area, including airport design, lighting, approach aids, runway design (e.g., crowned, grooved, porous), markings and signage, runway cleaning and clearing, runway condition measurement, runway end safety areas, and aircraft rescue and firefighting.

Air traffic management/air traffic control has two primary roles in reducing the risk of runway excursions: to provide air traffic services that give flight crews the opportunity to fly a stabilized approach and to ensure that aircrews are given the best available information on environmental and runway conditions in a timely manner.

Finally, the regulator needs to encourage and provide more approaches with vertical guidance, since these assist in enabling stabilized approaches. They also need to be sure that aircrews are given the best possible information from the manufacturers for operations under all conditions. Regulators should also require some universal system for measuring and reporting runway conditions.

### *In-depth study*

An in-depth data study was conducted of all runway excursion accidents from 1995 through March 2008 to investigate the causes of runway excursion accidents and to identify the high-risk areas. Following are some of the basic data from the study.

Landing excursions outnumber takeoff excursions approximately 4 to 1 (see Figure 3).

Almost two-thirds of the takeoff excursions are overruns (see Figure 4).

Landing excursion overruns and veer-offs occur at nearly the same rate (see Figure 5).

Among aircraft fleet types, turboprops

# Reducing the Risk of Runway Excursions

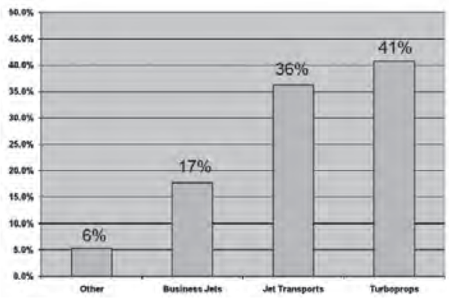


**Figure 6. Takeoff Excursions, By Fleet Composition**

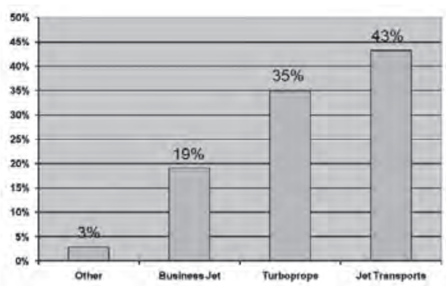


**Figure 7. Landing Excursions, by Fleet Composition**

are involved in the largest percentage of takeoff excursions, followed closely by jet transports (see Figure 6).

For landing excursions, the proportions between jet transports and turboprops were approximately reversed—jets were involved in more excursions than turboprops (see Figure 7).

The data were analyzed to identify the most common risk factors, both in takeoff excursions (see Figure 8) and landing excursions (see Figure 9). More than one risk factor could be assigned to an accident. The most common risk factor in takeoff excursions was a rejected takeoff (RTO) initiated at a speed greater than $V_1$. Loss of pilot directional control was the next most common, followed by rejecting the takeoff before $V_1$ is reached. This is of concern since aborting prior to $V_1$ should result in a successful RTO.

For landing excursions, the top risk factors were go-arounds not conducted, touchdown long, landing gear malfunction, and ineffective braking (e.g., hydroplaning, contaminated runway). Three of the top 5 risk factors deal with elements of a stabilized approach.

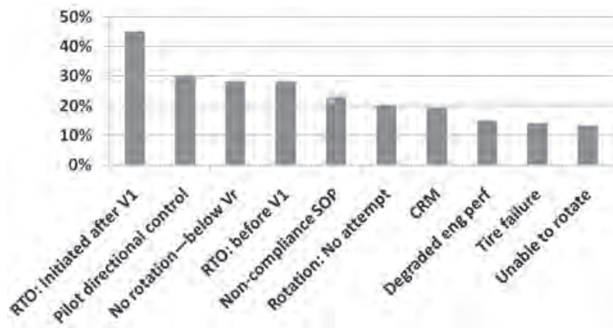


**Figure 8. Takeoff Excursion Risk Factors**

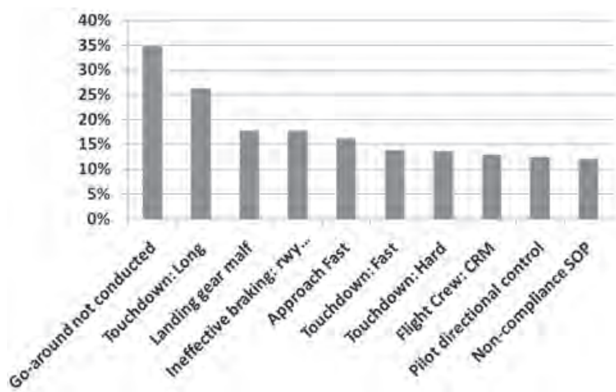


**Figure 9. Landing Excursion Top Risk Factors**

## Risk factor interactions

The risk of a runway excursion increases when more than one risk factor is present. Multiple risk factors create a synergistic effect (i.e., *two* risk factors *more than double* the risk). Risk factor interactions present the possibility of many associations between various contributing factors, but determining whether any pair of associated factors has a causal connection would require more detailed study and analysis.

As an example, risk factor interactions for landing overruns show strong associations between "go-around not conducted" and other factors such as "unstabilized approaches," "long/fast landings," "runway contamination," and "hard/bounced landings." Logically, these factors may have a causal connection to each other that significantly increases the probability of a runway excursion accident. In looking at some risk factor interactions for takeoff excursions, the risk factor interactions suggest that there might be interesting associations between engine power loss and aborts initiated above $V_1$, as well as an association between these high-speed aborts and the presence of runway contaminants.

## Conclusions and recommendations

The RSI team fully supports the many outstanding activities being conducted around the world by organizations like the FAA, ICAO, and Eurocontrol that have been responsible for the low number of runway incursion accidents. The specific goal of the RSI team was to provide data that highlight the high-risk areas of runway excursions and to provide interventions and mitigations that can reduce those risks. The RSI effort brought together multiple disciplines that included aircraft manufacturers, operators, management, pilots, regulators, researchers, airports, and air traffic management organizations. It used the expertise and experience of all the stakeholders to address the challenge of runway excursions.

**1. A mishandled rejected takeoff (RTO) increases the risk of takeoff runway excursion:**

- Operators should emphasize and train for proper execution of the RTO decision.
- Training should emphasize recognition

of takeoff rejection issues.
—Sudden loss or degradation of thrust.
—Tire and other mechanical failures.
—Flap and spoiler configuration issues.
• Training should emphasize directional control during deceleration.
• CRM and adherence to SOPs are essential in time-critical situations such as RTOs.

**2.Takeoff performance calculation errors increase the risk of a takeoff runway excursion:**
• Operators should have a process to ensure a proper weight and balance, including error detection.
• Operators should have a process to ensure accurate takeoff performance data.

**3. Unstable approaches increase the risk of landing runway excursions:**
• Operators should define, publish, and train the elements of a stabilized approach.
• Flight crews should recognize that fast and high on approach, high at threshold, and fast, long, and hard touchdowns are major factors leading to landing excursions.
• ATC/ATM personnel should assist aircrews in meeting stabilized approach criteria.

**4. Failure to recognize the need for and to execute a go-around is a major contributor to runway excursion accidents:**
• Operator policy should dictate a go-around if an approach does not meet the stabilized approach criteria.
• Operators should implement and support no-fault go-around policies.
• Training should reinforce these policies.

**5. Contaminated runways increase the risk of runway excursions:**
• Flight crews should be given accurate, useful, and timely runway condition information.
• A universal, easy-to-use method of runway condition reporting should be developed to reduce the risk of runway excursions.
• Manufacturers should provide appropriate operational and performance information to operators that accounts for the spectrum of runway conditions they might experience.

**6. Thrust reverser issues increase the risk of runway excursions:**
• Flight crews should be prepared for mechanical malfunctions and asymmetric deployment.
• Flight crew application of reverse thrust is most effective at high speeds.

**7. Combinations of risk factors (such as abnormal winds plus contaminated runways or unstable approaches plus thrust reverser issues) synergistically increase the risk of runway excursions:**
• Flight crews should use a runway excursion risk awareness tool for each landing to increase their awareness of the risks that may lead to a runway excursion.

**8. Establishing and adhering to standard operating procedures (SOPs) will enhance flight crew decision-making and reduce the risk of runway excursions:**
• Management and flight crews should mutually develop SOPs.
• SOPs should be regularly reviewed and updated by a management and flight crew team.

**9. The survivability of a runway excursion depends on the energy of the aircraft as it leaves the runway surface and the terrain and any obstacles it will encounter prior to coming to a stop:**
• All areas surrounding the runway should conform to ICAO Annex 14 specifications.
• All runway ends should have a certified runway end safety area (RESA) as required by ICAO Annex 14 or appropriate substitute (e.g., an arrestor bed).

**The Runway Safety Initiative effort brought together multiple disciplines that included aircraft manufacturers, operators, management, pilots, regulators, researchers, airports, and air traffic management organizations. It used the expertise and experience of all the stakeholders to address the challenge of runway excursions.**

• Aircraft rescue and firefighting (ARFF) personnel should be trained and available at all times during flight operations.

**10. Universal standards related to the runway and conditions, and comprehensive performance data related to aircraft stopping characteristics, help reduce the risk of runway excursions:**
• Regulators should develop global, uniform standards for runway condition measuring and reporting, and aircraft performance data. ◆

# Closing the Gap Between Accident Investigation And Training

**Full flight simulators are used to train pilots to fly airplanes and to carry out emergency procedures fastidiously. But are pilots, and should pilots, be trained to prevent accidents?**

By Michael Poole and Lou Németh, CAE Flightscape

*(This article is adapted with permission from the authors' paper entitled* Closing the Gap Between Accident Investigation and Training *presented at the* ISASI *2009 seminar held in Orlando, Fla., Sept. 14-18, 2009, which carried the theme "Accident Prevention Beyond Investigations." The full presentation, including cited references to support the points made, can be found on the ISASI website at www.isasi.org.—Editor)*

Intimacy with accident investigations and/or serious FOQA events results in intimacy with many of the often subtle factors and human factors issues that can ultimately culminate in a catastrophic outcome. While written accident reports supply a wealth of information, their shortcoming is that the reports are time consuming to read. More importantly, people often read the same sentence yet have a very different understanding of the sentence. There is arguably a gap between accident investigation and simulator training in that the problems we typically see in training are often not the same problems that cause accidents or that we see in daily FOQA program results. This article will explore a few accidents to demonstrate how improved intimacy about what happened, based on objective flight data, may benefit flight safety.

**Figure 1. Saab 340 accident site.**

As expert observers of cockpit behavior, instructor pilots have the unique skill of reliably predicting the outcome of even small omissions or lapses in procedures. This instructor skill comes naturally as a function of observing crews practicing skills over and over again. This same instructor skill, acquired through persistent analysis of crew behavior, is now extended to all crewmembers through flight data animation visualization and analysis tools. These technologies can communicate subtle causal factors effectively and consequently enable instructors to improve scenario-based training.

In addition to using flight data to develop enhanced scenario-based training, applying FOQA concepts to the full flight simulator will enable airlines to cross-reference problems encountered in simulator sessions with problems encountered in daily flight operations. Using flight data from the simulator session to objectively measure and report on the training pilot's performance allows the instructor pilot to focus on the subjective human factors aspects of the flight operation.

Understanding how seemingly benign events can lead to catastrophic situations is paramount to changing attitudes and vigilance in the cockpit. Augmenting simulator training to replicate real-world situations based on improved intimacy with the sequence of events beyond the investigation report and beyond the statistics of FOQA programs promises to bring accident prevention to a new level.

The following accidents are examples cases in which one of the authors (Poole) was directly involved in the flight recorder analysis when employed at the TSB. Hence, he has firsthand knowledge of the details of the accident sequence beyond what is typically ascertainable from the written reports. The authors believe that this level of intimacy can be more readily gleaned through the use of flight animations and the use of flight data to develop full flight simulator training scenarios.

## Saab 340 accident

On Jan. 10, 2000, a Saab 340, HB-AKK operated as Crossair 498, crashed shortly after takeoff from Zurich's Runway 28 during night IMC. The aircraft was destroyed and all 10 persons on board died (see Figure 1). The Swiss Aircraft Accident Investigation Board (AAIB) requested the assistance of the Transportation Safety Board of Canada (TSB) with the readout and analysis of the FDR and CVR. Approximately 50 parameters were recorded on the aircraft's solid-state FDR, and 30 minutes of good quality audio were recorded on the aircraft's CVR.

The Swiss AAIB IIC originally requested a "readout" of the recorders. Consequently, the TSB prepared printouts and graphs of the flight data along with a transcript of the audio, which the IIC intended to take back to Zurich to conduct the analysis. People intimate with the process of recovering flight data realize that the original data are a sea of binary 1s and 0s that need to be converted into meaningful engineering units. Many investigators believe that flight data are "factual," but the process to convert the data is fraught with the opportunity for error. Engineering conversion formulas, documentation, wiring, acquisition unit programming, software used to convert the data, timing issues, resolution issues, replay options, etc., will all affect the quality of the outcome. In fact, if the same source binary flight data are replayed with two different replay systems, it is highly *unlikely* that the same results will be produced.

Flight 498's data revealed that shortly after takeoff the aircraft, in night IMC, entered an increasing right turn apparently consistent with control inputs. As a flight data analyst, when you see this type of data, you immediately start to question if the data are being processed properly or are working properly (in this case if sign conventions are correct) because, on the surface, the sequence does not appear to make sense. The TSB started to work on a flight animation immediately in an effort to understand if the data were properly processed, because animations are an excellent means to validate the correct behavior of numerous interdependent parameters.

The level of "validation" of any given parameter should be proportional to what you intend to conclude. If you are putting a lot of weight on a given parameter, it is natural that you would check its validity more so than if it were a less important parameter. The IIC noticed the TSB was working on an animation and asked if it would be OK if the investigation team was brought to Ottawa to analyze the data interactively using the animation as opposed to trying to analyze printouts and plots. Indeed, in this particular investigation, the early animation with the audio and transcript synchronized was very useful to conduct the analysis of the data and greatly expedited a common understanding of what likely happened (see Figure 2).

The Swiss team came to the TSB and spent a few very fruitful days developing and studying the animation. Animations have two very distinct purposes—one is to assist in the analysis process and one is to communicate the findings. Often the display choices are different for each of these purposes. Some authorities still view animations as having little or no analytical value and use them only for communication purposes. But in the case of this accident, the animation had tremendous analytical value. Without the animation, understanding the sequence of events and gaining confidence in the data quality would have been much more difficult.

