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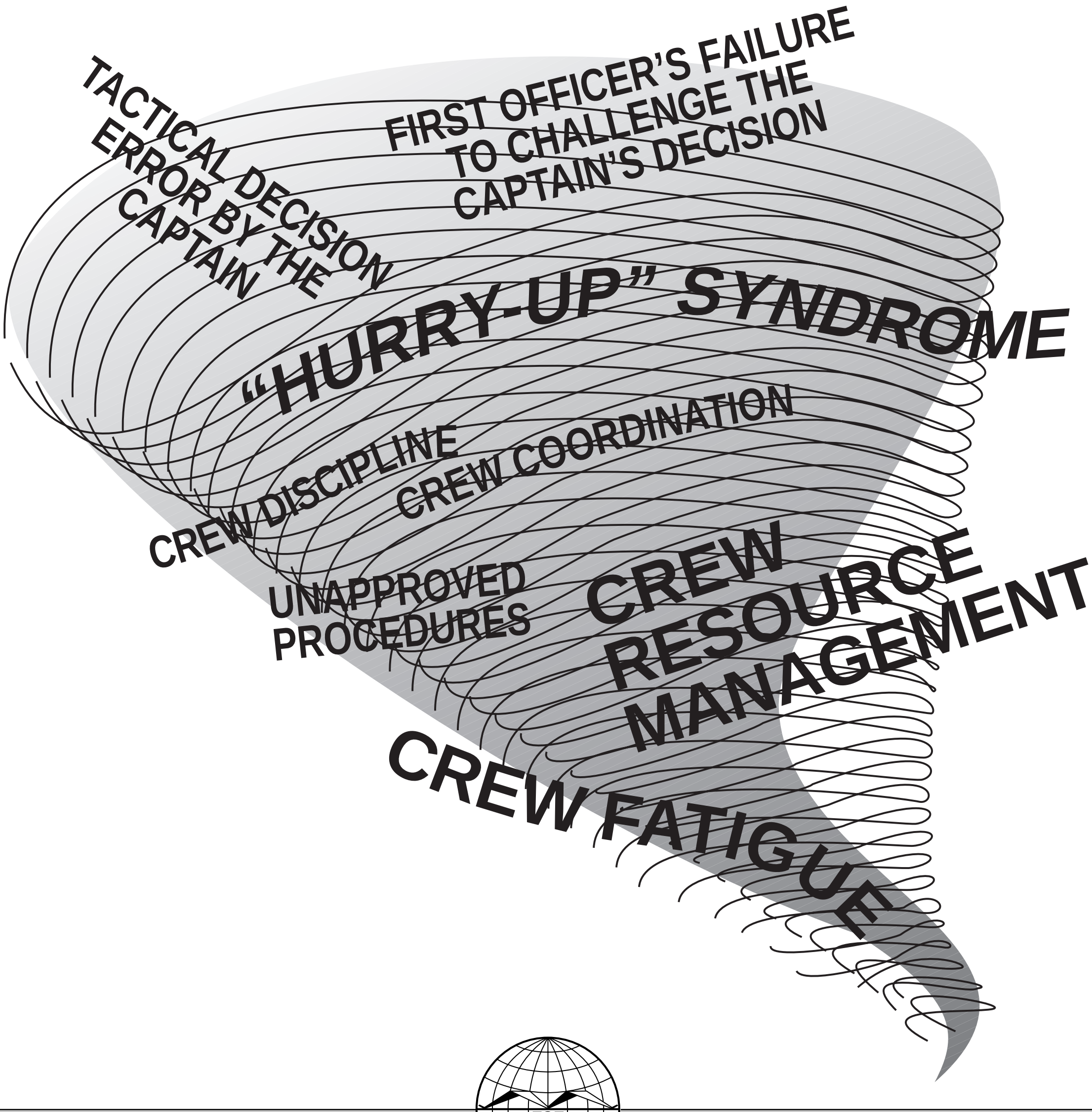
Comparing Accident Reports: Looking Beyond Causes to Identify Recurrent Factors



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In This Issue

Flight Safety Foundation (FSF) is an international membership organization dedicated to the continuous improvement of flight safety. Nonprofit and independent, FSF was launched in 1945 in response to the aviation industry's need for a neutral clearinghouse to disseminate objective safety information, and for a credible and knowledgeable body that would identify threats to safety, analyze the problems and recommend practical solutions to them. Since its beginning, the Foundation has acted in the public interest to produce positive influence on aviation safety. Today, the Foundation provides leadership to more than 660 member organizations in 77 countries.

Comparing Accident Reports: Looking Beyond Causes to Identify Recurrent Factors

Individual accident reports show what went wrong on a particular occasion. But comparing reports can reveal recurrent factors that need attention. A review of several accident reports raises questions about crew fatigue, the "hurry-up" syndrome and crew interaction.

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From May 1994 to January 1995, Flight Safety Foundation published nine issues of *Accident Prevention*. Each issue contained a concise article, without editorial comment, about a U.S. National Transportation Safety Board (NTSB) accident investigation final report on one specific aircraft accident. Read thoughtfully as a group, eight of the issues presented an opportunity to determine if causal factors common to two or more accidents suggested recurrent factors and — more important — to determine if actions could be taken to prevent them from recurring.

Ascertaining the causal factors in any individual accident can suggest problems that need to be addressed. But studying causal factors that appear as common denominators in multiple accidents helps us to advance one further step — namely, to set priorities when formulating regulations and procedures to enhance aviation safety. When themes emerge from the background, we know better how to concentrate resources.

This article examines the accidents reported in those eight issues and the ways that they are similar to each other, to identify any recurrent factors. Moreover, accidents are also discussed that involved similar factors and were reported in earlier issues of *Accident Prevention* and in two issues of *Flight Safety Digest*. Finally, some findings and recommendations from a 1994 NTSB safety study of 37 flight crew–involved accidents[1] are included because they are relevant to the recurrent factors that were identified in this article.

