The IHTAR Model

BY CHRIS NUTTER AND THOMAS ANTHONY

A three-step process for managing anomalous events — and maintaining aircraft control.

Pilots are problem solvers. Recently, with the proliferation of automated cockpits, problems have elicited the question: "Why is the airplane doing that?" These types of problems, involving *anomalous events* with unknown causes, often are the hardest to solve and present some especially difficult hazards.

Anomalous events can divert the attention of the flight crew from their normal safety-critical duties and create abnormal levels of confusion and pressure. The power of anomalous events to absorb the flight crew's attention cannot be underestimated. In some cases, they have the unnerving and completely absorbing effect of a hand grenade rolling into the cockpit and stopping between the two pilots.

The IHTAR ("I have the aircraft and radios; you have everything else") model is a process for managing anomalous events and preventing them from becoming anomalous emergencies. This procedural model is designed to do two things: first, to maintain the operational integrity of the aircraft ("fly the airplane"); and second, to establish a communication process that facilitates the solving of the anomalous event.

Although exacerbated by increasing automation, the power of anomalous events to seduce flight crewmembers into trying to solve the problem while diverting them from the essential task of flying the aircraft is not new. Several accidents serve as clear examples.

Eastern Airlines Flight 401, a Lockheed L-1011, crashed near Miami on Dec. 29, 1972, following a suspected nose landing gear malfunction on approach, a go-around and assessment of the problem in level flight on a downwind leg. The U.S. National Transportation Safety Board (NTSB) concluded that the flight crew became preoccupied with the malfunction and failed "to monitor the flight instruments during the final four minutes of flight and to detect an unexpected descent soon enough to prevent impact with the ground."

Six years later, on Dec. 28, 1973, the crew of United Airlines Flight 173, a McDonnell Douglas DC-8, heard an unusual noise and felt the airplane yaw when the landing gear was extended on descent to Portland (Oregon, U.S.) International Airport. Air traffic control (ATC) provided vectors to allow the crew time to deal with the problem. About an hour later, the DC-8 crashed near the airport, due to what the NTSB concluded was "the failure of the captain to monitor properly the aircraft's fuel state and to properly respond to the low fuel state and the crewmember's advisories regarding fuel state. This resulted in fuel exhaustion to all engines. His inattention resulted from preoccupation with a landing gear malfunction and preparations for a possible landing emergency. Contributing to the accident was the failure of the other two flight crewmembers either to fully comprehend the criticality of the fuel state or to successfully communicate their concern to the captain."

IHTAR

"I have the aircraft and radios; you've got everything else."

Nearly 29 years later, on Sept. 28, 2007, American Airlines Flight 1400, an MD-82, was departing from St. Louis when the crew observed an engine fire indication and several other abnormalities, including the absence of an indication that the nose landing gear had extended during the return to the airport (*ASW*, 9/09, p. 34). The crew conducted a go-around, used emergency procedures to extend the gear and landed without further incident. The engine fire, which substantially damaged the MD-82, had been caused by an improper starting procedure. Regarding the crew's handling of the anomalous event, NTSB concluded that "the pilots failed to properly allocate tasks, including checklist execution and radio communications, and they did not effectively manage their workload; this adversely affected their ability to conduct essential cockpit tasks, such as completing appropriate checklists."

These crews were all highly trained, experienced and professional. What went wrong?

Anomalous Event Management

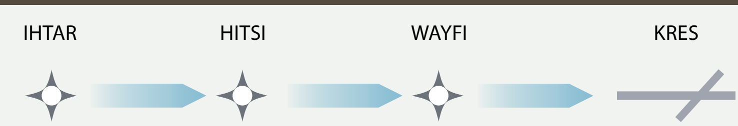
We believe that current airline training programs over-focus on practicing checklist responses to discrete failures. The time has come to integrate procedures that enable the crew to manage and solve anomalous events. The IHTAR model provides a framework for *anomalous event management* (AEM).