Key points of this accident related to the subject of this material are as follows.

The pilot flying (commander) became disoriented, essentially believing he was in a left turn when he was in a right turn. During the standard instrument departure (SID ZUE 1Y), ATC issued a change in the clearance, essentially cutting the SID short and instructing a turn direct to VOR ZUE. The first officer confirmed by radio stating "turning *left* to Zurich East." The SID calls for a left turn as shown in Figure 3.

The first officer reprogrammed the LRN (long range navigation system) from its present position to ZUE. At this point in the flight, the aircraft was more or less 180 degrees in the opposite direction of ZUE. When reprogramming the LRN, if the operator does not explicitly select left or right, the LRN will choose the turn direction offering the shortest distance. The aircraft was a few degrees closer to a right turn at this point, and it was apparent that the first officer inadvertently programmed a right turn by not explicitly selecting left. With both crewmembers believing they were to turn left and both crewmembers believing the flight director was programmed for a left turn, when watching the animation with the CVR transcript integrated it becomes relatively easy to understand how the commander could become disoriented and roll the aircraft into a right turn into the ground.


**Figure 2. Flight animation developed by TSB to support the investigation team (courtesy the TSB).**

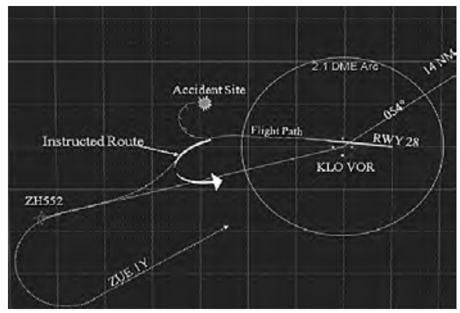


**Figure 3. Planned route, instructed route, and flight path to crash site.**

To further validate this early theory in the investigation, the TSB derived the theoretical behavior of the command bars (since this was not a recorded parameter) and displayed them in the animation, which further supported the supposition that the commander became disoriented. The Swiss AAIB report makes several excellent safety recommendations to prevent a recurrence. While the Swiss report is very thorough and filled with excellent safety information, it is still questionable as to whether this accident or similar accidents in which the crew is essentially "tricked" into a situation by a series of seemingly harmless events will effectively be prevented in the future.

To the authors' knowledge, there is no simulator training (brief, debrief, or in the actual simulator) whereby crews are ex-

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Photo not available

***Lou Németh** is the chief safety officer for CAE's ab-initio, helicopter, business, and commercial aviation training business. He joined CAE after a distinguished 26-year career at US Airways, where he served as a line pilot, instructor pilot, pilot training manager, and courseware developer. He has accumulated more than 25,000 hours of flight time and is type rated in nine commercial and business aviation jet aircraft.*

posed to the sequence of events identified in this accident. Even worse, there are many flight crews who have no knowledge of this accident or the specifics of what caused it. The safety community has benefited from the lessons learned from this accident; but are flight crews flying similar equipment benefiting from the lessons learned? The current approach is for the safety community to learn the lessons and implement changes by way of recommendations. It would arguably be much better if the crews could learn the lessons directly by exposing them to the sequence in the simulator training environment.

## Airbus A310 accident

On Jan. 30, 2000, an Airbus A310 registered as 5Y-BEN crashed shortly after takeoff from Runway 21 in Abidjan in night IMC (see Figure 4). The aircraft's flight data recorder and cockpit voice recorder were brought to the TSB Canada for readout and analysis. The aircraft's FDR recorded alternating streams of steady 1s and 0s indicating the flight data acquisition unit (FDAU) had malfunctioned and was sending erroneous data to the FDR. The CVR was of good quality and, although cryptic to determine the sequence of events, eventually enabled the investigation team to piece together what happened. Although there was no flight data available for this investigation, it is perhaps a good example of a case where the crew was essentially "tricked" and flew the aircraft into the ground without ever understanding the problem.

The aircraft's stall warning system activated on liftoff, which surprised the flight crew. As they attempted to diagnose the problem, the flying pilot instinctively pushed forward on the control column to eliminate the stall condition. However, the aircraft was not in a true stalled condition, and in less than one minute, the aircraft was essentially flown into the sea. It was concluded that one of the angle of attack vanes must have been damaged, causing the aircraft stall system to trigger as soon as the weight on wheels logic went to "air." No amount of forward control input could avert the stall (stickshaker) condition. Simulator tests confirmed that the only way to reach the crash site was to fly the aircraft in an "unstalled" condition.

The French BEA wrote a detailed report on this accident, but the question again comes up—Have we done enough or what more can be done to ensure there is not a repeat of this accident? As with the previous example, the authors know of no scripted simulator training in which crews are given a false stall warning on liftoff in night IMC to see how they react to this real-life known situation. Given the same circumstances, it is probable that many crews would react the same way as the crew in question did, so it is arguably only a matter of time before this accident repeats itself.

## B-727-200 accident

On July 7, 1999, a B-727-243F, registration VT-LCI, crashed in Kathmandu into the Champadev hills at 7,550 feet approximately 5 minutes after takeoff in IMC. The Ministry of Tourism and Civil Aviation of the government of Nepal investigated the accident. No report from the government of Nepal could be found in a search of the Internet; but the following was found on the NTSB website:

*"The investigation determined that the probable cause of the accident was the failure of the flight crew to adhere to a standard instrument departure (SID) and the failure of the controllers to warn the flight of terrain. Contributing factors were determined to be an incomplete departure briefing, unexpected airspeed decay during the initial climb, inadequate intra cockpit crew coordination and communication, and the slow response to the premonition given by the air traffic controller."*

The flight recorders were replayed at the TSB Canada. In this accident, the crewmember was a little late in carrying out a right turn as required by the SID and was consequently flying toward mountainous terrain. When they realized they were late, they immediately began a right turn to regain where they were supposed to be. During the right turn, they received a GPWS warning—Pull up. Instead of executing the escape maneuver in response to the GPWS, which requires a wings level maximum climb, they increased their turn radius to the right. In this case, given they knew they had made a mistake and had just corrected the mistake, it is understandable that when confronted with a GPWS their instinct was to tighten the turn rather than

**Figure 4. Undercarriage from A310 accident.**

execute an escape maneuver. How many crews would do the same thing in the same circumstances? Is this accident also a matter of time before it repeats itself? Simulator training replicating this sequence for pilots frequently flying into airports with mountainous terrain might go along toward reinforcing the need to carry out an escape maneuver in all cases.

## Closing the gap

All three of these cases exhibit similar human factors problems: The crewmembers did not correctly diagnose the problem and/or did not respond in a way that they were trained due to mitigating factors that led them to believe there was a better course of action. In all cases, the crewmembers were competent, well trained, and representative of the industry. It can be argued, however, that their response was understandable, which means another crew confronted with the same scenario may well respond the same way.

There have been numerous similar accidents in which crewmembers did not respond the way they were trained. It is the authors' opinion that this is in part because the training environment does not replicate real-world scenarios such as the three examples presented. One reason that the training environment does not replicate real-world scenarios like this is because the people developing the training simply do not know the intimate details of the accident sequence, not having been involved in the investigations. The same logic can apply to serious FOQA events. It really does not matter if the aircraft hits the ground or not in the end. FOQA events with a high potential for safety action need to be investigated and well understood and ideally used to develop simulator training scenarios if we really want to prevent them from becoming an accident.

Flight animations have the ability to disseminate complex information in a highly intuitive and entertaining manner in a fraction of the time it takes to read a report. Like any good movie, you tend to pick out details that you did not see before each time you watch the movie. Written reports also do not lend themselves to assessing timing issues while animations provide an immediate sense of timing, which can be important to the overall understanding of the accident.

Finally, flight animations are an excellent means to communicate *what* happened to a wide cross-section of people. Without consensus as to *what* happened, there is little point of trying to understand *why* it happened. Further, *what* happened is exclusive in that there is only one set of facts. The *why,* on the other hand, is not exclusive. For every *what,* there are many opinions as to *why*; there is not necessarily a right answer. Despite the best efforts of the investigation community, many people simply do not know the intimate details of the accident unless involved in the investigation, as it is impractical to glean this level of intimacy from a written report. Flight animations have a unique ability to quickly communicate *what* happened, which greatly facilitates determining *why* it happened and, more importantly, how to prevent it from happening to you.

Simulator training today largely focuses on how to fly the aircraft and how to respond to an emergency. It has not progressed to "evidence based" training in which we use objective flight data to develop explicit scenarios from known accidents, incidents, and FOQA events. If you ask a simulator instructor pilot for a list of problems training pilots experience in the simulator, you will discover that there is little or no correlation to the list of problems that are known to cause accidents. This suggests that there is a gap between the flight safety community and the training community and that there is benefit from a much closer relationship than exists today in many airlines.

It is timely for the industry to look at ways to improve the ability for the training community to exploit lessons learned by using actual flight data as the objective common base between the two communities. Coincidently, IATA within its ITQI (IATA Training and Qualifications Initiative) is actively exploring flight data from FOQA programs from volunteering airlines in an effort to change the regulations regarding simulator training to allow for evidence-based training. The following is an extract from the ITQI 2008 report from IATA's website:

"*Progress in the design and reliability of modern aircraft has prompted an industry review of pilot training and checking requirements. In addition to the wealth of accident and incident reports, flight data collection and analysis offer the possibility to tailor training programs to meet real risks. The aim is to identify and train the real skills required to operate, while addressing any threats presented by the evidence collected. The IATA best-practice document will facilitate regulatory change and enable more efficient safety-driven and cost-effective training.*"

One of the ways that CAE Flightscape is actively exploring to bring the FOQA and training communities together is through the development of our simulator brief debrief technology and FOQA technology. By using the same core technology to study and debrief a simulator flight as well as study and debrief a FOQA event from an actual aircraft, the potential for FOQA results to influence the training environment is significantly increased.

## Summary

Many people in the accident investigation business see the same core human factors issues over and over again. A combination of individually benign events led to a situation "outside the box" of current simulator training. It is, of course, impossible to train for every scenario possible, but it is technically possible to train using objective aircraft flight data from past accidents and serious FOQA events.

Evidence-based training scenarios need to be developed using objective flight data to ensure pilots appreciate the need for vigilance, communication, and a strong safety ethic. Many pilots read the accident headline and conclude that this would not happen to them—that the pilots in question were not doing a good job. If these same pilots participated in the investigation, they would undoubtedly conclude that this could happen to them as well, since they begin to appreciate the subtleties of the sequence. Any pilot who works for a year at a safety investigation authority comes out of that experience with a real appreciation for what really causes accidents and is a safer pilot for it.

**Figure 5: Simulator session animation replay using the same core technology as the accident investigation replay (courtesy Oxford Aviation).**

We cannot afford to send all the worlds' pilots for a one-year sabbatical at an investigation agency. What we can do is give these same pilots and instructor pilots easy access to flight data from accidents and serious FOQA events ideally in the form of interactive flight animations so that they can appreciate the intimate details of what went wrong. We can include simulator brief and debrief using actual flight data as an integral part of the training process, not a nice-to-have option. We can train instructors to leverage the technology to the benefit of the safety of flight. This will facilitate the creation of evidence-based training and allow the industry to better correlate problems identified through investigation and FOQA programs to problems encountered during flight simulator sessions. The main problems in the simulator are typically not related to reasons why airplanes crash. This is because we still train to regulatory requirements and to carry out emergency procedures. This is not to say we should no longer do this. The more the real aircraft data and the simulator data match in terms of problem areas, the more we will know that we are closing the gap between accident investigations and training. ◆

# How Significant Is The Inflight Loss of Control Threat?

**At all times, manufacturer recommendations for proper aircraft operation are controlling.**

By Capt. John M. Cox and Capt. Jack H. Casey,
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*(This article is adapted with permission from the authors' paper entitled* How Significant Is the Inflight Loss of Control Threat? *presented at the ISASI 2009 seminar held in Orlando, Fla., Sept. 14-18, 2009, which carried the theme "Accident Prevention Beyond Investigations." The full presentation, including cited references to support the points made, can be found on the ISASI website at www.isasi.org.—Editor)*

Airplane manufacturers, airlines, pilot associations, flight training organizations, and regulatory agencies are increasingly concerned with the incidence of loss of control events. Accidents resulting from loss of airplane control are, and continue to be, major contributors to fatalities in the commercial aviation industry. In fact, since the decline of controlled flight into terrain (CFIT) accidents due to technological breakthroughs, loss of control has become the No. 1 cause of hull losses and fatalities in the worldwide air carrier fleet.

Resources are finite in any business. Industry safety professionals are tasked with determining the primary issues of concern and addressing them in a planned and forthright manner with objective data and professional guidance. This is very difficult within a larger society that often decides issues with subjective data at best, "feelings" at worst. Data clearly establish loss of control flight upset (LOC-I) as the primary danger today in flight operations. Compare this with the news media interest regarding runway incursions that has driven FAA activity, rulemaking, and expense. A glance at the objective data establishes that while runway incursions are a concern as an issue it pales compared to loss of control. Industry statistical analysis shows 22 inflight, loss-of-control accidents between 1998 and 2007. These accidents resulted in more than 2051 fatalities. (*Airplane Upset Recovery Training Aid, Revision 3* [2009]).

Data also suggest an even larger number of "incidents" have occurred in which airplanes experienced near or actual loss of control and qualified as upsets. There are several reasons such events occur: flight control problems, environmental dangers, equipment, and pilot inattention or inaction. Investigation of pilot actions during these events suggest pilots require specialized training to cope with airplane upsets. Research indicates most airline pilots rarely experience airplane upsets during their flying careers. It also indicates that many pilots have never been trained in maximum-performance airplane maneuvering, such as aerobatic maneuvers. Additionally, those pilots who have been exposed to aerobatics lose their skills as time passes unless such flying is a consistent hobby or a second career.

This does not suggest training in aerobatics, although such training does improve an assortment of pilot skills. Indeed, for our purposes aerobatic training may be counterproductive, producing negative training outcomes, and possibly, as we will see, implanting incorrect technique. The aircraft in question, transport-category aircraft, are not designed nor intended for such flight.

## Airplane upset defined

While specific values may vary among airplane types, the unintentional conditions seen below generally describe an airplane upset *(Airplane Upset Recovery Training Aid, Revision 3)*. For our purposes, airplane upset is defined as an airplane unintentionally exceeding the parameters normally experienced in line operations or training.