Accident Prevention Vol. 51, No. 7 (July 1994) concerns a Cessna 402B, operated by Tropic Air, that crashed near San Pedro Airport, Ambergris Cay, Belize, on April 1, 1991, while maneuvering for another approach after a go-around that had been caused by congestion on the airport ramp. The accident report was prepared by the Belize civil aviation department and stated that while "there is no evidence which permits the investigation to determine with certainty the actual cause of the accident, it is considered a reasonable deduction that the pilot was unfit for flight due to fatigue, [that] he stalled the aircraft while flying a very low downwind with the landing gear down and [that] the aircraft was much too low to recover from the stall." Accident investigation authorities noted that in the 28 days before the accident, the pilot had flown more than 41 hours beyond the maximum duty time allowed by law, and had been on duty more than 30 hours in the 2.5 days before the accident.

Accident Prevention Vol. 51, No. 10 (October 1994) discusses the August 1993 crash of an American International Airways

Douglas DC-8-61 freighter while on an approach to the U.S. Naval Air Station, Guantanamo Bay, Cuba, during daylight in visual meteorological conditions (VMC).

The NTSB report said: "The probable causes of this accident were the impaired judgment, decision-making and flying abilities of the captain and flight crew due to the effects of fatigue; the captain's failure to properly assess the conditions for landing and maintaining vigilant situational awareness of the airplane while maneuvering onto final approach; his failure to prevent the loss of airspeed and avoid a stall while in [a] steep bank turn; and his failure to execute immediate action to recover from a stall."

The NTSB cited three background factors that are normally examined during accident investigations for evidence of fatigue: cumulative sleep loss, continuous hours of wakefulness and time of day. It went on to say, "The Safety Board's examination of the flight and duty time revealed the captain had been awake for 23.5 hours at the time of the accident, the first officer for 19 hours and the flight engineer for 21 hours. The crew had been on duty about 18 hours and had flown approximately nine hours at the time of the accident. The accident occurred at 1656, at the end of the afternoon physiological low period. The crew members had been awake for the preceding two nights and had attempted to sleep during the day, further complicating their circadian sleep disorders. Therefore, the evidence in this accident shows that the flight-crew members met all three of the scientific criteria for susceptibility to the debilitating effects of fatigue."

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In a DC-10 accident described on page 5, the NTSB report observed: "Finally, in light of the captain's improper control during the landing roll, the relatively long duration of his overnight flight, and the fact that the captain's sleep periods were disrupted in the 48 hours prior to the accident, the Safety Board considered the possibility that fatigue adversely affected his performance. These factors and the captain's age of 59 years led the Safety Board to believe that the captain might have been fatigued to some extent. Even though the circumstances surrounding the flight crew's activities from April 12 through 14 could have led to a deterioration of his judgment and piloting skills, there is no information available regarding the captain's ability to perform under either long-term or short-term fatigue. Therefore, a finding that his performance on the accident flight was the result of fatigue could not be supported, nor could it be dismissed."

In an Embraer accident described on page 7, NTSB investigators found that "for the two nights before the accident, the pilots averaged only about five to 5.5 hours of sleep per night. The accident occurred after a long and relatively difficult day of flying and on the last leg when the crew anticipated getting home. Further, the accident occurred late in the afternoon when the human body normally reaches a physiological low level of performance and alertness. The Safety Board believes that the combined effects of cumulatively limited sleep, a demanding day of flying and a time of day associated with fatigue had an effect on crew performance."

The three factors in the accident cited by the NTSB as evidence for fatigue — cumulative sleep loss, continuous hours of wakefulness and time of day — cannot always be counteracted by the simple application of flight and duty time restrictions or limitations.

Methods for predicting or measuring fatigue — such as calculating hours flown, type of weather, day or night flights, the number of instrument approaches, landings and takeoffs within the hours flown, rest time vs. duty time, etc. — continue to provoke discussion. All of these objective factors have a significant relation to fatigue, but we are less sure about the effects of other, more subjective, factors (such as pilot psychology or physiology). How stress can affect a person's fatigue has always been very difficult to measure, because each person has a different capacity to withstand stress.

Further complicating fatigue assessment is how a pilot spends rest time between scheduled flights, or between unscheduled "pop-up" flights. Flying for a U.S.-certificated air carrier is usually performed according to a monthly schedule based on flight-time and duty-time regulations that should allow sufficient rest time before the next flight. What an airline, regulation or flight schedule cannot dictate is how the pilot spends his rest time. That time, of course, can be spent on any number of nonrestful activities, even though the implied requirement is that a pilot should report for duty rested and physically fit.

One circumstance that is frequently overlooked is how a pilot's duty day may begin. Many pilots must commute some distance to an airport and it is common for a pilot to report one to two hours before departure to prepare for the flight. Assume that the first flight of the day is scheduled to depart at 0700 hours. If the plan is to report 1.5 hours before takeoff time, that makes the reporting time for that flight 0530. Assume that the pilot needs at least one hour for the commute to the airport. So, departing the resting place should be at no later than 0430. That means that the pilot should leave a wake-up call for 0330 (leaving time to shower, breakfast, etc.). The duty day will not officially start until the pilot reports at the airport, but the pilot has already begun to accumulate some degree of fatigue. How much high-quality rest should the pilot have had to arrive physically fit and ready for the flight? At what point during the duty day does the pilot reach the fatigue saturation point?

In all the four accidents previously discussed, the requirements of the flights placed the flight crews into situations that would be conducive to fatigue. Crews, although warned that flying when fatigued can degrade judgment and reaction time, are usually unwilling to decline a mission. Not only would such a declaration seem to undermine the self-confidence that is a necessary part of pilot psychology, but it might displease the pilot's employers.