This AEM process comprises three steps akin to three waypoints on an airway to resolution (Figure 1). These waypoints are: IHTAR, HITSI and WAYFI. The following scenario illustrates the model in action.

An air carrier aircraft is at 3,000 ft on an instrument approach. Everything is normal until, at about the same moment, the captain — the pilot flying (PF) — and the first officer — the pilot not flying/pilot monitoring (PNF/PM) — notice a warning light illuminate. There is no apparent cause of the configuration warning. The captain acknowledges the situation. The first officer confirms.

The captain then says, “OK, I have the aircraft and the radios [IHTAR]. You’ve got everything else.” The captain stabilizes the aircraft in airspeed, altitude and position. He reiterates to the first officer, “I have the aircraft and ATC. See what you can find out about the condition.” The crew agrees to abort the approach and climb to a safe altitude to manage the problem.

Waypoints to Resolving Anomalous Events



IHTAR = I have the aircraft and the radios, you’ve got everything else.
HITSI = Here is the way I see it.
WAYFI = What are you finding?
KRES = Resolution International

Source: Chris Nutter and Thomas Anthony

Figure 1

The captain tells the approach controller, “We have an aircraft configuration problem and are unable to continue our approach. We need a little time to sort this out.” The controller provides vectors out of the approach pattern and assigns a higher altitude.

The captain stabilizes the aircraft on the assigned vector and altitude, and summarizes the situation: “Here is the way I see it [HITSI]. ATC has taken us out of the pattern, so we have enough time and altitude to look into the warning light situation. Our destination remains the same. Does that sound right to you?” The first officer concurs, and the captain reiterates, “OK, again, I have the aircraft and the radios, you look into the warning light.”

The first officer proceeds to investigate the cause of the warning light. After a suitable interval, the captain asks the first officer, “What are you finding [WAYFI]?”

The captain listens as the first officer reports her assessment but continues to pay primary attention to control of the aircraft. He asks the first officer to restate what she has found so far because something about the assessment does not make sense or seems out of place. The captain seeks clarity or further assessment by saying, “Huh, I wonder why that would be occurring.”

ATC calls and asks if the crew needs more time. The captain replies in the affirmative. Just as this happens, the first officer says, “I think I’ve found it.” She explains the apparent cause of the problem and the solution. The captain affirms that the first officer’s findings are correct and works with her to complete the appropriate checklists.

During this process, the captain has communicated with dispatchers and flight attendants, and apprised the passengers of the situation, while maintaining the aircraft in level flight on the assigned vector and at the assigned altitude.

Having assurance that the aircraft has been returned to normal operating condition, the captain radios ATC: “We are back to normal operations and request the approach.” ATC assigns vectors and an approach clearance, and the flight lands without incident.

In this scenario and in the accident flights summarized previously, the initiating anomalous events were similar, but there were different event management strategies and different outcomes. In the accident flights, there was *no* established process for handling the anomalous events. In this case, the crew used the IHTAR model.

Task Prioritization

The *Oxford English Dictionary* defines *anomalous* as "unequal, unconformable, incongruous." An anomalous event doesn't fit. It doesn't make sense. It's one that we can't figure out. The IHTAR model provides pilots with a means of making sense of an anomalous event and solving it while maintaining control of the aircraft.

The first step, IHTAR — "I have the aircraft and radios, you've got everything else" —effectively accomplishes the "aviate, navigate, communicate" task prioritization that has served so well throughout the history of aviation. It does so as "Job 1" in a deliberate process designed for redundancy using *dynamic maneuvering monitoring* and established checklist procedures to assure flight control. Dynamic maneuvering monitoring clearly identifies roles as to who is expected to monitor what and when — and in doing so, ensures that both crewmembers do not become directly involved in the solution of the anomalous event or fail to ensure that aircraft path and configuration changes are accomplished safely.