- Aircraft pitch attitude greater than 25 degrees, nose up.
- Aircraft pitch attitude greater than 10 degrees, nose down.
- Aircraft bank angle greater than 45 degrees.
- Within the above parameters, but flying at airspeeds inappropriate for conditions.

Significantly, these flight conditions often occur in combination. Loss of control, flight upset (LOC-I) is established as the potential event demanding immediate and decisive attention by the aviation industry to avoid further loss of life, vast financial losses, and decline in the public's confidence. In past years, several developments in technology and improved training have resulted in significant safety improvements for the industry. Generally accepted developments that have increased safety have been

- the jet engine.
- improved and operator friendly avionics.
- improved training.
- proactive, not reactive, safety programs.
- technological improvements,

—weather radar,
—TCAS,
—TAWS (terrain awareness warning system).

The emergence of technology as the leading contributor to safety improve-

## Authors' Note

This article reflects the groundbreaking work contained in the Federal Aviation Administration's *Flight Upset Recovery Document, Revision 2.* It is consistent with the content and recommendations of that document, in addition to industry best-practice standards. The Royal Aeronautical Society will soon release a document on upset recovery intended to assist pilots who encounter an unexpected upset condition. ◆

ments is obvious. For example, CFIT reigned for years as the No. 1 cause of hull losses and loss of life. The industry has responded in a variety of ways, including increased training, at least in emphasis, and regulatory agencies have issued directives and regulations to companies and pilots regarding the seriousness of the matter. Such results produced some mitigation of the problem, but CFIT did not cease to be the major cause of accidents and loss of life until the advent of TAWS, *and its mandatory installation and use*.

However, technology offers little assistance (with the possible exception of protection offered by fly-by-wire technology providing hard envelope protection) with the challenges inherent in inflight upset. Technology, especially autoflight, has not reached the point where it can react and control flight actions at or beyond the parameters of LOC-I. In fact, in an era when regulators encourage crews to utilize autoflight and other sophisticated flight aids to the maximum degree possible, pilots are facing a situation in which the parameters of flight upset result in the disconnection of those same systems. Faced with such a challenge, a crew, whose individual flight skills might have atrophied due to reliance on automation, then must deal with an unfamiliar flight situation it has not prepared for. This "shock" or "stun" factor must be understood as part of the solution.


By necessity, flight upset becomes a training question because of the technology-resistant nature of the problem. The solution should demand a practical approach, using already existing training aids, while remaining within the regulatory guidance of the *Airplane Upset Recovery Training Aid, Revision 3.* The need is established by a string of deadly accidents that illustrate the problem.

One psychological barrier should be examined and dispensed with. Belief that "it won't happen here," because it has not happened, is meaningless. Anything less than a professional and active training program is no longer sufficient. Anything less creates an equation of when the inevitable will happen. Training for flight upset should be as much a business model as anything else related to training and safe operations.

No airline or operator expected the following accidents to occur with their crews and aircraft, yet they did.

USAir Flight 427 (Boeing 737), September 1994

American Airlines Flight 587 (A300), November 2001

Pinnacle Airlines Flight 3701 (CRJ200), October 2004

West Caribbean Airways Flight 708 (MD-82), August 2005

These tragedies were selected for brief examination because they illustrate the problem in clear and unambiguous terms. There are others. In fact recent tragedies, while investigations continue, show signs within regulatory public statements of possible crew control mismanagement and lack of awareness of actual flight conditions without autoflight.

## USAir 427

At approximately 19:03 Eastern Daylight Time on Sept. 8, 1994, USAir Flight 427 (ORD-PIT) descended out of control and crashed killing all aboard outside of Pittsburgh, Pa.

In the executive summary of the final report of this accident, the NTSB states the following: *"The National Transportation Safety Board determines that the probable cause of the USAir Flight 427 accident was a loss of control of the airplane resulting from the movement of the rudder surface to its blowdown limit. The rudder surface most likely deflected in a direction opposite to that commanded*

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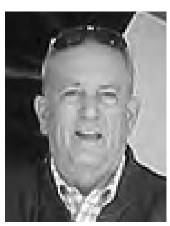


***Jack H. Casey** spent the 8 years prior to becoming a partner at Safety Operating Systems as the pilot liaison for Embraer Aircraft Holdings, Customer Services USA, achieving a reputation as a worldwide expert in Embraer aircraft and their operations in line service. Since leaving military service in 1975, he has been employed with airlines and has flown the BE18, DC-3, B-737, and FK27. In addition, Casey has developed expertise in the Mitsubishi MU-2 family of aircraft. He possesses five type ratings from DC-3 to B-737, and has flown more than 11,000 hours and 2.8 million miles without accident. During his career, Casey has served in all air carrier required positions, been a designated examiner, type rating examiner, and line check airman and gained considerable experience with the FAA, the NTSB, and numerous foreign regulators.*


*by the pilots as a result of a jam of the main rudder power control unit servo valve secondary slide to the servo valve housing offset from its neutral position and overtravel of the primary slide. The safety issues in this report focused on Boeing 737 rudder malfunctions, including rudder reversals, the adequacy of the 737 rudder system design; unusual attitude training for air carrier pilots; and flight data recorder (FDR) parameters."* (p. ix).

After the building of thousands of B-737 series aircraft, a significant danger to flight, existing since the original design, was discovered under tragic circumstances. The B-737 had been in service in various versions for years. The fault could not have been planned for in a standard business plan or normal testing. However, pilot training mitigation for such nasty surprises can be a mitigating factor.

The report includes commentary on the inadequacy of air carrier pilot training to address this type of unexpected flight upset. This resulted in remodeled training for crews flying the B-737, and increased knowledge of more sophisticated aeronautical issues like cross-over speeds. Although this crew had little chance given its previous experience and training, future B-737 crews should fare better. Prominent in the NTSB recommendations were suggestions for more sophisticated training of flight crews so that following such training, an event like USAir 427 could be prevented, but if encountered, be recoverable.

Of interest to operators is that this investigation required more than 4 years to complete and cost the industry more than $1.5 billion in direct and indirect losses.

## American Airlines 587

Barely one month following the attacks of Sept. 11, 2001, New York City again faced tragedy from the sky. This time it was not the madness of terrorism, but human error.

At 09:16 Eastern Standard Time, American Airlines Flight 587, an Airbus A300-605 N14053, crashed into a residential area of Belle Harbor, N.Y. Flight 587 was a regularly scheduled flight from JFK to Las Americas International Airport, Danto Domingo, Dominican Republic. Fatalities totaled 260 passengers and crew aboard the aircraft, and 5 people on the ground.

Once fears of terrorism were eliminated, it was evident the aircraft impacted the ground in an ominous fashion. The location of the vertical stabilizer and rudder in Jamaica Bay was proof positive of a structural breakup while in flight. The first officer was the pilot flying the aircraft.

During the investigation it became apparent that the aircraft encountered wake turbulence a few minutes after takeoff from a B-747 that departed the same runway immediately before. This encounter started the trouble. Wake turbulence around busy traffic areas mixing aircraft of various sizes and capability is hardly unknown; in fact, it is a frequent occurrence.

The executive summary of the NTSB final report on the loss of Flight 587 says the following: "The National Transportation Safety Board determines that the probable cause of this accident was the inflight separation of the vertical stabilizer as a result of the loads beyond ultimate design that were created by the first officer's unnecessary and excessive rudder pedal inputs. Contributing to these rudder pedal inputs were the characteristics of the Airbus A300-600 rudder system design and *elements of the American Airlines Advanced Aircraft Maneuvering Program."* (p. xi) (authors' italics)

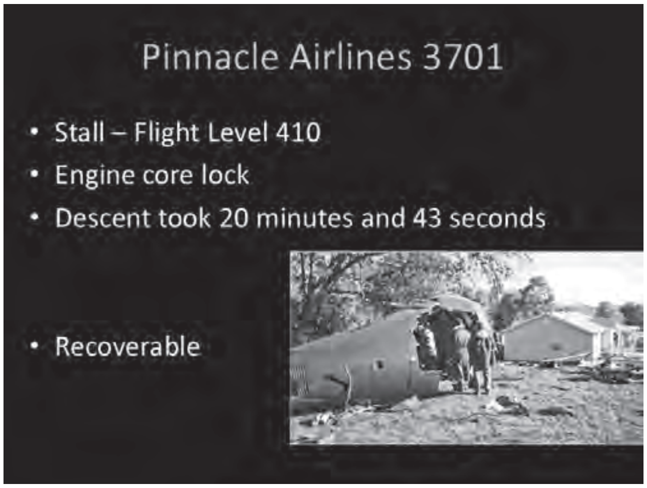
In effect the report states that the flying pilot excessively loaded the rudder beyond design limits and the system was designed to allow him to do it.

For our purposes, the Board concentration on the Advanced Aircraft Maneuvering Program is significant and troubling. It is clear that American Airlines made a strong commitment to address the clear dangers present in loss of control flight upset events. The airline created an aggressive program designed to improve a pilot's awareness and skills. The design of the program was an "in house" training department effort that, at least initially, sought input from manufacturers and regulators. However, as time passed, disagreements on basic aerodynamic theory and technique began to surface. While the program had the very best intentions, it came under question within the company's operations management. The NTSB Final Report discussed one significant issue.

"On Feb. 6, 2003, American Airlines provided the Safety Board with a copy of a May 27, 1997, memorandum from the company's managing director of flight operations technical to the company's chief pilot and vice-president of flight. The memorandum stated that the managing director of flight operations technical had 'grave concerns about some flawed aerodynamic theory and flying techniques that have been presented in the AAMP.' The memorandum also stated that it was wrong and 'exceptionally dangerous' to teach pilots to use the rudder as the primary means of roll control in recoveries from high AOAs."

The memorandum continued to request a review of a number of concerns regarding the program, some raised by manufacturer test pilots. In addition to the propensity of the first officer to use excessive rudder, such instruction created a toxic combination that, under demands of the event, stressed the Airbus vertical stabilizer and rudder beyond design limits.

This chain of events illustrates key issues regarding training for inflight upsets. This event brought the entire concept into question in some minds. Carriers developing such programs ceased their development. The fact that American Airlines increased exposure and liability through such a program was not lost on the industry. It also provided additional rationalization for those opposed to such training for various reasons, such as cost, the effort involved, or simple resistance to change. By any estimation, Flight 587




stands as a classic inflight upset event with unintended consequences.

### Pinnacle Airlines 3701

On Oct. 14, 2004, at approximately 2215:06 Central Daylight Time, Pinnacle Airlines Flight 3701, a repositioning flight from Little Rock, Ark., to Minneapolis-St. Paul International Airport in Minnesota, crashed near the Jefferson City, Mo., airport, killing the crew of two, the only souls aboard the aircraft.

The NTSB final report was scathing: *"The National Transportation Safety Board determines that the probable causes of this accident were (1) the pilots, unprofessional behavior, deviation from standard operating procedures, and poor airmanship, which resulted in an inflight emergency from which they were unable to recover, in part because of the pilots' inadequate training; (2) the pilots' failure to prepare for an emergency landing in a timely manner, including communicating with air traffic controllers immediately after the emergency about the loss of both engines and the availability of landing sites; and (3) the pilots' improper management of the double engine failure checklist, which allowed the engine cores to stop rotating and resulted in the core lock engine condition. Contributing to this accident were (1) the core lock engine condition, which prevented at least one engine from being restarted, and (2) the airplane flight manuals, which did not communicate to pilots the importance of maintaining a minimum airspeed to keep the engine cores rotating."*

Professionalism and aircraft knowledge, as well as basic aerodynamics, can be trained. Additionally a well-designed and appropriately taught and monitored training program, containing an inflight upset section, is a useful tool for detecting and, if need be, removing pilots from the system who cannot or will not improve their performance.

The key issue established by Pinnacle 3701 is that regardless of the behavior and the predicament that resulted, the crew could have probably recovered sufficiently to save their lives and the aircraft with knowledge contained in inflight upset training programs.

### West Caribbean Airways 708

On Aug. 16, 2005, West Caribbean Airways Flight 708, an MD-82 (HK-4374X) charter flight from Panama to Martinique, descended from cruise altitude in a nose-up flight attitude and crashed near Machiques, Venezuela, killing all 160 persons aboard.

Investigation by the CIAA of Venezuela showed the following:

- Ground scarring indicated impact in a nose-up, slight right roll attitude.
- Wreckage was distributed over a triangle-shaped area approximately 205 meters long by 110 meters at the widest point.
- Both engines exhibited indications of high-speed compressor rotation at the time of ground impact.
- The engine inlets, empennage, and wing leading edges showed no sign of pre-impact damage.
- The horizontal stabilizer was found at about the full airplane nose-up position (12 units).

Additionally, the FDR showed that the aircraft had slowed while at cruise altitude before beginning a descent that did not cease until ground impact.

The events discussed here demonstrate the challenge ahead for the industry. Issues include the proper use of technology, preserving, and enhancing non-automated pilot flying skills, corporate commitment, regulatory understanding and oversight, and significantly "buy in" by the pilot groups.

The post American 587 syndrome is finally waning under the pressure of events and acceptance of the problem. A growing number of operators are developing and implementing pilot training programs, including academic and simulator training. Regulatory agencies are again encouraging airlines to provide education and training in the subject. Airplane manufacturers responded to the challenge by leading an industry team formed to develop the *Airplane Upset Recovery Training Aid, Revision 3* with the FAA and other industry experts. This aid provides basic, but useful, guidance and templates for a training program as well as sample training manual revisions and lessons to begin the process on the correct footing.

**Accident data are clear—the greatest risk to the fleet of transport aircraft is loss of control in flight. Through proper training and education, this risk can be reduced.**

As we have seen, airplane upsets happen for a variety of reasons. Some events are more easily prevented than others. Improvement in airplane design and aerodynamic simplicity and equipment reliability continues to be a goal. Automation may have a result counter to its intention: we have arrived at the point that when airplane upsets occur pilots discover degradation in basic flying skills.