This tendency to avoid recognizing fatigue must change — and for that to happen, both pilots and operations management must learn to look at the subject differently. Pilots should be in touch with their own fatigue level. If they determine that their alertness is seriously compromised, they should refuse to fly, or turn control of the aircraft over to a crew member (if one is available) who is in better condition and better able to ensure a safe flight.

Management must remind itself every day that the majority of accidents are caused by human factors, to which fatigue often contributes. Insisting that pilots fly on schedules that are unduly demanding physically and psychologically (resulting in subpar performance), or refusing to recognize that pilots may occasionally, through no fault of their own, be too fatigued to fly safely is short-sighted and irresponsible management.

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One variable considered in the comprehensive 1994 NTSB safety study was crew-member time since awakening (TSA). Flight crews that had been involved in accidents were classified according to whether their TSA was above or was below the median for their crew position.

It was found that there were no significant differences between high-TSA crews and low-TSA crews in what were classified as "errors of commission." But high-TSA crews made an average 5.5 "errors of omission" vs. an average 2.0 errors for low-TSA crews. "These results," the report said, "suggest that the decrements in performance by high-TSA crews tended to be in the form of ineffective decision making, such as 'failed to perform a missed approach,' and procedural slips, such as 'did not make altitude-awareness call-outs,' rather than a deterioration of aircraft handling skill."[2]

In that safety study, the NTSB recommended that the FAA "require air carriers to include, as part of pilot training, a program similar to the NASA [U.S. National Aeronautics and Space Administration]-Ames Fatigue Countermeasures Program, to educate pilots about the detrimental effects of fatigue, and strategies for avoiding fatigue and countering its effects."[3]

"Hurry-up Syndrome" a Frequent Killer

Accident Prevention Vol. 51, No. 8 (August 1994) described the October 1993 crash of a Beechcraft Super King Air 300/F, operated by the FAA to inspect navigational facilities. The King Air had departed Winchester Regional Airport, Winchester, Virginia, U.S., after inspecting the localizer approach facility at that airport. In their haste to reach the next destination before their workday expired, the flight departed under visual flight rules (VFR) and attempted to obtain an instrument flight rules (IFR) clearance from air traffic control (ATC) once airborne. The NTSB reported that, after contacting ATC, the crew was told to maintain VFR and to stand by because of controller workload. Eleven minutes later, the crew was advised to change to a different frequency for an IFR clearance. Before the crew could acknowledge the frequency change, the airplane crashed into a ridge line about 15 miles south of the airport. Instrument meteorological conditions (IMC) prevailed at the time of the accident.

"The probable causes of this accident," said the NTSB, "were the failure of the pilot-in-command to ensure that the airplane remained in visual meteorological conditions over mountainous terrain, and the failure of the Federal Aviation Administration executives and managers responsible for the FAA flying program to: (1) establish effective and accountable leadership and oversight of flying operations; (2) establish minimum mission and operational performance standards; (3) recognize and address performance-related problems among the organization's pilots; and (4) remove from flight operations duty pilots who were not performing to standards."

Some circumstances in this accident are similar to a Beechjet (Be400) accident that occurred in December 1991, near Rome, Georgia, U.S. (*Accident Prevention*, Vol. 49, No. 10, October 1992).

In the Beechjet accident, the company-owned aircraft was transporting corporate executives on a tour of a chain of supermarkets and related stores. The trip was running slightly behind schedule and, although the captain filed for an IFR departure, the aircraft departed Rome under VFR in marginal VFR weather conditions. When the captain called ATC for an IFR clearance, Atlanta Air Route Traffic Control Center (Atlanta Center) told the flight to maintain VFR because "we have traffic four and five right now southeast of Rome. We will have something for you later." Some three minutes after takeoff, the aircraft crashed near the 1,701-foot [519-meter] mean sea level (MSL) summit of Mt. Lavender, about six miles west of the Rome Airport.

The first similarity is that the King Air and the Beechjet captains were attempting to save time by departing VFR in marginal weather conditions, intending to pick up an IFR clearance after becoming airborne. In both instances, the aircraft crashed before the IFR clearance could be obtained.

In these demonstrations of the “hurry-up syndrome,” minutes may have been saved but all lives were lost.

In commercial and corporate aviation, the hurry-up syndrome usually appears when a flight has been delayed and the flight crew feels pressured to make up for lost time. The NTSB safety study looked for correlations between flight-delay status and accidents. Of the 31 accident flights in the study for which schedule information was available, 17 (55 percent) were delayed. Of those 17 delayed accident flights, seven (41 percent) involved weather as a causal or contributing factor to the accident; thus, a majority (59 percent) of the delayed flights did not involve weather as a factor in the accident.

Data from the accident flights were compared with a sample of on-time performance statistics for nonaccident flights during each December, 1987 through 1992, which were compiled by the U.S. Department of Transportation (DOT). “Compared to the sample of nonaccident flights,” the report said, “a larger proportion (55 percent) of accident flights were running late. This held true whether considering nonaccident flights that departed late” (between 17 percent and 28 percent of the flights) “or arrived late” (between 21 percent and 35 percent).

“Flight delays can be a source of perceived time pressure for flight crews,” the NTSB safety study said. “The Safety Board notes that the difference in flight delay status between the 31 accident flights for which data were available and the nonaccident sample is not inconsistent with anecdotal evidence of a relationship between time pressure and flight-crew errors in the air carrier environment.”[4]

… the first officer … had complained to … the company “that the captain was operating the airplane in violation of FARs and in disregard of good operating practices.”

Another similarity exists in the attitudes of the captains and their relationships with their first officers or second-in-command pilots.

The NTSB report on the King Air accident said: “The [captain’s] supervisor … stated that there were significant objections to his selection for the PIC [pilot-in-command] position. Several of the SICs [second-in-command pilots] expressed a desire not to fly with him at that time.”

