BY ROBERT I. BARON

How much are we *really* learning from accidents?

Double Trouble

Accident investigations yield useful information. But is all this information actually being fed back to the system and acted upon?

The primary objective of accident investigations is to determine the causal factors and to use that information to prevent that type of accident from occurring again. However, the same types of accidents still occur.

Through no fault of the accident investigation agencies around the world, the industry is not doing a very good job of assimilating their findings into effective training examples in the classroom.

Although the sequence of factors leading up to an accident may be complex, the final triggering mechanism itself often is simple — such as taking off with ice on the wings or intentionally descending below landing minimums when a go-around should be conducted. In most cases, these triggering events can be ascribed to fundamental decision errors by the crew.

These are what I label *thematic accidents*. Four such thematic accidents, with almost identical probable causes, occurred over a 21-year period (Table 1, p. 40). The probable causes are extracted verbatim from the official accident reports.

The first of these four accidents occurred in 1987, the most recent in 2008. Each was attributable to deficiencies in checklist usage, adherence to standard operating procedures and cockpit discipline. Each crew failed to set the flaps/slats for takeoff and, in each case, the takeoff configuration warning system was inoperative for unknown reasons. If the warning systems had been functional, these accidents could have been prevented.

This shows how much trust we bestow on a defense that should warn of impending danger. Unfortunately, in each of the accidents, that defense was not available. Additionally, in the Northwest Flight 255 (1987) and Delta Air Lines Flight 1141 (1988) accidents, there were flagrant violations of the "sterile cockpit" rule. The Northwest pilots were chatting about non-flight-related items during taxi (in lieu of executing the proper "Taxi" and "Before Takeoff" checklists). In the Delta accident, the pilots and a flight attendant riding in the jumpseat were discussing the dating habits of flight attendants and — in reference to being recorded by the cockpit voice recorder — how they needed to leave something for their wives and children to listen to in case they died.

Why, after the first accident in 1987, did we not learn enough to prevent the same type of accident? In fact, it was just one year later that the almost identical Delta accident happened. It could be argued that, despite the shock factor of Northwest 255, the full investigation into that crash was still not complete. Then, it appears, from 1988–2005, there was a "latent period" for this type of accident.

Was it because of lessons learned? Maybe the significance of the Northwest and Delta accidents finally got the attention of global airlines — or maybe not; in 2005, the same accident occurred again (Mandala Airlines Flight 091), and again in 2008, with the crash of Spanair Flight 5022.

The Spanair accident occurred although there had been *three almost identical accidents* to learn from over the previous 21-year period. This was just one of numerous recurring accident themes that could have been chosen.[1]

True, major accidents of the past *have* been catalysts for important safety initiatives such as ground-proximity warning systems, smoke detectors and automatic fire extinguishers in lavatories and cargo holds, on-board wind shear detection equipment and crew resource management (CRM). But, while these initiatives have made a remarkable improvement in safety, we still need to shore up the human performance aspects of flight operations. Each of the aforementioned accidents was caused by a lapse in human performance.

The following recommendations are offered to overcome the apparent gap between the rich data available from accident reports and the effective assimilation of those data. The recommendations focus on the recurring accident theme highlighted in this article.