In too many recent accidents, pilot inability to recover from an unintended inflight condition (upset or stall) has resulted in the loss of the aircraft and occupants. The number of this accident type can, and should, be reduced. Accident data are clear—the greatest risk to the fleet of transport aircraft is loss of control in flight. Through proper training and education, this risk can be reduced. ◆

*(This article is adapted, with permission, from the author's paper entitled* Bringing the Worldwide Helicopter Accident Rate Down by 80% *presented at the ISASI 2008 seminar held in Nova Scotia, Canada, Sept. 8-11, 2008, which carried the theme "Investigation: The Art and the Science." The full presentation, including cited references to support the points made, can be found on the ISASI website at www.isasi.org.—Editor)*

**THE INTERNATIONAL HELICOPTER SAFETY TEAM (IHST) TAKES THE PROACTIVE ATTITUDE THAT ANYONE'S HELICOPTER ACCIDENT BELONGS TO ALL OF US.**

# Bringing the Worldwide Helicopter Accident Rate Down by 80%

By Jack Drake, Helicopter Association International, USA

This presentation was motivated by a personal desire to spread the word about an exciting new approach to accident prevention that has particular applicability to air safety investigators, safety researchers, and aviation safety agencies. Traditionally, if we were participants in a government-led aircraft accident investigation, the objectives would be to determine the factors that led to the accident, to define the "probable cause" (or causes), and to initiate corrective actions to prevent future accidents. The safety recommendations that followed would usually advocate regulatory change to require sometimes narrowly defined corrective actions. This methodology is frequently addressed as the reactive approach or "preventing the last accident."

That's the way fatal air carrier accidents have been addressed in many countries during the past 40 years, and despite lots of criticism, the approach has helped to bring the air carrier accident rate down substantially. Unfortunately, general aviation accidents, especially those that did not involve mechanical failures of critical components, although much more numerous, usually do not result in the issuance of safety recommendations—either because the accidents were not investigated to sufficient depth to support recommendations or because regulatory change could not be justified. Studies of similar accidents are infrequently conducted, and we continue to experience accidents just like we did before.

A more proactive approach and a desire to improve the worldwide helicopter accident rate, which was perceived to be unacceptably high and negatively influencing the safety image of all helicopter operations, led to the formation of the International Helicopter Safety Team (IHST) in late 2005 and its commitment to reduce the worldwide helicopter accident rate by 80% in 10 years. It was recognized by the government-industry partnership that constituted the IHST that its goal could not be achieved by looking at general aviation and helicopter accidents and investigative reports in the same way.

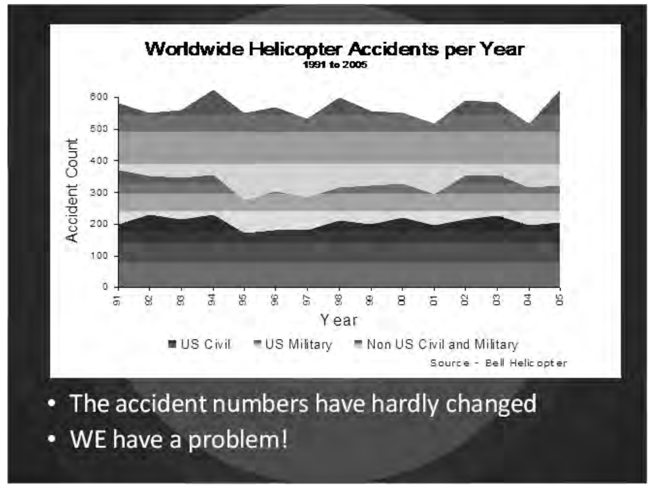
The taskforce formed to address and try to correct the problems contributing to the helicopter accident rate was led initially by the U.S. FAA, airframe and engine original equipment manufacturers (OEMs) in the United States, and by operators and associations, such as the Helicopter Association International (HAI), which represented U.S. operators. As the initiative has grown internationally, other countries have stepped up or expressed interest in using or adapting the model developed in the U.S. by the IHST.

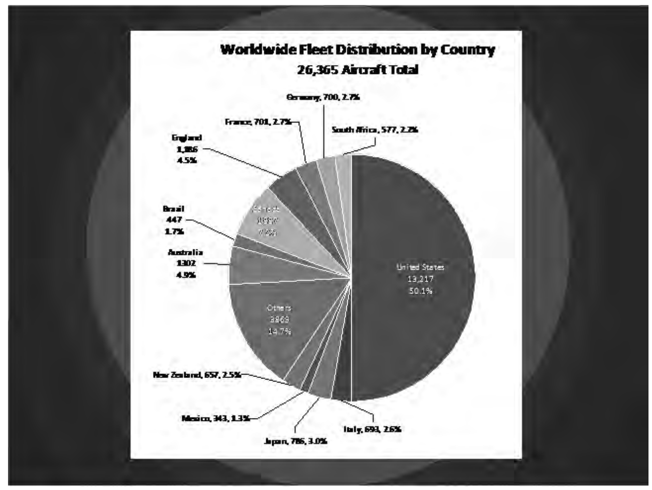
At the writing of this paper, the European Aviation Safety Agency (EASA) and Canada are continuing the initiative by examining more closely their regional accidents while refining the IHST methodology to optimize the ability to identify corrective actions there. Several other countries and regions have begun to organize similar teams to determine how the process can reduce accident risk elsewhere. The methodology of the IHST was adapted from the U.S. Commercial Aviation Safety Team (CAST), which set out to substantially reduce worldwide commercial airline fatal accidents by addressing proactively common accident causes. Many of us have seen some of the by-products that addressed controlled flight into the ground, approach and landing accidents, and uncontained engine failures. The IHST set a similar but higher goal—to reduce the rate of *all* helicopter accidents, worldwide, by 80%—and progress is already being made.

## Measuring our progress

While it must be admitted that the 80% goal was borrowed from CAST, the expectation from the beginning was that the goal could be achieved—because of the early success of CAST in bringing down the fatal air carrier accident rate and a belief that the helicopter community could be convinced that a systematic approach to helicopter safety was both overdue and needed. The IHST hoped for and saw an early reduction in the U.S. helicopter accident count and rate (in 2006) that was apparently the result of enthusiasm for the program and improved industrywide safety awareness.

While that improvement was gratifying, it also became apparent that we didn't actually know the U.S. and worldwide helicopter accident rates because we didn't have a good handle on the denominator in the equation, helicopter operating hours. Measuring future helicopter accident rates (and our progress) would require more accurate measures of helicopter flight hours, which had traditionally been estimated based on limited operator surveys and were notoriously inaccurate. FAA flight hour estimates were used by the helicopter industry to calculate accident rates. The IHST decided it would start its program using industry-accepted accident rate data from the years immediately preceding the start of its programs, but it also committed to initiate an effort to improve the flight hour measurement that was critical to accurate accident rate calculations.




Bell Helicopter has taken the lead on this and is collecting flight hour data for all helicopter models worldwide. The process will use data points from aircraft sales, public records of aircraft registrations, service difficulty reporting, maintenance data, and other sources. The data will allow us to calculate accident rates more accurately in the future and (we believe) will allow us to show that flight hours are higher than previously estimated and that accident rates are lower than previously indicated by industry data.

## The IHST process

The process whereby the IHST is analyzing accident data to achieve a higher safety goal is illustrated by the following charts and described briefly here. First, IHST is a government-industry partnership that seeks to bring about safety change without increasing regulation. It is not a U.S. program (although it was dominated by U.S. participants in its first 2 years). It is an international safety program that hopes to grow to a worldwide effort to reduce the risk of helicopter accidents worldwide.

Further, there is no reason its principles couldn't be applied proactively to all segments of aviation and to other industries. Very simply, it uses the combined talents represented by regulators, manufacturers, operators, and other safety specialists to examine accident reports to identify the events that contributed to accident causes (root cause analysis) and to find interventions to address each of those factors. Recommendations that would come from the analysis process would be based on those interventions that are considered most feasible and economically acceptable to a cost-conscious industry.

The analysis function and production of recommended interventions is the function of the IHST's Joint Helicopter Safety Analysis Team (JHSAT). The vetting, prioritizing, and selling of the best of the recommendations is the work of the IHST's Joint Helicopter Safety Implementation Team (JHSIT). Figure 1 illustrates the IHST organization and the initial makeup of the U.S. JHSAT and JHSIT teams. Not surprisingly, the roles of the U.S. teams have evolved, partly because of the expansion of the process internationally and partly because of the evolution of the tasking. One noteworthy change is that the U.S. JHSAT has gradually assumed a regional role in a coordinated effort with other state or regional JHSATs while it has also refined its accident analysis process.

Figure 2 illustrates the analytical process used by the JHSAT. The charter of the organization established the ground rules, and the CAST-based process ensured that the result would be data-based, objective, and acceptable to the majority of the team. The team was selected from ap-

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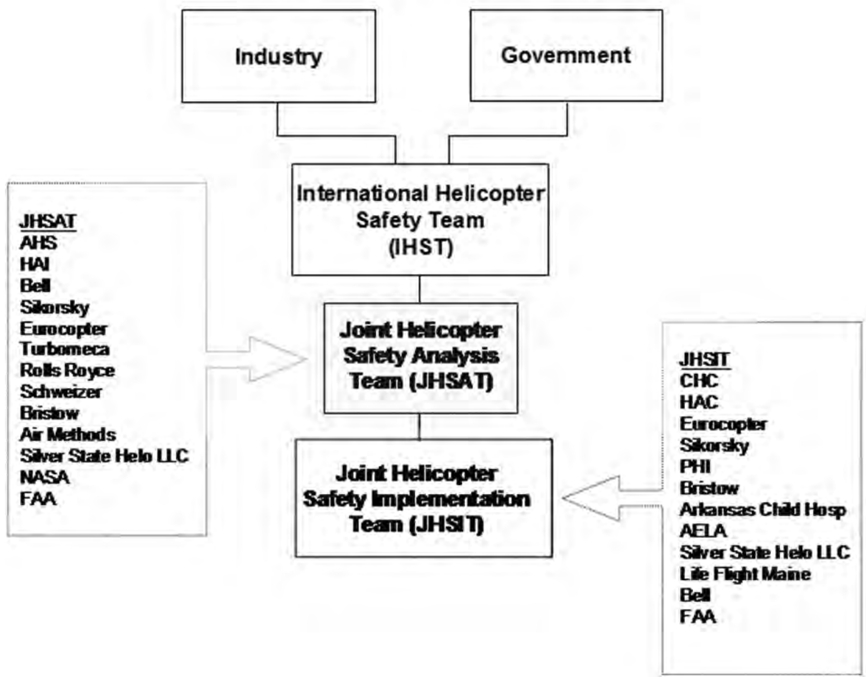
**Figure 1. U.S. JHSAT and JHSIT Stakeholders**




plicants with accident investigation, safety research, and proactive aviation safety experience, who also represented a cross-section of the industry. There was a deliberate effort to achieve balance between members who would represent regulators, manufacturers, and operators and to bring to bear real-world experience.

It was necessary to select a dataset that was several years old because it takes a few years before entire calendar year accident sets are completed by investigation authorities and recent accidents might still be in litigation (precluding some members from participating in the JHSAT group analyses). Thus, the U.S. JHSAT decided to start (in early 2006) with the U.S. NTSB calendar year 2000 accident dataset, which consisted of 197 accident reports and about 4,000 docket items (reports, statements, photos, and supporting documents).

Having established what we would examine, we developed a methodology that included development of standardized problem statements (SPS) corresponding to the events or links in the safety chain that were considered to have contributed to the causes of the accidents or our ability to define those causes (missing data). Having defined the problems, we developed a set of corresponding interventions that were thought to be appropriate mitigations for the SPSs. When data were insufficient to define exactly why an event occurred, we still attempted, based on our collective experience, to determine how the problem or accident might have been prevented. We did not rely on "probable cause" determinations and typically arrived at more problem statements and interventions than would be found in the conclusions of the NTSB reports.

The identified SPSs and interventions were "scored" based on how well the group felt the SPS or linked intervention defined the problem or would eliminate it in a real-world setting. In the roll up of the data, there were about 1,200 SPS-intervention pairs. Those interventions that became the recommendations of the JHSAT (numbering about 135) were those that appeared most frequently in the roll up of all of the data, as the frequency of occurrences was found to outweigh the qualitative analysis of individual interventions.

The U.S. JHSAT report summarizing its first year of accident data analysis and recommendations is available to the public by free download from the IHST website (http://www.ihst.org/Default.aspx?tabid=1797&language=en-US). It is interesting to note that while the report discusses the accidents from the prospective of 15 different mission categories, the majority of the safety issues and intervention recommendations were substantially the same across mission categories. Most of the problems defined were operational, and most of the interventions addressed better risk management, operational oversight by operators, and training. The presentation of the JHSAT report to the IHST, in September 2007, officially transferred the result of the first year of JHSAT effort to the JHSIT, which was tasked with deciding which recommendations to prioritize and how they should be implemented. That work is on-going, even as the JHSAT is now concluding its second year of accident data analysis. (A later IHST report summarizing the U.S. JHSAT analysis of CY2001 accidents from the respective of "occurrence" types is now available on the IHST website, and the U.S. JHSAT, having now analyzed more than 500 helicopter accidents, is currently preparing its analysis of the CY2006 accidents.)

## We know more than we know!

An in-depth review of a large number of accident reports and their probable causes reveals many things, but not all we'd like to know—particularly if our task is to determine responsibility for the accident (our tasking was to look for prevention opportunities, not for causes). We'd like to know more about the pilot's training and decision-making, whether undocumented human factors were involved, the exact sequence of events, what the pilot saw and what actions were taken, how the aircraft systems responded, and how company standards (or lack thereof) and pressures affected crew performance on the accident flight. Without detailed documentation of these things and digital data from the aircraft, many of those questions remain unresolved in too many cases.