The NTSB report continued: “During interviews at the Atlantic City FIAO [Flight Inspection Area Office], Safety Board investigators were told by flight crewmembers that the PIC involved in the accident had demonstrated poor judgment on previous flights. It was alleged that he had: continued on a VFR positioning flight into IMC; conducted VFR flight below clouds at less than 1,000 feet [305 meters] above the ground in marginal weather conditions; replied to an ATC query that the flight was in VMC when it was in IMC; [and] disregarded checklist discipline on numerous occasions.”

After noting that the PIC had performed a “below–glide path check” in IMC when VMC conditions were required, the NTSB report added: “Following this (below–glide path) incident, the SIC formally complained to the flight operations/scheduling [section] supervisor for management resolution of this matter; however, no action was taken.”

In the Beechjet accident, the NTSB report noted, “[the captain] had mentioned to a close acquaintance that he believed that the first officer occasionally paid unnecessary attention to checklists.” The captain reportedly said that he did not believe that it was necessary to read the airplane checklist verbatim “because he had considerable experience in the airplane.”

The NTSB report noted that several pilots who had flown with the captain had observed him performing what they considered questionable practices. The NTSB report said, “One pilot noted that the captain did not conduct departure briefings and, on occasion, would fly through or very close to thunderstorms. The captain was also observed to fly below decision height without having the runway or its associated lights or markings in sight.” A pilot who had flown as first officer with the captain believed that the captain “did not have a complete understanding of U.S. Federal Aviation Regulations (FARs). He saw the captain cancel his IFR flight clearance and descend through clouds to locate an airport and, on another occasion, he saw the captain descend below decision height before identifying the runway.”

NTSB investigators were told that the first officer on the Beechcraft accident flight had complained to an executive of the company “that the captain was operating the airplane in violation of FARs and in disregard of good operating practices.” When questioned by the NTSB, the executive denied receiving complaints from the first officer.

The captains in the King Air and Beechcraft accidents seem to have had much in common. Both tended to disregard FARs and good operating practices, and believed that departing under VFR in marginal weather conditions on the assumption that ATC would issue an IFR clearance without delay would not only save time but would be acceptably safe.

Both captains were flying with first officers who disapproved of their respective captains’ operating practices, and whose complaints about the captains to management had been disregarded or denied. That raises the question as to what action would be appropriate for a first officer/SIC who finds the safety of his or her flight being compromised by a captain who has little regard for or knowledge of the FARs, or has contempt for checklists. Whether it be a government operation, such as the FAA flight, or a corporate business aircraft operation, how should management treat a complaint? In the interest of personal safety, is the first officer's/SIC's best option a quietly submitted resignation and, if that course is followed, what repercussions might be anticipated?

Captain Takes Control Suddenly

Accident Prevention, Vol. 51, No. 5 (May 1994) describes an American Airlines flight from Honolulu, Hawaii, U.S., to Dallas/Fort Worth, Texas (DFW), that departed the right side of Runway 17L following landing on April 14, 1993. There were injuries to passengers and crew members during the evacuation. Damage to the airplane was estimated at US$35 million and because of the repair costs, the hull was considered destroyed.

The NTSB determined that the probable cause of the accident was "the failure of the captain to use proper directional control techniques to maintain the airplane on the runway."

Weather was of serious concern as the DC-10 made its approach to DFW. After being handed off from the ARTCC to DFW approach control, the flight engineer briefed the captain on the current automatic terminal information service (ATIS) as follows: "Echo, 1,400 feet [427 meters], overcast, 2.5 miles [four kilometers] visibility, winds 220 at six, altimeter 29.49 inches (998 millibars), lightning cloud-to-cloud, cloud-to-ground, thunderstorms moving northeast and pressure falling rapidly."

The NTSB report said that the first officer was flying the airplane but did not state whether this was because it was a monitored approach (in which the first officer is the pilot flying and the captain monitors the instruments until the runway environment is in sight, at which point the captain takes control and lands the airplane) or whether it was, as part of a normal routine, the first officer's leg to fly to a full-stop landing.

After the DC-10 was cleared for the approach, "the first officer," said the NTSB report, "requested that the captain and flight engineer be alert for any indication of wind shear. The captain encouraged him to carry 10 to 15 knots of extra airspeed and the first officer assured him that he would do so." About three minutes later, "the captain reported a 10- to 15-knot gain in airspeed … ."

The DFW tower controller cleared the flight to land and informed the flight crew that winds were calm. The airplane was in a 10-degree right crab to compensate for a right crosswind. The flight engineer reported descending through 500 feet [152.5 meters] and the captain reported the runway lights in sight. About 30 seconds later, the captain said, "I've got a plus ten, sinking a thousand." Thirteen seconds later, the automated cockpit voice called out "50" (feet [15.2 meters]), and the first officer said, "I'm gonna go around." The captain stated, "No, no, no, I got it." The first officer responded, "You got the airplane." According to the NTSB report, the captain took control and landed the airplane. The DC-10 touched down 4,303 feet (1,312 meters) beyond the runway threshold, paralleled the runway centerline for approximately 1,700 feet (518 meters), then turned gradually to the right until it went off the runway, coming to rest upright about 2,607 feet (795 meters) from the departure end and 250 feet (76 meters) from the right edge of the runway.

The NTSB report said, "The first officer said that after the captain took control of the airplane, the airplane seemed to 'float,' and that he was not sure where the touchdown was made. The CVR [cockpit voice recorder] data showed that the first officer made call-outs expected of the nonflying pilot. After the landing, he did not hold forward pressure on the control yoke after the nosewheel touchdown. He said it was not normal procedure to do so unless he was previously briefed. When asked his opinion regarding the captain continuing the approach to landing after the first officer judged the need to initiate a missed approach, the first officer replied, 'I've got to trust him.'"

" … prior to the beginning of the airplane's approach to DFW, no briefings on approach, landing or go-around procedures, emergency or otherwise, were conducted."

NTSB investigators found that "prior to the beginning of the airplane's approach to DFW, no briefings on approach, landing or go-around procedures, emergency or otherwise, were conducted. Without an approach briefing, the flight crew must fall back upon standardized operational training."