The model acknowledges the captain's responsibility to designate the PF and the PNF/PM, and allows for the captain, if desired, to designate the first officer as PF while he or she exercises as PNF/PM what might be vastly more experience in directly working the problem. In any case, IHTAR ensures that one pilot maintains aircraft control and situational awareness, and continues to communicate with ATC, which can provide the time and space needed to allow for resolution of the problem.

The second step, HITSI — "Here is the way I see it" — follows the assignment of the essential flying and problem-assessment tasks, and allows the captain to summarize the situation as he/she sees it and to identify the critical elements. It puts the captain and the first officer on the same page *and*, just as importantly, gives the first officer the opportunity to provide additional insight and perspective in answering the question: "Does that sound right?"

HITSI is a transitional step that allows both crewmembers to start the process of anomalous event management with the same mental picture, minimizing preconceptions.

HITSI

"Here is the way I see it."

While the captain might have more experience to draw from in order to frame the situation, the first officer may also bring perspectives that would help.

The final step, WAYFI — "What are you finding?" — presents an important question that does not focus the first officer on any particular concern or limit cognition to a predefined system or component. Rather, it is open-ended, asking for the view of the situation from another set of eyes and an independent assessment about the initial indication or condition.

WAYFI enables discovery. It does not force the first officer to "solve the problem" and thereby create a condition of myopic problem fixation. Rather, by asking the first officer to report what he/she is finding, it allows the flight crew — as a problem-solving team — the opportunity to notice non-linear, non-obvious relationships that are significant to resolving the anomalous event.

In essence, while the first officer proceeds to investigate and report what he/she is finding regarding the problem, the first officer is the "pilot flying the problem," and the captain is the "pilot monitoring the problem."

Because an anomalous event is a problem that defies direct identification, it is necessary that a method of resolving such situations be able to draw from the combined and complete experience of the flight crew. These situations are ill-suited to linear checklist solutions until the exact cause of the anomalous event is identified. The WAYFI step allows the captain to utilize his comprehensive training in a non-directive manner while monitoring the reports of the first officer. It, in essence, facilitates the subconscious processing of information leading to problem resolution. It evokes perceptions and questions such as, "Huh? That doesn't sound right." It allows the "little voice" at the back of every pilot's mind the opportunity to be heard.

WAYFI is a structured dialog. And dialog, in itself, is *heuristic*, which loosely translates from the Greek *heurka* to: Eureka, I have found it! A heuristic process is a process of discovery. It is a synergistic process that facilitates and generates new insights among the participants. It is like a handball game in which the ball gains energy, rather than loses it, each time it strikes the wall.

Another analogy is William Faulkner's observation about the process of writing. He said, "I never know what I think about something until I read what I've written on it."

New Approach

The evidence that event management should be considered as a new approach in pilot training is compelling.

In their book *The Multitasking Myth*, authors Loukia Loukopoulos, R. Key Dismukes and Immanuel Barshi make the point that standard operating procedures, including emergency procedures, are presented as serial procedures — that is, to be conducted in order, one step at a time.[1] This creates the expectation that emergencies can be resolved in a serial manner. Such is not the case in the real world of aircraft operations and especially not in the case of anomalous events.

NTSB Member Robert Sumwalt, a former airline captain and president of a research organization called Aviatrends, pointed out the critical importance of effective flight crew monitoring skills in a review of several reports and studies (*Flight Safety Digest*, 3/99, p. 1). A common finding among the studies was that many of the observed monitoring problems involved preoccupation with other duties. Sumwalt also noted the finding of a relationship between monitoring errors and the crews' preoccupation with non-monitoring tasks.