`However, the accident reports, especially when examined in the context of

**The JHSAT examination, even of investigation reports that were lacking, found lots of fertile ground for interrupting the causal chain with proactive action to reduce the accident frequency and rate.**

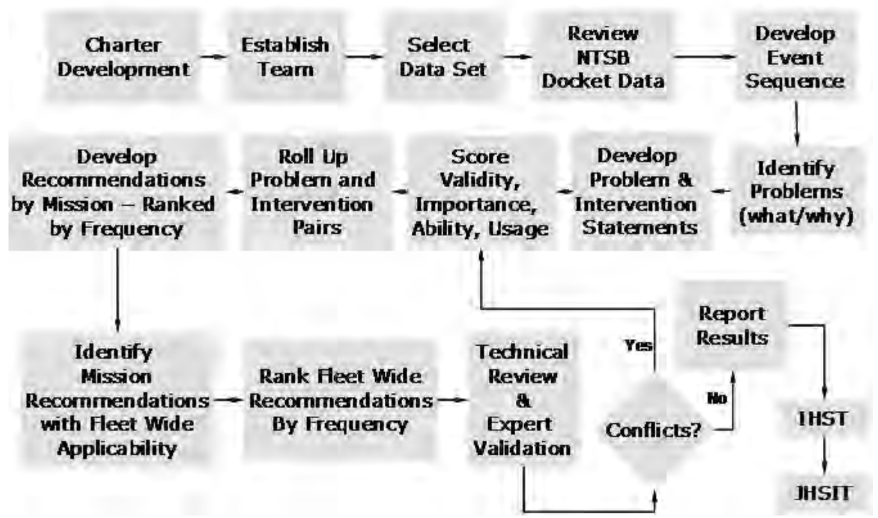



**Figure 2. JHSAT Process Overview**

reports of similar events, do reveal a great deal about how such accidents might have been prevented. We can read between the lines to some extent, especially when we've seen the same set of circumstances described in a variety of reports. The JHSAT examination, even of investigation reports that were lacking, found lots of fertile ground for interrupting the causal chain with proactive action to reduce the accident frequency and rate.

The following case studies are offered to illustrate the process and the potential value of the JHSAT process and data.

***Case Study #1: Offshore, Part 135 Cargo***—The helicopter went missing and presumably crashed on a night overwater flight in support of oil industry operations over the Gulf of Mexico (GOM) in deteriorating weather. The accident flight was one of several that day for the 61-year-old pilot, who transported personnel and cargo between shore bases and oil rigs, and from rig to rig. The pilot's duty day began at 0800 and was drawing to a close 13.5 hours later, after about 7 hours of flight time, as he tried unsuccessfully to find the oil rig that was his final destination.

Meteorological data indicated that the flight most likely encountered adverse weather (high winds, low ceilings, rain, and reduced visibility) in darkness. Although he was highly experienced in VFR operations, the pilot was not IFR-rated and the aircraft was not equipped for instrument flight. The pilot relied on a GPS receiver, a telephone, and DR navigation to find his destination, as there was no FAA communications or radar flight following available near the presumed crash site. Analysis showed that the aircraft was about 25 miles from its destination and well off course when the pilot last spoke to a company dispatcher. The aircraft never arrived, and the wreckage was not found. As with all the other cases examined, the aircraft was not, nor was it required to be, equipped with cockpit or digital flight data recorders. Nonetheless, the NTSB report was rich with information that provided an understanding of the circumstances that may have led to the accident, and the JHSAT elected to consider this information as it examined how the accident might have been prevented. Probable cause: Undetermined. NTSB recommendations: None.

**Problem statements**

• Pilot experience lead to inadequate planning with regard to weather.
• IFR system incompatible with mission.
• Management policies/oversight inadequate.
• Management disregard of human performance factors (i.e., duty/flight time, fatigue).
• Pilot disregarded cues that should have led to termination of course of action.
• Darkness, fog, and rain.
• Data/information not available to investigators.

**Proposed interventions**

• Company risk assessment/management program.
• FAA installation of ADS-B in GOM to facilitate IFR operations in adverse weather and at night.
• Establish company SOP that disallows flying in adverse weather at night except under IFR.
• Company SOP to eliminate onerous flight schedules and reduce risk of fatigued pilots.
• Incorporate non-punitive fatigue call-in protocol.
• Company risk assessment/management program.
• Cockpit recording device with underwater locator.

***Case Study #2: EMS Positioning Flight***—"Fire-Radio Dispatch" directed the launch of an EMS helicopter to a landing zone (LZ) on a residential city street at night, although the LZ was only a few minutes away and an ambulance was already on scene. Patient transport was intended to end at a hospital in another city. The launch decision by a non-aviation dispatcher was not questioned by the pilot/operator. Operator guidance (to ground emergency response crews) had previously established minimum LZ requirements, but a non-conforming LZ was selected and was accepted by the pilot. The pilot's high/low recon did not detect obstructing wires, and ground personnel incorrectly advised the pilot that there were no wires. Ground personnel did not adequately protect the LZ from approaching automobile traffic, which necessitated a go-around on final approach. The approach was not stabilized—the pilot carried insufficient power to clear obstructing wires—necessitating a controlled crash under the wires. The pilot had only 28 hours in make/model. NTSB probable cause: Pilot failed to detect the presence of the wires and his misjudgment of clearance from the ground during the evasive maneuver. NTSB recommendations: None.

**Problem statements**

• Improper launch decision by non-aviation dispatch/communications center.
• Customer pressure to complete mission.
• Flight crew decision-making inadequate.
• Management policies/oversight inadequate.
• Improper landing site selection by ground emergency personnel.

• Pilot unaware of obstructing wires near the LZ.
• Evasive maneuver required—pilot inexperienced in make/model.

**Proposed interventions**
• Mission-specific (EMS) risk assessment training for dispatch/communications center personnel.
• Assertiveness/AMRM training for flight crew.
• Mission-specific (EMS) operational risk assessment program.
• Establish/assert operational control/oversight by operator.
• Reinforce the purpose and importance of landing site recon.
• Establish preapproved landing sites for EMS activities.
• Risk assessment/training for LZ personnel.
• Risk assessment program that addresses night LZ operations.
• Establish EMS mission-specific operational risk assessment standards/controls.

***Case Study #3: Returning from Electronic News Gathering (ENG) Flight***—Two ENG aircraft were flying several hundred feet from one another when one pilot radioed the other, "Hey, watch this." The pilot subsequently lost control and crashed; there was a post-crash fire, and both occupants were killed. The investigation revealed that the accident pilot had a history of aggressive flying and risk taking, and he had a criminal record. Probable cause: The pilot's decision to perform an abrupt low-altitude aerobatic maneuver. NTSB recommendations: None.

**Problem statements**
• Improper pilot decision-making and actions.
• Pilot disregarded rules and SOPs.
• Inadequate company SOP and operational oversight.
• Inadequate crew hiring/screening criteria.
• Absence of threat-free safety event reporting system.
• Data unavailable to analyze the LOC maneuver.
• Crash-resistant fuel system had been removed.

**Proposed interventions**
• Establish an operator safety/risk management program.
• Develop hiring/screening criteria for pilot applicants.
• Conduct procedural intentional noncompliance (PINC) training.
• Implement a non-punitive safety event reporting system.
• Use crash-resistant fuel systems (when available).
• Install cockpit data recording devices.
• Include helicopter data in PRIA (Pilot Records Improvement Act).

## U.S. JHSAT fleetwide recommendations

The proposed interventions in the case studies above illustrate the kinds of safety recommendations being considered by the IHST. Together they demonstrate there are many ways of preventing the same or similar accidents. The roll up of the similar interventions sometimes resulted in combining, rewording, or dropping some potential recommendations when others seemed more viable. These case studies and the roll up of the intervention recommendations show that there is greater potential for prevention based on the analyses of general aviation or helicopter accident reports than we have tapped in the past. While the resultant recommendations addressed mission groups separately, ISASI members may be more interested in the kind of data-based recommendations that were proposed across mission groups (the fleetwide recommendations). Some of these are summarized below.
• Develop and use formalized Safety Management Systems (SMSs) to reduce risk and to improve individual and organizational decision-making. Establish and use non-punitive safety event reporting systems to address employee safety concerns.
• Identify and manage risks associated with mission, low/slow and other higher risk maneuvers, and flight in close proximity to obstacles.
• Promote increased use of simulators, training aids, and training devices to reduce training risk and improve training and aeronautical decision-making (ADM) with regard to autorotation, loss of tail rotor effectiveness (LTE), aircraft performance capabilities and limitations, emergency procedures, inadvertent flight into instrument meteorological conditions (IIMC), make/model transitions, model-specific power and energy management, quick-stop maneuvers, landing practice on platforms and in unimproved areas, and pinnacle approaches.
• Provide extensive initial and recurrent emergency training as described in the *Rotorcraft Flying Handbook* and as outlined in the OEM rotorcraft flight manual to address autorotation, vortex ring state (settling with power), dynamic rollover, systems and equipment malfunctions, and LTE.
• Infrastructure: Ensure that crews are aware of adverse or deteriorating weather conditions by expanding availability of weather data needed for preflight planning and for inflight decision-making. Improve the Automated Weather Observing System (AWOS) infrastructure and other weather reporting sources to provide greater access to weather information. Share weather information, both reporting and receiving, through PIREP, the helicopter EMS (HEMS) weather tool, and other systems.
• Companies operating in the same local areas should formalize agreements to share weather data, especially when weather considerations result in refusing to accept or canceling flight operations.
• Improve maintenance by better integration of quality assurance systems and ensured adherence to instructions for continued airworthiness (ICA). Push strict adherence to ICA, including improved regulatory oversight of maintenance.
• Regulatory: Hold public-use military surplus helicopter maintenance to civil ICA (or equivalent) standards. Require that public-use operators comply with Part 91 operating rules. GSA: Take stronger action to minimize unapproved part use in public-use operations. Defense Reutilization and Marketing Services (DRMS)—develop an easily accessed database to identify released military surplus aircraft, engines, and critical parts.

**Those of us on the JHSAT hope you'll find our process useful and employ it elsewhere to improve accident investigations and make better use of the information contained in those reports.**

• Regulatory: Make Pilot Records Improvement Act of 1996 (PRIA) information more readily available to employers for background checks by helicopter operators. Expand PRIA to include helicopter pilots and FAA disciplinary actions and make this data available for aviation employer background checks.
• Implementation of health and usage monitoring systems (HUMS) or engine monitoring systems (EMS) capability for early detection of impending failure. Regulatory: Provide regulatory flexibility for installation of (HUMS/EMS) data recording systems.
• Improve crash survival by making greater use of available crash-resistant fuel systems and personal locator devices.
• Make greater use of helicopter terrain avoidance warning systems (HTAWS), obstacle proximity detection and protection equipment, radar altimeters, synthetic/enhanced vision systems (SVS/EVS), video recording systems (including rearward-facing cameras), and wire strike protection systems (WSPS) as applicable to aircraft mission.
• Encourage development and use of optional aircraft warning systems to include low rotor speed, low fuel quantity, and dynamic rollover alert systems.
• Utilize HOMP to monitor and provide safety oversight of flight operations.
• Install cockpit/data recording devices appropriate to mission and aircraft model—such as cockpit image/information recorders (CIR), low-cost flight operations data recorders, GPS positional flight recorders, CVR/DFDR, and FOQA quick access recorders (QAR).

Note: Although cockpit and flight data recorders were not installed on any of the 197 helicopters in the calendar year 2000 accident dataset, it is not farfetched to be asking for their installation in many helicopter make/models. Sikorsky (as part of its Safety Enhancement Program) is currently installing CVR, FDR, and current generation TAWS as standard equipment in its commercial helicopter models and offering retrofit kits for its S-76 helicopters that were produced before 2005. Bristow/Air Logistics has installed low-cost flight operations data recorders in its Bell 206 and 407 aircraft and has recently received FAA approval for its flight operations quality assurance (FOQA) program, and ERA Helicopters was the first FAA-approved helicopter FOQA program. Without digital or video recording equipment installed, it is virtually impossible to accurately reconstruct the events leading to many helicopter accidents. With such recorders, it is possible to improve accident investigations and also to use digital data to reconstruct training or operational flights as a means of improving training and flight crew performance.

## Accident investigating and reporting

The IHST sought improvement in accident investigation reporting so that reports by the investigating authority would be more useful for identifying root causes and implementing appropriate and responsive safety actions. To facilitate this, in June 2007 members of the JHSAT and JHSIT met with two NTSB members, the deputy director for regional operations, regional directors, and helicopter experts to discuss IHST findings and to offer suggestions, including a checklist seeking documentation of the planning that preceded the accident flight, weather data available to the pilot, a description of any inflight emergency and how the pilot responded to it, a description of the size and complexity of company operations, the operator's program for managing risk and safety, the pertinent operator SOPs and operational oversight, the pilot's pertinent (mission) training and experience, company hiring criteria, the availability and usage of safety/mission equipment (including recording devices), and other information that would aid the investigator in determining root causes of the accident. The NTSB subsequently responded that it would use the IHST suggestions to improve its accident investigations.

The IHST participants were very encouraged by the NTSB response in 2007 and met with the NTSB Board and senior staff in 2009 to provide further data to justify NTSB action. The IHST is very encouraged by the interest shown by NTSB and have high hopes that the result will include better accident investigation documentation in the future, allowing more in-depth root cause analysis and better safety recommendations in the future. If there is similar progress in getting more helicopters equipped with recording devices in the future, a quantum leap in credible accident investigation findings can be expected to follow

## Safety is an attitude

I'd like to refer to some anonymous ramblings (author unknown) that attempt to define what we are trying to do.
• Safety is not an activity to be engaged in only when one is being watched or supervised.
• Safety is not posters, slogans or rules; nor is it movies, meetings, investigations, or inspections.
• Safety is an attitude, a frame of mind.
• It is the awareness of one's environment and actions all day, every day.
• Safety is knowing what can injure or damage, knowing how to prevent the injury or damage, and acting to prevent it.

The International Helicopter Safety Team (IHST) takes the proactive attitude that anyone's helicopter accident belongs to all of us. Accidents affect our collective reputation as the providers of air transportation and the suppliers of air services that don't exist elsewhere. We don't need to accept accidents or a high industry accident rate, and it affects our profitability if we do so.

The U.S. JHSAT attitude is that interventions can be identified and mitigated for all accidents, even when the exact causes are not known to the operator or the investigators. We don't have to sit back any longer and wait for a probable cause determination before we initiate risk reduction measures. We can use the data-based solutions derived by a team with broad helicopter safety expertise to reduce risk and the helicopter accident rate, and we can use that process to learn from other accidents.

Other groups of helicopter safety experts representing other countries and regions are using similar processes to examine accident data from other parts of the world. All of us are working hard to deliver to you unbiased and data-based solutions to prevent the problems that show up in the accident reports. But what is your attitude? Are you ready to use that data to bring about a more proactive safety culture, better operational oversight, better mission-specific operational training, better risk-based launch and inflight decision-making, and the installation of equipment that will reduce pilot workload, reduce accident risk, and better define why accidents occur? Those of us on the JHSAT hope you'll find our process useful and employ it elsewhere to improve accident investigations and make better use of the information contained in those reports. ◆

# SIFTING LESSONS FROM THE ASHES

## CURRENT PROCESSES FOR IDENTIFYING, DEFINING, COMMUNICATING, AND ACTING ON LESSONS TO BE LEARNED ARE INADEQUATE TO TAKE ADVANTAGE OF THE OPPORTUNITIES OFFERED BY INVESTIGATED ACCIDENTS.