The NTSB report went into considerable detail about the airline's operational procedures and operating techniques.

The NTSB report concluded that the captain was "well within his authority to take the airplane from the first officer after the first officer had announced, without prior warning, that he was going around. The fact that the captain was able to land the airplane on centerline provides evidence that he was in control of the airplane through the touchdown. No clear evidence exists that there was any fault in the captain's decision-making throughout the initiation or continuation of the approach to [Runway] 17L, or in his decision to take control of the airplane from the first officer and land on the intended runway. The departure from the runway resulted from the captain's failure to maintain directional control of the airplane after touchdown rather than from events or decisions made prior to touchdown."

The question of who should be flying the aircraft in weather-induced or other marginal safety conditions was discussed by the author in *Flight Safety Digest*, Vol. 7, No. 8 (August 1988). Four accidents (a Boeing 737 in January 1982, at National Airport, Washington, D.C., U.S.; a Boeing 727 in July 1982, at New Orleans, Louisiana, U.S.; a Lockheed Martin L-1011 in August 1985, at DFW; and a McDonnell Douglas DC-9 in November 1987, at Denver, Colorado, U.S.) have occurred in marginal weather when the first officer was the pilot flying. Since that publication, two additional accidents that have occurred in which the first officer was the pilot flying are notable.

Flight Safety Digest, Vol. 10, No. 2 (February 1991) describes an accident that occurred on Sept. 20, 1989. A USAir Boeing 737-400 was taking off in IMC from LaGuardia Airport, New York, New York, U.S., with the first officer flying. As the takeoff began, the airplane drifted to the left because of a mis-trimmed rudder. Later in the takeoff run, the flight crew heard a "bang" and a rumbling noise, which the NTSB report said probably resulted from the captain's continuing attempt to steer the aircraft during takeoff using the nosewheel tiller. The "bang" was probably caused by the left nosewheel tire suddenly coming off the rim, allowing air to escape violently. The captain then took over control from the first officer and rejected the takeoff but was unable to prevent an overrun. There were fatalities and injuries and the aircraft was destroyed. Among the 18 NTSB conclusions, as numbered in the report, were:

"6. Both pilots were relatively inexperienced in their respective positions. The captain had about 140 hours as a Boeing 737 captain. The first officer was conducting his first nonsupervised line takeoff in a Boeing 737 and his first takeoff after a 39-day nonflying period.

["In the 29 accidents for which data were available," the 1994 NTSB safety study reported, "the median number of flight hours accumulated by first officers in the accident-involved crew position and aircraft type, while employed by the air carrier, was 419 hours. In the 32 accidents for which data were available, 53 percent of the first officers were in their initial year as a first officer for that air carrier."[5]]

"9. Because of poor communication between the pilots, both attempted to maintain directional control initially and neither was fully is control later in the takeoff, compounding directional control difficulties."

"10. Neither pilot was monitoring indicated airspeed and no standard airspeed callouts occurred."

The NTSB also concluded that the captain's briefing on departure and emergency procedures was not adequate for the circumstances of this takeoff. At LaGuardia, the NTSB said, the captain should have been even more aware that the first officer needed a discussion of emergency procedures, such as rejected takeoffs. This was to be the first officer's first nonsupervised takeoff in line operational status in conditions that included darkness, low ceiling and a wet runway that was also relatively short with no appreciable overrun, with water at its end. These factors, the NTSB said, should have categorized the takeoff as nonroutine and should have prompted the captain to review emergency procedures.

Good airmanship, the NTSB added, should have dictated such a discussion and the captain might even have made the takeoff himself.

Accident Prevention, Vol. 50, No. 8 (August 1993) describes a July 30, 1992, accident. The first officer was making a takeoff from John F. Kennedy International Airport, New York, New York, U.S., in a fully loaded (within 1,300 pounds [590 kilograms] of the maximum allowable takeoff weight) TWA [Trans World Airlines] Lockheed Martin L-1011 during daylight VMC. Barely one second after rotation, the first officer decided that the aircraft was not going to fly and told the captain, "You got it." The captain, faced with a split-second decision, chose to reject the takeoff. The flight data recorder (FDR) showed that the airplane was airborne for about six seconds. The aircraft touched back down on the runway but the left main landing gear departed the left side about 11,350 feet (3,462 meters) from the runway threshold and the right main landing gear departed the left side of the runway about 13,250 feet (4,041 meters) from the threshold.

… only seconds were allowed for the captain to make the decision to take control of the airplane.

The NTSB determined that the probable causes of this accident were "design deficiencies in the stall warning system that permitted a defect to go undetected, the failure of TWA's maintenance program to correct a repetitive malfunction of the stall warning system, and inadequate crew coordination between the captain and first officer that resulted in their inappropriate response to a false stall warning."

Although the LaGuardia and Kennedy accidents occurred during takeoff, both aircraft were being flown by the first officer and a situation resulted whereby only seconds were allowed for the captain to make the decision to take control of the airplane.

In the DC-10 approach-and-landing accident at DFW, the captain also had to make a rapid decision to accept the first officer's decision or to take control of the airplane and continue the landing. The NTSB report indicated that it was at about 0659:13 that the first officer said, "I'm gonna go around." After the captain took control of the landing, "a sound of a thump, similar to aircraft touchdown was recorded at 0659:29 on the CVR. The second thump was recorded at about two seconds later."

The timing would indicate that the captain had about 13 seconds from the time he took control until the aircraft touched down. In view of previous accidents where shifting control from the pilot flying to the pilot not flying is reduced to a matter of seconds, was 13 seconds sufficient for the captain to make a decision to take control of the airplane and transition from a monitoring role to flying the airplane to a touchdown?