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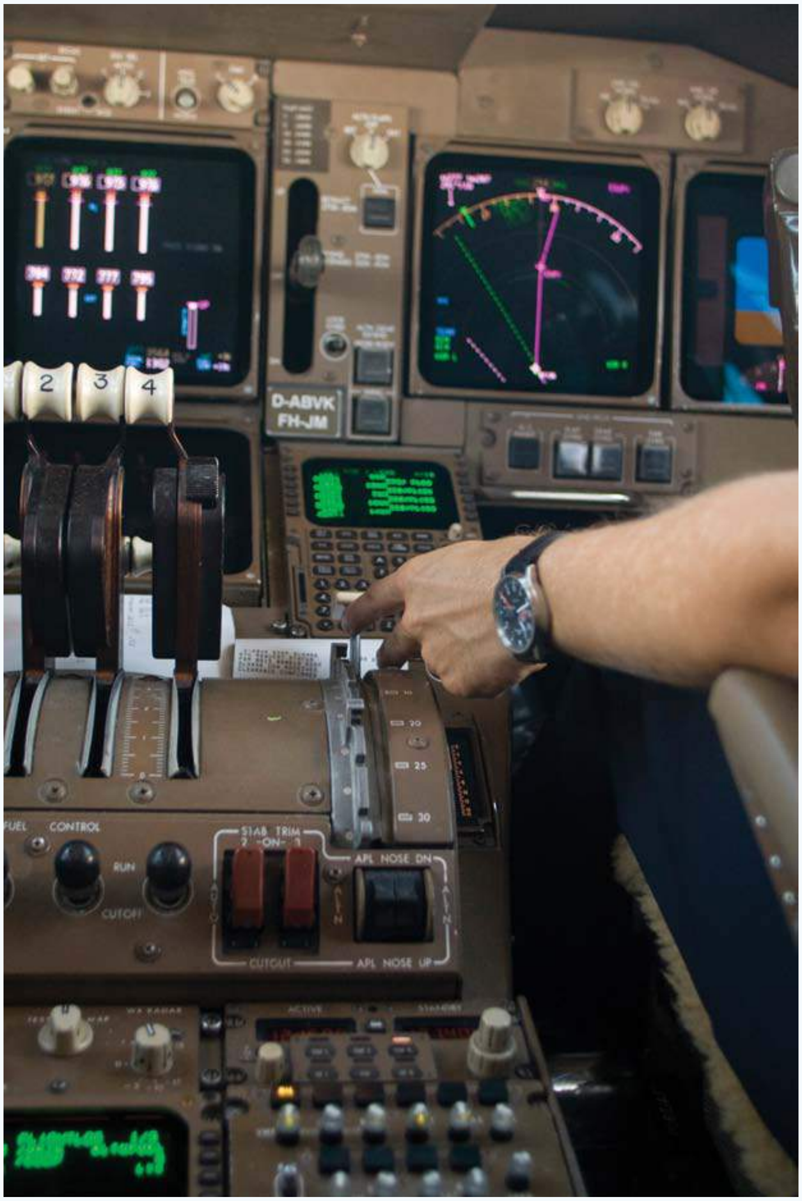
Air Traffic Control

Military air traffic controllers have long used the "check gear down" reminder for pilots of landing aircraft. This has prevented a number of gear-up accidents. The same type of reminder should be considered for civil aviation, particularly airline operations. Why not make it a requirement for



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Selected Accidents Involving Flaps/Slats Incorrectly Set for Takeoff

1987: Northwest Flight 255 (McDonnell Douglas DC-9); Crashed shortly after takeoff at Detroit Metro Airport; 156 fatalities

The U.S. National Transportation Safety Board (NTSB) determines that the probable cause of the accident was:

The flight crew's failure to use the taxi checklist to ensure that the flaps and slats were extended for takeoff. Contributing to the accident was the absence of electrical power to the airplane takeoff warning system, which thus did not warn the flight crew that the airplane was not configured properly for takeoff. The reason for the absence of electrical power could not be determined.

Source: NTSB Aircraft Accident Report: NTSB/AAR-88/05

1988: Delta Flight 1141 (Boeing 727); Crashed shortly after takeoff at Dallas-Fort Worth International Airport; 14 fatalities

The NTSB determines the probable cause of this accident to be:

(1) The captain and first officer's inadequate cockpit discipline, which resulted in the flight crew's attempt to take off without the wing flaps and slats properly configured; and (2) the failure of the takeoff configuration warning system to alert the crew that the airplane was not properly configured for the takeoff.

Source: NTSB Aircraft Accident Report: NTSB/AAR-89/04

2005: Mandala Airlines Flight 091 (Boeing 737); Crashed shortly after takeoff at Polonia International Airport in Medan, Indonesia; 149 fatalities

The National Transportation Safety Committee of Indonesia (NTSC) determines that the probable causes of this accident are:

- The aircraft took off with improper takeoff configuration, namely with retracted flaps and slats, causing the aircraft [to fail] to lift off.
- Improper checklist procedure execution had led to failure to identify the flap in retract position.
- The aircraft's takeoff warning horn was not heard on the … CVR [cockpit voice recorder]. It is possible that the takeoff configuration warning horn was not sounding.