By Ludwig Benner, Jr., Principal, Starline Software Ltd., and Ira J. Rimson, Forensic Engineer

*(This article is adapted with permission from the authors' paper entitled* Sifting Lessons from the Ashes: Avoiding Lost Learning Opportunities *presented at the* ISASI *2009 seminar held in Orlando, Fla., Sept. 14-18, 2009, which carried the theme "Accident Prevention Beyond Investigations." The full presentation, including cited references to support the points made, can be found on the ISASI website at www.isasi.org.—Editor)*

Recent high-visibility accidents demonstrate that processes for learning costly lessons that should have been identified by investigations continue to underperform expectations. The accident scenarios of the crash of a Continental-Colgan de Havilland Dash 8-Q400 in Buffalo, N.Y.; and the crash of a FedEx MD-11 in Narita, Japan, a month later, reflect missed opportunities to learn the lessons from similar previous accidents, or analyses by those who might have used that knowledge successfully to avoid the latest crashes. Current processes for identifying, defining, communicating, and acting on lessons to be learned are inadequate to take advantage of the opportunities offered by investigated accidents.

The official motto of ISASI is "Safety through Investigation." ISASI was incorporated 45 years ago, and its official motto was adopted at that time. Its Code of Conduct has been in effect for more than 25 years. It states

"**5. ACCIDENT PREVENTION…** Each member shall: "5.1 Identify from the investigation those cause-effect relationships about which something can be done reasonably to prevent similar accidents;" and "5.3 Communicate facts, analyses, and findings to those people or organizations which may use such information effectively…."

Recurrence of accidents from similar sources *should* have been reduced substantially, if not eliminated, had investigations fulfilled the expectations of ISASI's founders. What happened?

What happened has been the recurrence of accidents that bear striking similarities to those that have happened before. We call these recurrences "retrocursors." Unlike "precursors," which presage events to come in the future, retrocursors reenact behavior patterns that have led to accidents in the past. At the time of this paper's writing in late June 2009, the most recent of these was the loss of Air France Flight 447 over the equatorial Atlantic enroute from Rio to Paris. Facts are not yet adequate to support any of the many hypotheses, at least two of which have happened before—

- air data inertial reference unit (ADIRU) faults resulting from errant input signals, with resulting reversion of control laws from (normal) computer control to one of three degraded levels demanding immediate manual control by the crew in an ambiguous situation. Out-of-envelope airspeed signals could have resulted from pitot tube icing in severe thunderstorm;
- overstress separation of the airplane's

### AUTHORS' NOTE

After we submitted the paper to ISASI's seminar committee, our continuing analysis revealed more insights about successfully identifying and applying lessons that should be learned from accidents and incidents. As reported during our seminar presentation, we realized that

1. Standardizing input data structure is essential to identifying and communicating behavior sets that were significant during the mishap process.
2. Employing social networking to transmit accident data is both quicker and more accurate than current communication alternatives.
3. Digitizing operational data has opened the capability for capturing real-time aviation information and new opportunities for instant access to the behavioral data needed to achieve lessons learning system results.
4. Evaluating the occurrence of "retrocursor" accidents, which repeat the lessons that should have been learned historically, provides a metric both for the insightfulness and accuracy of investigations and their reports, and the effectiveness of lessons learned users' applications of the lessons of history. ◆

vertical stabilizer and subsequent loss of control; or

- a combination of both.

Continental-Colgan Flight 3407, a Bombardier Dash 8-Q400 that crashed on approach to Buffalo, N.Y., on Feb. 12, 2009, and Turkish Airlines Flight 1951, which crashed on approach to Amsterdam's Schiphol Airport 13 days later, were high-profile retrocursors. In both cases minor anomalies distracted the crews from the principal airmanship rule: "First fly the airplane." Crew distraction accidents have been a bane for decades.

A third retrocursor was the FedEx MD-11 landing crash at Narita, Japan, on March 22, 2009, that duplicated a similar FedEx MD-11 at Newark, N.J., in 1997. A China Airlines MD-11 crash at Kai Tak in August 1999 exhibited similar operational behavior. Why hadn't the lessons that should have been learned from earlier accidents been communicated well enough to the crews and internalized sufficiently to prevent the retrocursors?

## Contemporary lessons learned practices

Are there formal contemporary lessons learned "systems," and, if so, why don't they maximize learning from lessons generated by accidents?

Historically, investigators acquire, document, and report factual data in many forms and formats, by many diverse and often-isolated systems. These data are used by investigators and analysts to piece together a description and explanation of what happened, usually in narratives or on preexisting forms, using natural language. These accident data comprise the bases for cause-oriented conclusions from which findings and recommendations are derived. Causes, findings, and recommendations rarely specify the lessons learned from an investigation. Analysts abstract, code, characterize, aggregate, or otherwise refine or condense the data. They are then "published": disseminated internally or made public in various media, as databases, reports, articles, papers, books, stories, graphics, training materials, checklists, etc. Published data are stored in organizational files or databases for retrieval and use. They may also find their way eventually into revised procedures, standards, and regulations.

Dissemination practices vary, but include electronic dissemination in computerized databases, e-mails, and Internet sites. Non-electronic dissemination may include hard-copy investigation reports, tables, checklists, on-the-job training, safety meetings, standardization, training sessions, codes or regulations, and books. Deriving lessons from the data depend on someone recognizing the value of the content and generating and communicating the lessons.

Reported investigation data may also be used for research to develop lessons learned in the form of historical trends or statistical correlations, using statistical analyses or data mining techniques. Data are frequently abstracted or characterized to generate "taxonomies" of causes and causal factors referenced in investigation report databases, safety digests, and investigation software.

We analyzed contemporary "lessons learning" practices, focusing on how data are analyzed to isolate and describe the lessons that should be learned. Major inadequacies we observed include

- Authors variously define lessons as causes, cause factors, findings, conclusions, recommendations, issues, statements, or scenarios in texts of narrative reports.
- Authors often obscure lesson data within excessive wordiness and jargon.
- Authors do not explicitly list lessons learned as such.
- Analysts rarely categorize investigation data to facilitate end-users' retrieval and use.
- Analysts assume that proposed changes alter system behavior favorably, without testing.
- Lessons are "pushed" to pre-established recipients, but must be "pulled" by other users.

What inadequacies of current lessons learned practices have already been reported? Dr. Paul Werner and Richard Perry cited the following barriers to effectively capture and apply lessons learned by investigators:

- Data are not routinely identified, collected, and shared across organizations and industries.
- Unsystematic lessons are too difficult to use because

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***Ira Rimson** completed a Navy career as director of safety of the Naval Air Systems Command. He joined senior FAA retirees founding Aviation Resources Group in 1981, heading its safety services. He has consulted and performed private safety investigations since 1977. He is a Fellow of ISASI, the American Academy of Forensic Sciences, and the American College of Forensic Examiners, and is a senior member of the International System Safety Society.*

—there is too much material to search,
—they are formatted differently in different reports, or
—they are not readily available.

• Applications are unplanned and haphazard.
• "Taxonomy" categories obscure data searches.

We observed two categories of inhibitions to developing lessons learned within the investigation process itself. The more fundamental is a mindset of unquestioned acceptance of "how things have always been done," and can include

• archaic accident "causation" models,
• unwillingness to share investigation data,
• language barriers that obscure identification of relevant behaviors,
• data loss from software obsolescence and lack of standardization, and
• concerns for legal liability.

A secondary category frequently derives from the obstacles above and occurs at the levels of individual investigators and analysts. It includes missing data, biased scope and data selection, logic errors, misinterpretation or misrepresentation of observations, flawed assumptions, and premature conclusions during investigations. Each inhibits development of useful lessons.

## Clarification of terms

Lessons learned are often considered to be new knowledge obtained from experience, applied to benefit future performance. The questions arise: knowledge about what? And how can we put it to beneficial use? We find it helpful to think of the new knowledge generated by investigations as clarification of what happened, and why it happened. That new knowledge can be applied to change behaviors of people, systems, or energies. This concept distinguishes between the lessons and the learning, identifying the tasks required of those documenting the lessons to describe and communicate them so that end-users can apply them to initiate desired behavioral changes.

What data are needed to develop lessons to be learned?

Mixed perceptions of the investigation data that need to be acquired and disseminated as lessons may be the greatest obstacle to learning. Accident causation and investigation models influence those perceptions. Current investigation goals do not prioritize information needed by end-users who initiate behavioral changes. Investigations focus on determining "causes": cause factors, multiple causes, "root" causes, and other easily labeled actions from which investigators and analysts infer lessons and propose corrections. Investigation report authors typically do not provide data in forms from which end-users can derive the behavioral changes they need to prevent recurrence. Instead, the "expert" investigating agencies select changes they deem desirable and direct them to target audiences of their choice in the form of recommendations.

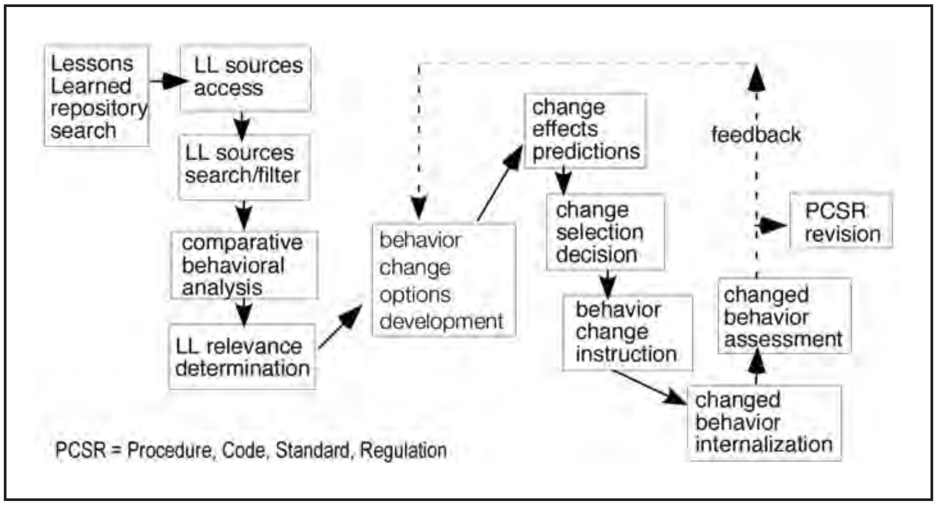


**Figure 1. User's Component of Lessons Learning Model**

## Developing lessons learning systems

The challenges to lessons *learning* systems are to collect accurate mishap-based data and communicate them quickly and efficiently to end-users that can develop and implement changes.

The first challenge is to define the end-users of lessons from investigations and how they would use them. End-users are all entities that can change behaviors that led to an undesired outcome, or initiate new avoidance behaviors, in their operations, in objects or systems they design or operate, or in energies they manage. Current investigation data are designed to fulfill the needs of the agency conducting the investigation. The investigation community would better serve its prevention goal by devoting priority attention to fulfilling the lessons learning data needs of end-users that can apply that new knowledge to changing behaviors.

A second challenge is to systematize investigation data inputs and outputs by standardizing and applying scientific language. Common grammar, structure, and format for investigation input data should thoroughly and objectively describe behaviors that constituted the mishap process. Investigators must test behavioral data sequencing, coupling, and logic during investigations. That will ensure the identified, needed data will be developed and delivered to end-users in formats they can internalize readily and directly, and provide them with unambiguous reasons for changing the behaviors that produced the unwanted outcomes.

A third major challenge is to define the structure and content of the lessons learning system. It must satisfy end-users' needs and, at the same time, support machine documentation, processing, remote access, interoperability among users, and easy access. Its goal should be timely and efficient identification of the behavioral changes needed to effect the lessons that need to be learned, and their delivery to those who need to learn them.

## A Lessons learning system

We developed a model of a comprehensive lessons learning system from investigations by tracking the functions and tasks required to achieve changed behaviors. The system begins with capturing the lessons-to-be-learned data during the accident process and ends with an archive of lessons and responses that have been tested and shown to produce effective results.

Users' components of the learning system model are shown in Figure 1. The model assumes that lessons learned are new knowledge developed by investigators about behaviors that interacted during the accident process. Each task can be decomposed further for specific applications.

What should users expect from a lessons learning system (LLS)? LLS users deal with dynamic processes. LLS documentation must be behaviorally consistent with dynamic processes to enable comparing behavior sets, defining alternative changes to behavioral relationships, and predicting effects that changes might introduce. The system should enable translating LLS response options into some form of change management analysis, and into instructions to incorporate the changed behavior in the targeted person, object, energy, or process. Therefore, LLS must describe behavioral interactions among people, objects, and energies, rather than linear "causes" or abstracted "factors."

- timely repository updating.

From a developer's perspective, shown in Figure 2, investigation components of LLS should support development of lessons-to-be-learned source data with such attributes as

- establish investigation goals to provide lessons that can change future behaviors.
- establish an input-output framework for defining what happened by LLS data sets that describe behaviors in non-judgmental and logically verifiable terms.
- focus on behavior data acquisition and processing.
- specify a structure for input data documentation that ensures data consistency and economy, and facilitates data coupling and support for documenting output LLS.
- machine supportable input data management, display, and expansion to reduce latency.
- objective quality assurance and validation processes.