Weather factors may have categorized the DC-10 approach as nonroutine and that, coupled with the first officer's relatively low time (4,454 flight hours of which 376 were as a first officer in the DC-10), prompts a reconsideration of the NTSB's statement in the Boeing 737 accident — "Good airmanship should have dictated such a discussion [a review of emergency procedures] and the captain might even have made the takeoff himself." Substituting "landing" for "takeoff" shows the similarity.

As in the DC-10 accident, the NTSB raised training, procedural, technical and record-keeping issues in the L-1011 and B-737 accidents.

Accident Prevention, Vol. 51, No. 9 (September 1994) describes the crash of a British Aerospace Jetstream BA-3100, operated by Express II Airlines Inc., at Hibbing, Minnesota, U.S., on Dec. 1, 1993.

The NTSB report said, "The probable causes of this accident were the captain's actions that led to a breakdown in crew coordination and the loss of altitude awareness by the flight crew during an unstabilized approach in night instrument meteorological conditions. Contributing to the accident were: the failure of the company management to adequately address the previously identified deficiencies in airmanship and crew resource management of the captain; the failure of the company to identify and correct a widespread, unapproved practice during instrument approach procedures; and the Federal Aviation Administration's inadequate surveillance and oversight of the air carrier."

Accident Prevention, Vol. 51, No. 11 (November 1994) describes the in-flight loss of control and subsequent forced landing of an Embraer EMB-120 RT Brasilia, operated by Continental Express Inc., at Pine Bluff, Arkansas, U.S., on April 29, 1993.

The NTSB said that "the probable causes of this accident were the captain's failure to maintain professional cockpit discipline, his consequent inattention to flight instruments and ice accretion, and his selection of an improper autoflight vertical mode, all of which led to an aerodynamic stall, loss of control and a forced landing. Factors contributing to the accident were poor crew discipline, including flight crew coordination before the stall and the flight crew's inappropriate actions to recover from the loss of control. Also contributing to the accident was fatigue induced by the flight crew's failure to properly manage provided rest periods."

Accident Prevention, Vol. 51, No. 1 (January 1995) describes the crash of a British Aerospace Jetstream J-4101, operated by Atlantic Coast Airlines Inc. (ACA), at Columbus, Ohio, U.S., Jan. 7, 1994.

The NTSB said that the probable causes of the accident were:

"(1) An aerodynamic stall that occurred when the flight crew allowed the airspeed to decay to stall speed following a very poorly planned and executed approach characterized by an absence of procedural discipline;

"(2) Improper pilot response to the stall warning, including failure to advance the power levers to maximum, and inappropriately raising the flaps;

"(3) Flight crew inexperience in glass-cockpit automated aircraft, aircraft type and in seat position, a situation exacerbated by a side letter of agreement between the company and its pilots;

"(4) The company's failure to provide adequate established approach criteria, and the FAA's failure to require such criteria;

"(5) The company's failure to provide adequate crew resource management training, and the FAA's failure to require such training; and,

"(6) The unavailability of suitable training simulators that precluded fully effective flight-crew training."

These last three accidents were in commuter air carrier operations. There are recurrent factors among these (and several other) accidents, indicative of a pattern.

Such descriptions as "failure to maintain professional cockpit discipline," "poor crew discipline, including flight crew coordination," "flight crew's inappropriate actions," "breakdown in crew coordination," "failure of the company management to adequately address the previously identified deficiencies in airmanship and crew resource management of the captain" and "the company's failure to provide adequate crew resource management training" are causal factors cited in the three NTSB accident reports involving commuters. It appears that the causal factors in those accidents are nearly interchangeable. A pattern emerges of a common problem with crew discipline and coordination, and a lack of crew resource management (CRM) training by the commuter operators.

A pattern emerges of a common problem with crew discipline and coordination, and a lack of crew resource management (CRM) training by the commuter operators.

In the Columbus Jetstream accident, the NTSB report noted: "The events of this accident reflect a total breakdown in crew coordination, an essential element of conducting successful instrument approaches. CRM training is not currently required under [FARs Part] 135; nonetheless ACA did include a one-hour class during its J-4101 ground school that included previous accidents/incidents, human factor considerations and the NASA [Aviation Safety Reporting System]. The training did not provide for interaction of the crewmembers or feedback and continued reinforcement regarding their performance, as described in [FAA] Advisory Circular (AC) 120-51A, *Crew Resource Management Training.*" [AC 120-51A provides nonregulatory guidance to air carriers regarding the content of CRM programs.] To reverse the pattern, one action would be for Part 135 carriers to institute CRM training.

[The NTSB safety study identified monitoring/challenging failures in 31 of the 37 accidents studied. "A pattern common to 17 of the 37 accidents," the study said, "was a tactical decision error by the captain (with more than half constituting a failure to initiate required action), followed by the first officer's failure to challenge the captain's decision."

[The NTSB safety study also said: "The Safety Board is concerned about the high incidence, in the accident flights, of first officer failures to challenge decision errors made by the captain/flying pilots. The high incidence highlights a need for air carrier training programs to devote additional attention to the monitoring/challenging function of crew members."[6]]

Coupling the lack of crew discipline, coordination and CRM training with any other poorly judged action — unapproved practice during instrument approaches, selection of improper autoflight vertical mode, flight crew's inappropriate actions from loss of control or improper response to a stall warning — would almost guarantee the path to an accident.

There is no excuse for a crew's use of an unapproved procedure, no matter how much that unapproved procedure may appear to benefit a flight. Those responsible for monitoring crew performance must ensure that crews routinely use approved procedures.

Increased procedural training, preferably in simulators, should aid in preventing accidents caused by incorrectly performed procedures. If a pilot in training has difficulty mastering aircraft procedures, that pilot should not be approved for flight operations until proficiency is clearly demonstrated.