Source: NTSC Aircraft Accident Report: KNKT/05.24/09.01.38

2008: Spanair Flight 5022 (McDonnell Douglas MD-82); Crashed shortly after takeoff at Barajas Airport in Madrid, Spain; 154 fatalities

The Comisión de Investigación de Accidentes e Incidentes de Aviación Civil of Spain (CIAIAC) has determined that the accident occurred because:

- The crew lost control of the aircraft as a result of a stall immediately after takeoff, because they did not have the correct plane configuration for takeoff (by not deploying the flaps and slats, following a series of errors and omissions), coupled with the absence of any warning of the incorrect configuration.
- The crew did not recognize the indications of stall, and did not correct the situation after takeoff, and — by momentarily retarding the engine power and increasing the pitch angle — brought about a deterioration in the flight condition.
- The crew did not detect the configuration error because they did not properly use the checklists to select and check the position of the flaps and slats during flight preparation, specifically:
  - They failed to select the flaps/slats lever during the corresponding step in the "After Start" checklist;
  - They did not cross-check the position of the lever and the state of the flaps/slats indicator lights during the "After Start" checklist;
  - They omitted the flaps/slats check under "Takeoff Briefing" (taxi) checklist; [and]
  - The visual inspection carried out in execution of the "Final Items" step of the "Takeoff Imminent" checklist — no confirmation was made of the position of the flaps and slats, as shown by the cockpit instruments.

The CIAIAC determined the following contributory factors:

- The absence of any warning of the incorrect takeoff configuration because the TOWS [takeoff warning system] did not work. It was not possible to determine conclusively why the TOWS did not work.
- Inadequate crew resource management, which did not prevent the deviation from procedures and omissions in flight preparation.

Source: CIAIAC Aircraft Accident Report: A-032/2008

Table 1

air traffic controllers to add the phrase "check configuration" when the pilots receive their takeoff clearance? I would bet that this simple, additional safety net would have prevented most of the accidents mentioned.

Flight Attendant Awareness

Flight attendant training should include an increased awareness of misconfiguration issues. Because flight attendants still are walking through the aisles during the pre-takeoff cabin check, and the aircraft by this time should have flaps extended for takeoff, they are in an excellent position to detect a misconfiguration. However, it should be made clear to the flight attendants that *not all* aircraft require flaps to be extended for takeoff. Ensure that the information is aircraft-specific.

Focused Flight Crew Training

Although some links in the accident chain can be traced to the organizational level, the responsibility for prevention of these types of accidents still lies squarely on the flight crews, as they are the last line of defense. Thus, an approach consisting of more focused flight crew training and awareness is appropriate. All four accident examples occurred due to deficiencies in human performance — centered primarily on handling interruptions, sterile cockpit procedures and checklist usage — involving unprofessional behavior and lack of discipline.

Some of these deficiencies are *externally propagated*, or beyond the pilot's control, such as interruptions, the effects of which can be addressed with good threat-and-error management skills. Other deficiencies may be *internally propagated*, for example, when crews violate the sterile cockpit rule. In this case, the pilots have full volition, and thus control, of their behaviors. Additional focus should be aimed at these types of internally propagated behaviors.

More Effective Use of Accident Reports

My final recommendation is to enhance learning by making more, and better, use of the rich data available from accident reports. Thematic accidents should receive special attention. This can be accomplished by using relevant case studies and crafting a learning module that not only stimulates the pilots' attention, but also enhances *retention*. I have seen, and heard of, too many CRM courses that simply rehash the Tenerife runway disaster and/or the American Airlines crash near Cali, Colombia.

While in no way diminishing the importance of learning valuable lessons from these accidents, I believe that they have been studied to excess. We need to be more forward-thinking and focus on current accidents whose causes are more elusive. I am confident that CRM and threat-and-error management trainers can craft more effective learning modules that produce better retention and transfer to the real world. I wrote "learning modules" rather than "training modules" because the emphasis is on *learning* from other crews' errors and misfortunes. We are not simply training to prevent accidents; we want to develop better critical thinking and error-avoidance skills.

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Note

1. Space does not allow for a discussion of the research related to the pre-departure and taxi phases of flight. See, however, the work of R. Key Dismukes and his colleagues at NASA Ames Research Center's Flight Cognition Laboratory, <humansystems.arc.nasa.gov/flightcognition>. Dismukes et al. have conducted extensive studies related to, among others, *checklist usage, interruptions, concurrent task demands*, and *prospective memory*, each being highly relevant to all the accidents presented in this article. An increased understanding of these factors is imperative in preventing further accidents of these types.