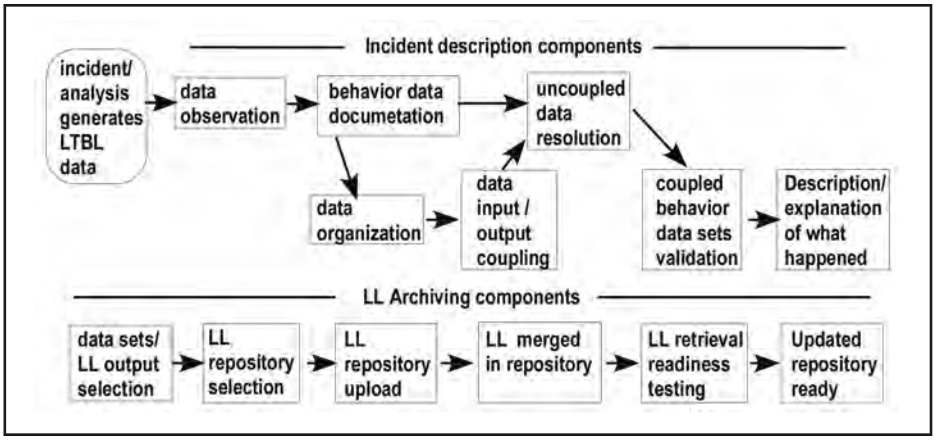


**Figure 2. Developers' Components of Lessons Learning Model**

Ideal LLS attributes include

- open to multiple change options.
- inclusive of context identification.
- accessible expeditiously to all potential users.
- backward compatibility with legacy data repositories.
- minimize elapsed time (latency) between the occurrence that generates data for LLS, and when the lesson becomes available to end-users.
- maximize "signal to noise" ratio; i.e., maximizing relevant content.
- enhanced determination of relevance.
- enhanced assimilability.
- scalability: the ability to increase data quantity without sacrificing quality.
- cost sensitivity: the value of the system in terms of results it produces.
- improved acceptance and more actions initiated by end-users.
- performance metrics for behavioral changes.

LLS documentation derived from investigation descriptions must fulfill end-users' needs. System attributes should include

- requirements that behavioral data outputs provide context, minimize interpretive and analytical workload, maximize signal-to-noise ratio, and reduce latency.
- provisions for machine processing support, interoperability, and repository uploading capabilities to accelerate documenting and distributing lessons to all collections.
- establish accessible Internet LLS output data libraries and end-user notification to support both "push" and "pull" data distribution and minimize latency.
- easy repository access, with search and filter capability to minimize end-user access time, cost, and workloads.
- objective verification and validation to ensure quality before dissemination.
- provisions to modify and update collected data with new knowledge.

During the study of lessons learned processes; we noted two other significant observations—

- Special investigating bodies appointed to inquire into specific accidents often address lessons learned explicitly in their reports. Yet the reports we surveyed by traditional government investigation bodies lack a discrete section addressing, documenting, or summarizing the lessons found during the investigation. No standardized guidance exists for doing so. For example, ICAO Annex 13 does not define or otherwise mention lessons learned. Lack of standardized methodology for reporting "lessons" burdens prospective end-users by requiring them to search and interpret voluminous data with little assurance of finding what they need to initiate changed behaviors.
- LLS requires designers to make strategic choices about investigation process frameworks, purposes, scope, and data structures; LLS content, form and language; and appropriate choices of repositories, distribution, updating, and metrics. Traditional (or inadvertent) strategic system design choices have adversely affected the utility of current LLS processes, operation, and performance.

## Conclusions

Contemporary investigation-based LLS has not prevented recurrence of accidents from known behaviors that produced undesired outcomes. Their primary weakness lies in neglecting the knowledge requirements of users capable of changing those behaviors. Current reports are too often inconsistent, ambiguous, and vague. Investigating agencies should design LLS to identify and report all the lessons that can be learned from each mishap, record them explicitly for ready access and retrieval, oversee their application where they can contribute to avoiding retrocursors," and measure the results. The first steps needed to improve lessons learning practices are

- redesigning the form and substance of lessons-to-be-learned source data to improve their usefulness for users, and
- redefining investigation data product specifications to require that lessons learned be an explicit documented output of the investigation processes. ◆

# ISASI 2010: Sapporo, Japan

The International Society of Air Safety Investigators 41st annual international conference on air accident investigation, "ISASI 2010," will be held in Sapporo, Japan, September 6-9.

The event is being hosted by Japan's local Seminar Committee under the auspice of the Japan Transport Safety Board (JTSB). The Seminar Committee consists of Chairperson: Mamoru Sugimura; Technical Program: Yukiko Kakimoto and Robert Matthews; Sponsorship: Koichi Saito and Ron Schleede; Companion Program: Hideyo Kosugi; Website: Hiroshi Itokawa; and Registration: Sharon Morphew and Masaru Chiba.

The decision to host the conference is the planners' acknowledgement that in recent years the environment surrounding air accident investigators has dramatically changed. From the worldwide perspective, with the introduction of bigger aircraft into airline fleets and increased influx of Asian passengers, more and more people will be on the move by air around the world. From the investigators' standpoint, it is imperative to understand local culture, customs, and peoples' sentiments to overcome cultural differences and language barriers to better cope with severe accident situations.

Taking such a trend into consideration, the conference theme selected is "Investigating ASIA in Mind-Accurate, Speedy, Independent, and Authentic." The theme embodies the seminar goal of presenting material that reflects the latest trends and practices in accident investigation and prevention, with particular emphasis on Asia overcoming cultural and language problems. The 5-day program consists of a day of tutorial workshops, a 3-day technical program, and an optional day of touring. The tutorial and technical program will be held at Royton Sapporo (http://www.daiwaresort.co.jp/English/29_royto.html), located in the center of Sapporo with its Odori Park and many shopping districts. Seminar details are now in the reconciliation stages and will be posted in the next issue of *ISASI Forum*, as well as on the seminar website, which is also nearing completion.

**General information**

Sapporo is the capital of the island of Hokkaido, which is located at the north end of Japan, near Russia. The city's "birth" is recorded as being 1868, and its name can be translated to "dry, great river." Sapporo is located in the southwest part of Ishikari Plain and the alluvial fan of the Toyohira River, a tributary stream of the Ishikari River. The western and southern part of Sapporo is occupied by a number of mountains including, Mount Teine, Maruyama, and Mount Moiwa.

Today it is a city of 2 million and ranks as the fifth largest city in Japan. Many will recall that it hosted the Winter Olympics in 1972. Seminar attendees can expect the weather to range from a high of 22C/72F to a low of 14C/55F, or a daily mean of 18C/64F. The airport serving Sapporo is New Chitose Airport. It is the island's major airport and is serviced directly from a number of Asian cities. Travel to the hotel from Chitose is by taxi, rail, or bus.

Only the Japanese yen is acceptable at regular stores and restaurants. Coins are in denomination of 1, 5, 10, 50, 100, and 500 yen. Bill denominations are 1,000, 2,000, 5,000, and 10,000 yen. Credit cards are widely used in the urban areas. Tipping is not customary in restaurants, hotels, taxies, or anywhere. Instead hotels impose a service charge, and a 5% consumption tax for goods and services exists throughout Japan. Electricity is 100V/50Hz (60Hz in western Japan) for appliances with a two-prong plug.

Citizens of countries that have a reciprocal visa exemption arrangement with Japan are not required to have a visa to enter the country for the seminar. To see if your country has such an arrangement go to website http:///www.mofa.go.jp. On the upper tool bar click "visa" then "Other nationalities, if visa not required" and scroll down to the 63-country listing. ◆

## Kapustin Scholarship Applications Now Being Sought

The ISASI Rudolf Kapustin Memorial Scholarship Fund administrators, Richard Stone and Ron Schleede, urge all members to quicken their search for students to apply for the memorial scholarship offered by ISASI. The deadline for applications is April 15. Full application details and forms are available on the ISASI website, http://isasi.org.

Given the lead time to the application deadline, the fund administrators encourage all ISASI societies, chapters, working groups, and individual members to promote the availability of the ISASI scholarship and its application procedures to students, student groups, and education centers whenever the opportunity presents itself. Fund administrators stress the need for applicants to adhere to the deadline date and to not exceed the word limit of the required 1,000-word essay.

To date, ISASI has awarded 15 scholarships since the inception of the program in 2002. Continued funding for the Memorial Fund is through donations, which in the United States are tax-deductible. An award of US$2,000 is made to each student who wins the competitive writing requirement, meets the application requirements, and who registers to attend the ISASI annual seminar. The award will be used to cover costs for the seminar registration fees, travel, and lodging/meals expenses. Any expenses above and beyond the amount

# ISASI 2010 CALL FOR PAPERS

ISASI's 41st annual seminar will be held in Sapporo, Japan September 6-9. Our Japanese hosts have chosen the theme of "Investigating ASIA in Mind-Accurate, Speedy, Independent, and Authentic." Papers are invited that address methods, issues, or past findings from accident investigations and analyses that address the issues of timeliness, technical competence, and intellectual integrity that are free of political constraints. Topics may address any segments of the air carrier industry or general aviation. An expression of interest in delivering a paper should be sent by e-mail no later than February 1 to bob.matthews@faa.gov or to kakimoto-yukiko@gmail.com. Please include a working title for your presentation. Abstracts must be submitted by April 1, from which final papers and presentations will be invited for submission by June 15. ◆

of the award will be borne by the recipient. ISASI corporate members are encouraged to donate "in kind" services for travel or lodging expenses to assist student scholarship recipients.

Students granted a scholarship also receive

- a one-year membership to ISASI.
- tuition-free attendance from the Southern California Safety Institute (SCSI) to any regularly scheduled SCSI course. This includes the 2-week Aircraft Accident Investigator Course or any other investigation courses. Travel to/from the course and accommodations are not included. For more information, go to http://www.scsi-inc.com/.
- a tuition-free course from the Transportation Safety Institute. Travel to/from the course and accommodations are not included. More information is available at http://www.tsi.dot.gov/.
- tuition-free attendance from the Cranfield University Safety and Accident Investigation Centre for its 5-day Accident Investigation Course, which runs as part of its masters degree program at the Cranfield campus, 50 miles north of London, UK. Travel to/from the course and accommodation are not included. Further information is available at www.csaic.net/.

The Fund is administered by an appointed committee and oversight of expenditures is done by the ISASI treasurer. The Committee ensures that the education program is at an ISASI-recognized school and applicable to the aims of the Society, assesses the applications, and determines the most suitable candidate(s). Donors and recipients will be advised if donations are made in honor of a particular individual.

Students who wish to apply for the scholarship may acquire the application form and other information at the ISASI website: www.isasi.org. Students may also request applications by sending an e-mail to isasi@erols.com. The ISASI office telephone number is 1-703-430-9668.

**Application requirements**

- Applicants must be enrolled as full-time students in a recognized (note ISASI-recognized) education program, which includes courses in aircraft engineering and/or operations, aviation psychology, aviation safety and/or aircraft occurrence investigation, etc., with major or minor subjects that focus on aviation safety/investigation.
- The student is to submit a 1,000 (+/- 10 percent) word paper in English addressing "The Challenges For Air Safety Investigators." (Adherence to length requirements is important.)
- The paper is to be the student's own work and must be countersigned by the student's tutor/academic supervisor as authentic, original work.
- The papers will be judged on their content, original thinking, logic, and clarity of expression.
- The student must complete the application form and submit it to ISASI with the paper by April 15.
- Completed applications should be forwarded to ISASI, 107 Holly Ave., Suite 11, Sterling, VA 20164-5405 USA. E-mail address: isasi@erols.com. Telephone: 703-430-9668.
- The decision of the judges is final. ◆

## Nominations Sought for The Jerome F. Lederer Award

Nominations for this prestigious award are open until May 31. Chairman Gale Braden urges ISASI members to look for deserving candidates in the various fields of aircraft accident investigation and nominate those meeting the criteria. Year 2009 awardees were Capt. Richard B. Stone and the Australian Transport Safety Bureau (ATSB). It was only the second time that the Award was bestowed on two recipients.

Each year, at our annual seminar, we recognize positive advancements in the art and science of air safety investigation through the Jerome F. Lederer Award. The criterion for the award is quite simple. The Lederer Award recognizes outstanding contributions to technical excellence in accident investigation. Any member of the Society may submit a nomination, and the nominee may be anyone in the world. The Award may be given to a group of people or an organization, as well as an individual, and the nominee does not have to be a Society member. The Award may recognize 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.

Each nominee competes for 3 years unless selected. If not selected during that time, the nominee can be nominated after an intervening year for another three-year period. (See "Lederer Award Selection Process," *Forum,* October-December 2009, page 18).

This is a prestigious award usually resulting in good publicity for the recipient, and might be beneficial in advancing a recipient's career or standing in the community.

Nomination letters for the Lederer Award must be limited to a single page. Nominations should be mailed, or e-mailed, to the ISASI office or directly to Awards Committee Chairman Gale Braden, 13805 Edmond Gardens Drive, Edmond, OK 73013, USA. E-mail address: galebraden@cox.net. ◆

## ISASI Executive Nominations Due April 1

Nominations for election to the ISASI offices of president, vice-president, secretary, treasurer, U.S. councillor, and international councillor for the term 20011-2012 are due to the Nominating Committee by April 1. Any member in good standing may submit a nomination.

Each potential candidate whose name is submitted to the Nominating Committee must have consented to the submission. The nominator must submit a short biographical sketch of the nominee. Nominees must be at least a full member in good standing to be eligible for office. Nominations should be sent to ISASI, attention Nominating Committee, Park Center, 107 East Holly Ave., Suite 11, Sterling, VA, USA, 20164-5405. ◆

## MOVING? Please Let Us Know

Member Number____________________

Fax this form to 1-703-430-4970 or mail to
ISASI, Park Center
107 E. Holly Avenue, Suite 11
Sterling, VA USA 20164-5405

**Old Address** (or attach label)

Name ____________________

Address ____________________

City ____________________

State/Prov. ____________________

Zip ____________________

Country ____________________

**New Address***

Name ____________________

Address ____________________

City ____________________

State/Prov. ____________________

Zip ____________________

Country ____________________

E-mail ____________________

*Do not forget to change employment and e-mail address.

## In Memoriam

**Michael J. Baker** (LM3240), Wellington, New Zealand, July 30, 2009
**Carlos Jose Bondio** (LM2120), Pica Cordoba, Argentina, May 29, 2009
**Robert R. Crispin** (MO0919), Higley, Ariz., USA
**Berry M. Sweedler** (MO4862), Lafayette, Calif., USA ◆

## ISASI Issues Guidelines For Human Factors Investigation

ISASI's International Council members adopted the newly developed *ISASI Guidelines for Investigation of Human Factors in Accidents or Incidents* booklet prepared by Richard Stone, chairman of the ISASI Human Factors Working Group and ISASI executive advisor.

The booklet is an outgrowth of a prior 2-year-long effort to prepare material to help field investigators improve comprehension of human factors in accident investigation by using human factor tools to understand, guide, and report the role the human played in the accident/incident. Unfortunately, the effort's goal was not reached. However the need to provide human factors information relative to accidents and incidents remained a priority for the ISASI Human Factors Working Group.