The fundamental goal for any aviation operation should be "zero accidents." Management must establish from the top down a safety culture that recognizes the threats posed by such factors as those discussed in this article. Management must employ qualified personnel who are properly trained to maintain and operate properly equipped aircraft. Moreover, every employee must have the explicit support of management at every level to do his or her best to ensure the safety of every flight. Anything less sets the stage for an accident.♦

References

1. U.S. National Transportation Board (NTSB). *Safety Study: A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 through 1990*. Report No. NTSB/SS-94/01. January 1994. Reprinted in *Flight Safety Digest* Volume 12 (4) (April 1994).

2. *Ibid.*, p. 68.

3. *Ibid.*, p. 73.

4. *Ibid.*, p. 20.

5. *Ibid.*, p. 76.

6. *Ibid.*, p. 75, p. 60.

About the Author

John A. Pope established John A. Pope & Associates, an aviation consulting firm located in Arlington, Virginia, U.S., after retiring in 1984 as vice president of the U.S. National Business Aircraft Association. He has assisted more than 60 corporations in developing their operations manuals. He has also conducted more than 20 workshops dedicated to developing corporate aviation operations manuals.

He served as a command pilot in the U.S. Air Force and the Air National Guard. He retired as a colonel from the U.S. Air Force Reserve after 33 years of service.

U.S. Commercial Aviation Fatal-accident Rate Remains Lower Than Worldwide Rate in 1994

Long-term trends in Boeing study show higher fatal-accident rates in early years of service for new aircraft types.

Editorial Staff

The worldwide fatal-accident rate for commercial jet aircraft in 1994 remained within a range that has varied little since the mid-1970s, according to statistics released by Boeing.[1] Although the fatal-accident rate for U.S. carriers continued to be lower than the fatal-accident rate for non-U.S. carriers, the gap narrowed slightly, with an increase in the rate for U.S. operators and a decrease in the rate for non-U.S. operators.

Boeing's statistics, which covered the years 1959 through 1994, showed a steep reduction in the overall commercial jet fatal-accident rate since the beginning of the period. Nevertheless, there were clearly defined "spikes" in the fatal-accident rates for statistical groupings of new types of aircraft in the years following their introduction to fleets.

The study defined fatal accidents as those "with on-board [fatalities] or those where persons other than aircraft occupants are fatally injured," but counted as fatalities only aircraft occupants. Fatal accidents involving turboprop aircraft were excluded from the study. The statistics also ignored accidents stemming from sabotage, hijacking, suicide, military action or test flying.

Figure 1 (page 10) shows the overall fatal-accident rate graphed for the 1959–1994 period according to rates per million departures and numbers of fatalities. The decline in the fatal-accident rate during the first decade of commercial jet operation was dramatic, but the rate has continued on a plateau — although at a relatively low rate — since the late 1970s.

The lower graph in Figure 1 shows the annual numbers of on-board fatalities in commercial jet aviation, starting in 1959.

The influence of changes in aircraft types in the worldwide jet fleet is apparent in Figure 2 (page 11). Airplanes have been categorized into three groups: "second generation" jet transports that began to be incorporated into fleets in the early 1960s; the first generation of widebody transports, which entered service beginning in the late 1960s; and more recent types, introduced in the 1980s and 1990s. In each group, the accident rate peaks in the early years of introduction to service.

Figure 3 (page 12) compares fatal-accident rates for U.S. and non-U.S. operators. A long-term pattern is visible in which the rate for non-U.S. operators exceeds that of U.S. operators, although generally only to a small degree. But the trend lines for U.S. and non-U.S. carriers parallel one another fairly closely, especially in the early years of commercial jets.♦

Reference

1. Boeing Commercial Airplane Group. *Statistical Summary of Commercial Jet Aircraft Accidents: Worldwide Operations, 1959–1994.* March 1995.