The results of a recent study of 1,020 U.S. air carrier and commuter airline accidents from 1990 to 2002 indicated the potential benefit of developing specific event management training, standardized throughout a company and perhaps the commercial aviation industry.[2] The study found that:

- Overall, nearly 70 percent of the commercial aviation accidents were associated with some type of aircrew or supervisory error.
- Approximately half of the accidents were associated with at least one skill-based error, and more than a third involved decision errors.
- Crew resource management (CRM) was a factor in approximately 20 percent of the major air carrier accidents.
- There had been little impact on reducing any specific type of human error over the study period.

The finding that, despite a low accident rate, the industry had not improved on human error for more than a decade, is stunning. It implies that highly trained, experienced and professional crews will continue to make errors that result in fatal accidents. It is a warning shot that we need something new, different, more effective and more reliable to manage anomalous events.

Basic "skills training" may have reached a practical limit, and what may be needed is a well developed event management strategy — a context in which to employ those skills. As the airline industry prepares for an era of retirements, a new generation of pilots and ever-increasing automation, the time

Investigators faulted the flight crew's task allocation after an engine fire and several other abnormalities afflicted an MD-82 in 2007.

U.S. National Transportation Safety Board has come to improve what hasn't worked and to lay a foundation for more effective training.

Training for the Real World

We believe that anomalous event management training, as represented in the IHTAR model and with associated AEM policies and procedures, can improve airline pilot training programs. AEM involves a comprehensive plan and a disciplined execution. Training today does not emphasize enough how to develop that plan and how to execute the plan in a manner that keeps everyone "on task" and avoids distraction, omission and undetected error.

It should be recognized as well that problem-solving in an environment pressurized by an anomalous event presents an additional factor that must be included in the training syllabus.

Many of today's training programs are excellent, but accident/incident investigations and data analyses have shown that we need new training that embraces real-world factors and incorporates a new topic: event management. The industry needs to design, develop and train new ideas for systematic methods to manage events; use redundant processes to assure a high reliability operation; and integrate CRM, threat and error management (TEM) and line operations safety audit (LOSA) lessons and best practices.

In a column titled "Myths and Training," William R. Voss, president of Flight Safety Foundation, raised the same issues in relation to the Air France 447 accident (*ASW*, 7–8/11, p. 1):

"This tragedy compels us to ask some tough questions about training. Do we spend so much time driving simulators around at low altitudes with one engine out that the real risks are only discussed in the break room? This issue extends far beyond Air France and Airbus; it is about an industry that has let training get so far out of date that it is irrelevant, and people are left filling in the blanks with folklore."

While flying as a line captain for US Air, Robert Sumwalt established a cockpit procedure similar to the IHTAR call-out to clearly identify who was flying the aircraft and who had responsibility to perform other tasks.

Regarding the Jan. 15, 2009, ditching of US Airways 1549 in the Hudson River, NTSB concluded that a contributing factor in the survivability of the accident was "the decision making of the flight crewmembers and their crew resource management." This accident highlighted the challenges that crews face in managing abnormal and emergency events, and the success that is achievable when these events are well-managed.

WAYFI

"What are you finding?"

The IHTAR model directly addresses the challenges presented by anomalous events, giving crews a redundant, highly reliable and repeatable process to initiate AEM. Dynamics will always impose requirements to modify the process, but at least a well-trained AEM process can help crews embark on a path to maintain aircraft control and logically manage all of the components of an event for a successful conclusion.

We believe that the IHTAR model establishes an AEM procedure that optimizes the abilities of a crew to communicate and resolve anomalous events before they become anomalous emergencies.

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Notes

1. Loukopoulos, L.D.; Dismukes, R.K.; Barshi, I. *The Multitasking Myth: Handling Complexity in Real-World Operations*. Burlington, Vermont, U.S.: Ashgate Publishing Co. 2009.

2. Shappell, S.; Detwiler, C.; Holcomb, K.; Hackworth, C.; Boquet, A.; Wiegmann, D. *Human Error and Commercial Aviation Accidents: A Fine-Grained Analysis Using HFACS.* DOT/FAA/AM-06/18. FAA Office of Aerospace Medicine. July 2006.