To fill that need, Chairman Stone secured permission from the Transport Safety Board of Canada and Leo Donita, manager of human factors, to borrow from material the TSB uses in its Human Factors Course taught in Canada and attended by every investigator associated with the Board. The result is the 30-page booklet that highlights issues of human factors or performance in accidents or incidents. It is intended for use by accident investigators-in-charge (IIC) specifically on the subject of human factors. ISASI especially wants to provide these basic concepts to IIC's who haven't had an opportunity to attend formal courses in accident investigation or human factors. However, users should bear in mind that the guidelines are not a substitute for specialists in human factors. The booklet is posted on the ISASI website: http://isasi.org, under the tabs, About ISASI, General, Guidelines.

The following is excerpt from the *Guidelines*.

### Background

Accident statistics show that issues associated with human performance are major contributors to incidents and accidents in commercial aviation and can become the subject of much controversy. Worldwide, investigations vary significantly with respect to the beliefs about the role of humans and appropriate methods for investigating human factors. Ideally, an investigation will seek to understand the context of human

## Correction

The Past Lederer Award Winners listing in the October-December 2009 *Forum*, page 19, inadvertently omitted the following recipients: 1977-Samuel M. Phillips, 1978-Allen R. McMahan, 1979-Gerard M. Bruggink, and 1980-John Gilbert Boulding. Our apologies to these dedicated safety advocates. ◆

## NEW MEMBERS

**Corporate**
Australian and International Pilots Association (AIPA), Australia
Angela Williams, Research & Technical Support Officer
Capt. Barry Jackson, President
AVISURE, Australia
Jeff J. McKee, Principal Research Scientist
Phillip E. Shaw, Managing Director
Nova Aerospace, Australia
Brett Martin, Systems Engineer
Seamus Miller, Systems Engineer

**Individual**
Abdul Wahed, Ismaeil, Dubai, United Arab Emirates
Aziz, Imran, Karachi, Pakistan
Bailey, Mark, N., Surrey, BC, Canada
Barriere, Brendan, J., Melbourne, FL, USA
Bartenstein, Jennifer, A., Manassas, VA, USA
Beyer, Deanna, M., Golden Valley, MN, USA
Bledsoe, Justin, M., Anchorage, AK USA
Bolton, Michelle, A., Deland, FL, USA
Byrne, Alan, J., Vincentia, NSW, Australia
Carl, Cecil, R., Pembroke Pines, FL, USA
Carl, Katherine, B., Pembroke Pines, FL, USA
Cepus, Elvis, Vancouver, BC, Canada
Chopin, Robert, C., Bridgeman Downs, OLD, Australia
Civetti, Chad, R., Wilbraham, MA, USA
Cowell, Steven, R., Denver, CO, USA
Curran, Thomas, F., Malahide, Co. Dublin, Ireland
Dunn, Leigh, M., Leighton Buzzard, Bedfordshire, United Kingdom
Ellis, Clyde, N., Hoover, AL, USA
Evans, Zoe, J., Christchurch, New Zealand
Granger, Scott, C., Powell Butte, OR, USA
Grounsell, Colin, P., Lower Hutt, New Zealand
Hanson, John, M., Prescott, AZ, USA
Henegar, Kristopher, J., Melbourne, FL, USA
Hodges, Nancy, O., Panama City Beach, FL, USA
Hoepel, Jonathan, G., Melbourne, FL, USA
Horton, Curtis, H., Melbourne, FL, USA
Huysmans, Roel, J.M., Koksijde, Belgium
Jackson, Lincoln, B., Kingston, Jamaica
Jones, Richard, A.D., Kingston, Jamaica
Lattimore, David, Auckland, New Zealand
Lomas, Stuart, W., Port Melbourne, VIC, Australia
Marinkovich, Leslie, J., South Auckland, New Zealand
McCarthy, Michael, E., Sanford, FL, USA
McGregor, Andrew, B., Auckland, 0620, New Zealand
McKinnon, Joshua, D., Jacksonville, FL, USA
Mee, Jeffrey, J., Portsmouth, NM, USA
Monteith, David, J., Toronto, ON, Canada
Nicholson, Eric, S., Burkburnett, TX, USA
Odle, William, D., Saint Charles, MO, USA
Pantas, Lee, J., Leesburg, VA, USA
Pellegrino, Gina, T., Rumford, RI, USA
Poole, Michael, J., Frankston, VIC, Australia
Rajnicek, Mary, J., Roseville, MI, USA
Rivera, Edwin, F., Holly Hill, FL, USA
Robbins, Brian, L., Columbus, NJ, USA
Ross, Stewart, G., Fraser, ACT, Australia
Satran, Maximilian, F., Melbourne, FL, USA
Schoenberg, Daniel, I., Melbourne, FL, USA
Schwyzer, Walter, Zell, Switzerland
Sedor, Joseph, M., Ellicott City, MD, USA
Sevillian, Dujuan, B., Wichita, KS, USA
Simen, Nelly, A., Melbourne, FL, USA
Stacy, Phillip, E., Sunbury, Vic, Australia
Staszel, Michael, M., Park Ridge, IL, USA
Steinberg, Markus, HB, Hamburg, Germany
Telya, Murtaza, Palmerston North, Manawatu, New Zealand
Thorpe, Ricki, K., Yukon, OK, USA
Timmermans, Linda, Den Haag, Netherlands
Van Geffen, John, T., San Francisco, CA, USA
Villela, Bruno, T., Port Orange, FL, USA
Weselak, Marissa, K., Melbourne, FL, USA
White, Benjamin, M., Tolland, CT, USA
Wulber, Mark, S., Independence, KY, USA ◆

performance and how it contributes to the observed behaviors and decisions. Whether designing equipment, planning training programs, integrating new aircraft into a fleet, or finding out what went wrong in an accident or incident, understanding the human component is critical to developing and maintaining a safe air operation.

Accident and incident investigation presents a real opportunity to examine the interactions between the human and the other system components. While human factors expertise is available to inform investigations, this expertise is not uniformly applied. By developing new guidelines, ISASI intends to enhance existing guidance documents now available to investigators. ISASI hopes these guidelines will highlight critical areas that affect human performance.

**General statement of suggested policies**
To provide for optimum investigation of the role played by humans in accidents or incidents we suggest

- That all agencies involved in accident investigation endorse the policy that the investigation of human performance proceeds without the presumption of human error or negligence. An investigative process that seeks to ascertain what occurred rather than who was at fault will yield more vital and accurate information. It is currently true that accident investigators can begin an investigation by sifting through pieces of aircraft wreckage and have no presumption of a mechanical fault. It should also be true that investigators can gather data on human performance and the conditions of human performance without presuming human error or negligence.
- The identification of a human "error"—which simply refers to a deviation between the behavior observed or decisions made by a human (e.g., pilot) and the behavior or decision that, *in hindsight*, seemed most appropriate—is the starting point of the investigation into the precursors of human performance contributions to an accident or incident. The identification of "human error" is not a stopping point.
- The collection of human performance data should not be seen as implying that human error is a working hypothesis for the investigation. Initial interviews of operational personnel involved in the accident or incident (e.g., pilots, air traffic controllers, maintenance technicians) should be conducted in a way to maximize the retrieval of information about the event; they should not focus on finding fault with the actions taken or decisions made.
- Every accident or incident investigation should initiate human performance data collection, as soon as possible, for data that are easily lost or tainted with the passage of time.
- That appropriate human factors expertise is brought to bear on all investigations of human performance issues.
- Accident and incident databases worldwide share a common taxonomy for identifying and listing human performance issues so that the databases can be used to track trends over time.
- Investigations to assess criminal behavior alleged to have occurred in an aircraft accident should be carefully conducted so as not to impact negatively the air safety investigation. States that have attempted to conduct both an air safety and criminal investigation concurrently, particularly where human performance is involved, have found negative effects to both investigations. ◆

## Toulouse, France, Is Site of ESASI Seminar

The European Society of Air Safety Investigators has selected Toulouse, France, as the site of its third air safety seminar to be held on April 29-30, with

# ISASI ROUNDUP

***Continued . . .***

an optional technical visit to the Airbus A380 assembly line followed by a meal on April 29. The event will emphasize current European issues in the investigation and prevention of accidents and incidents. Presentations will address current issues in the European environment and the challenges of modern air safety investigations.

Toulouse, also known as la ville rose (Pink Town), is the fourth largest city in France. Located in the southwest of France, within a few hours of the Atlantic Ocean, the Mediterranean Sea, and the Spanish border, Toulouse is a beautiful town filled with friendly people and interesting architecture. It is also the home of the European aerospace industry and, in particular, Airbus

The 2-day program (details to be confirmed) will be held at the École Nationale de l'Aviation Civile (ENAC), situated in the south of Toulouse. Hotel accommodation has been arranged at the Mercure Toulouse Saint Georges with a discounted room rate of 130.90 Euros (taxes and breakfast included). The hotel is located in the Toulouse city center, 500 m from the capitol and 800 m from the Musée des Augustins. Hotel bookings should be made directly with the hotel. Telephone: (+33)5/62277979. Fax: (+33)5/62277900. E-mail: H0370@accor.com.

For seminar bookings and further details, contact ESASI Councillor Anne Evans. Telephone: +44 (0) 1252 510300, e-mail: aevans@aaib.gov.uk; or contact ESASI Secretary John Dunne. Telephone: +44 (0) 7860 222266, e-mail: j.dunne@btinternet.com. ◆

## CSASI, ACPA Score High with Winter Ops Conference

More than 200 persons from 13 countries attended the Canadian SASI and the Air Canada Pilots Association's (ACPA) technical and safety division jointly hosted International Winter Operations Conference held in Ontario, Canada, on Oct. 7-8, 2009. CSASI's president, Barbara Dunn, said the effort carried the theme "Winter Operations: Safety Is No Secret."

"It was an inaugural event at which participants learned how to cope with winter weather in all its forms," said Dunn.

The first day's program began with a welcome from Capt. Paul Strachan, ACPA president. Capt. Robert "Hoot" Gibson (USN, Ret.), mission commander aboard the space shuttles *Challenger, Columbia, Atlantis,* and *Endeavor* gave the keynote address and spoke of the challenges and high points of space travel.

Additional speakers included Chris St. Clair of the Weather Network and representatives from the Toronto and Chicago area airports. Chief Robert Donahue of the Massachusetts Port Authority Fire Rescue Department discussed airport emergency planning, and other excellent presentations on deicing and runway contamination completed the first day's program. That evening found everyone enjoying a welcome reception while catching up with old and new friends.

The same level of excellent presentations continued throughout the second day.

Representatives from Bombardier, Airbus, Embraer, and Boeing presented aspects of winter operations, including airframe and engine icing, both on the ground and in flight, runway contamination, and takeoff and landing performance. Transportation Safey Board and NTSB representatives discussed challenges, past and present, related to flying in winter conditions.

It is hoped that the Conference will become a biannual event. ◆

# ISASI Information

## COMMITTEE CHAIRMEN

*Audit,* Dr. Michael K. Hynes (hynesdrm@aviationonly.com)
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AeroVeritas Aviation Safety Consulting, Ltd.
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Air Astana (Kazakhstan)
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Air Line Pilots Association
Air New Zealand, Ltd.
Airbus S.A.S.
Airclaims Limited
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Aircraft Mechanics Fraternal Association
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AirTran Airways
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American Eagle Airlines
American Underwater Search & Survey, Ltd.
AmSafe Aviation
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Bombardier Aerospace
Bundesstelle fur Flugunfalluntersuchung—BFU
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Cavok Group, Inc.
Centurion, Inc.
Charles Taylor Aviation, Singapore
China Airlines
Cirrus Design
Civil Aviation Safety Authority Australia
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Comair, Inc.
Continental Airlines
Continental Express
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Era Aviation, Inc.
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EVA Airways Corporation
Exponent, Inc.
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Flight Safety Foundation
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GE Transportation/Aircraft Engines
Global Aerospace, Inc.
Gulf Flight Safety Committee, Azaiba, Oman
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Honeywell
Hong Kong Airline Pilots Association
Hong Kong Civil Aviation Department
IFALPA
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Int'l Assoc. of Mach. & Aerospace Workers
Interstate Aviation Committee
Irish Air Corps
Irish Aviation Authority
Japan Airlines Domestic Co., LTD
Japanese Aviation Insurance Pool
Jeppesen
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## WHO'S WHO

# Australian and International Pilots Association

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

Established in 1981, the Australian and International Pilots Association (AIPA) is the professional association representing pilots employed by Qantas Airways Limited and its wholly owned subsidiaries in domestic and international airline operations.

AIPA represents more than 2,600 airline transport-category flight crews and is the largest professional body of airline pilots in Australia. AIPA's membership comprises training captains, captains, first officers, and second officers flying aircraft ranging from regional turboprops to 569-ton Airbus A380s. Its offices are located in Sydney and Melbourne, Australia.

The Association considers flight crews as an essential part of a quality-control process that ensures safety remains at the center of aviation decision-making—an independent role that AIPA believes to be increasingly important within liberalized aviation settings.

In assuming this role, AIPA takes an active stake in the Australian aviation industry by participating in a wide range of government, legislative, and regulatory inquiries and development processes. Internationally, AIPA members are recognized as being among the most experienced flight crews in the world, and AIPA is an active member of the global pilot body, the International Federation of Air Line Pilots' Associations (IFALPA). A number of AIPA pilots hold IFALPA senior executive positions. IFALPA links upward to the International Civil Aviation Organization (ICAO). International airspace, airports, accident investigation, and flight crew licensing are among some of the matters of interest that are dealt with through ICAO.

Both the Australian civil aviation legislation and Chicago Convention 1944 standards clearly define the pilot-in-command's role as being responsible for the safe conduct of a flight. All other considerations, such as the efficient operation of the aircraft, are secondary to the pilot's primary mission of safety.

AIPA, through its Safety and Technical Subcommittee, is committed to protecting and advancing aviation safety standards and operations and ensuring that the views of Australia's professional airline pilots are considered in important safety and technical matters. Recently, the Association has worked with the Civil Aviation Safety Authority to draft regulations in relation to multicrew pilot license, aeronautical information publications, unmanned aerial systems, fatigue risk management systems, and alcohol and other drugs. AIPA is also committed to consulting with the Department of Infrastructure, Transport, Regional Development, and local government on aviation security matters.

Some recent achievements include the signing of a memorandum of understanding with the Australian Transport Safety Bureau in April 2009 to test an expertise sharing arrangement in the interests of improving aviation safety through accident investigation. ◆