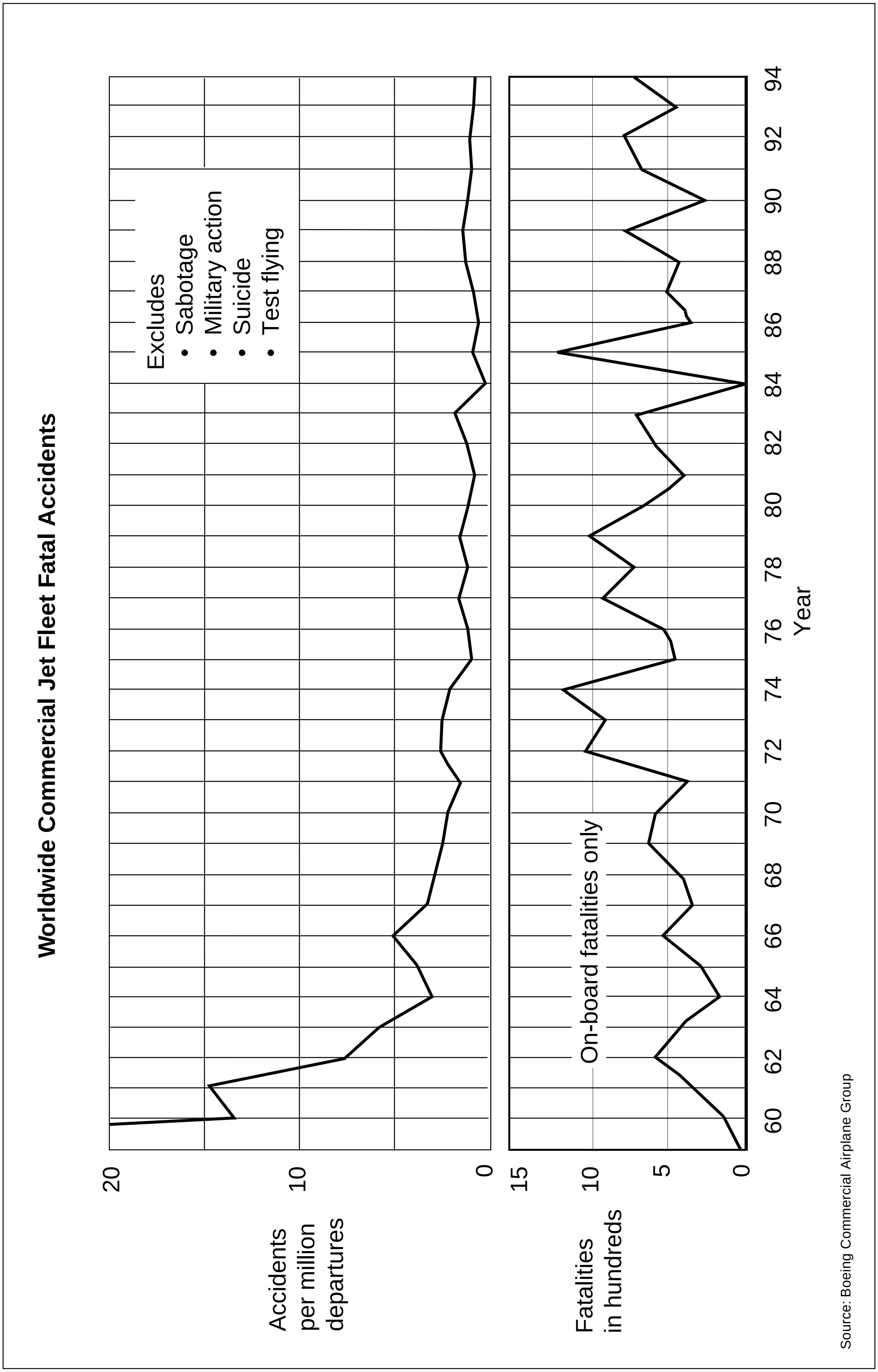
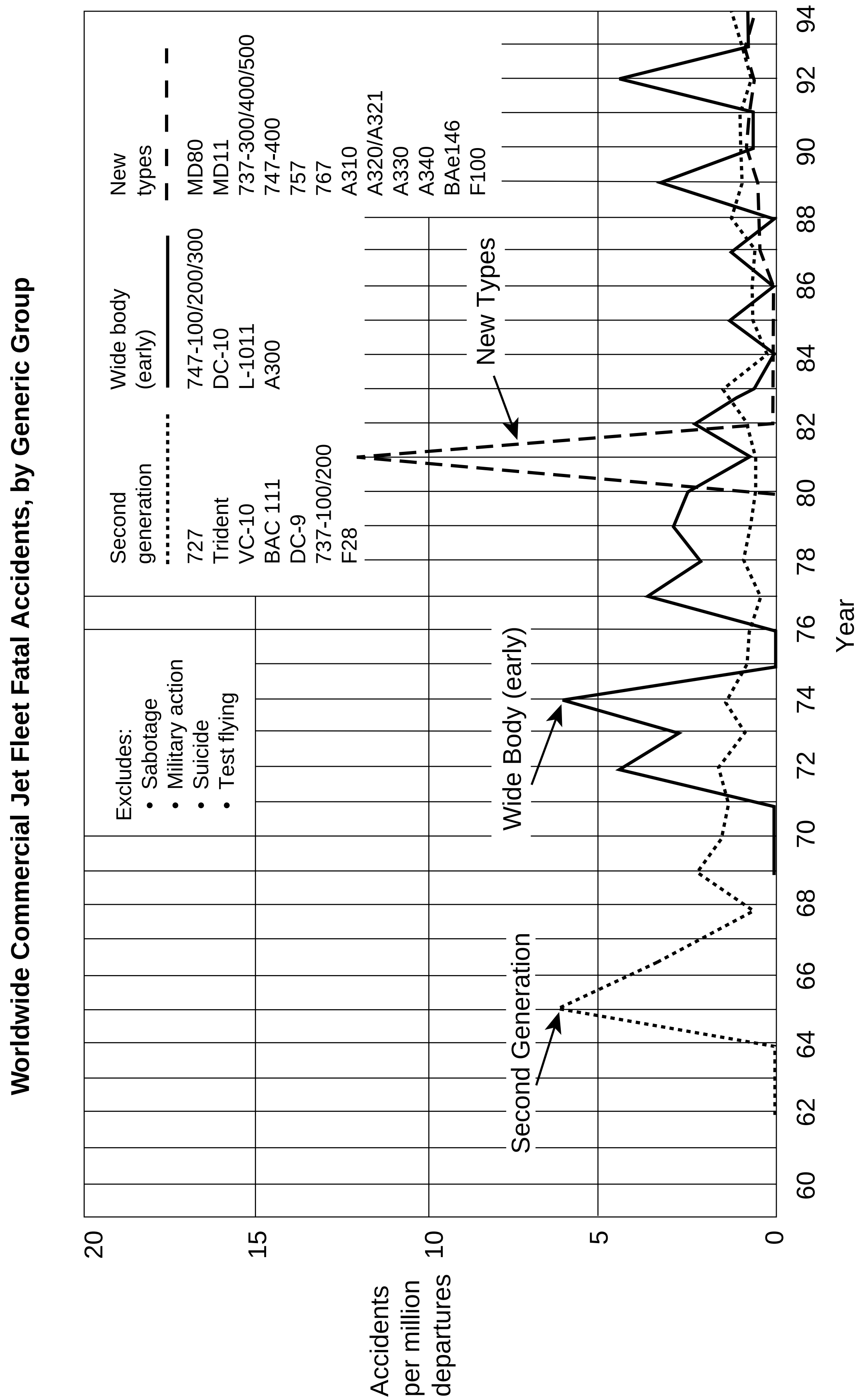

Worldwide Commercial Jet Fleet Fatal Accidents
Accidents per million departures
20
10
0
Excludes
• Sabotage
• Military action
• Suicide
• Test flying
Fatalities in hundreds
15
10
5
0
On-board fatalities only
60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94
Year
Source: Boeing Commercial Airplane Group

Figure 1



Source: Boeing Commercial Airplane Group

Figure 2

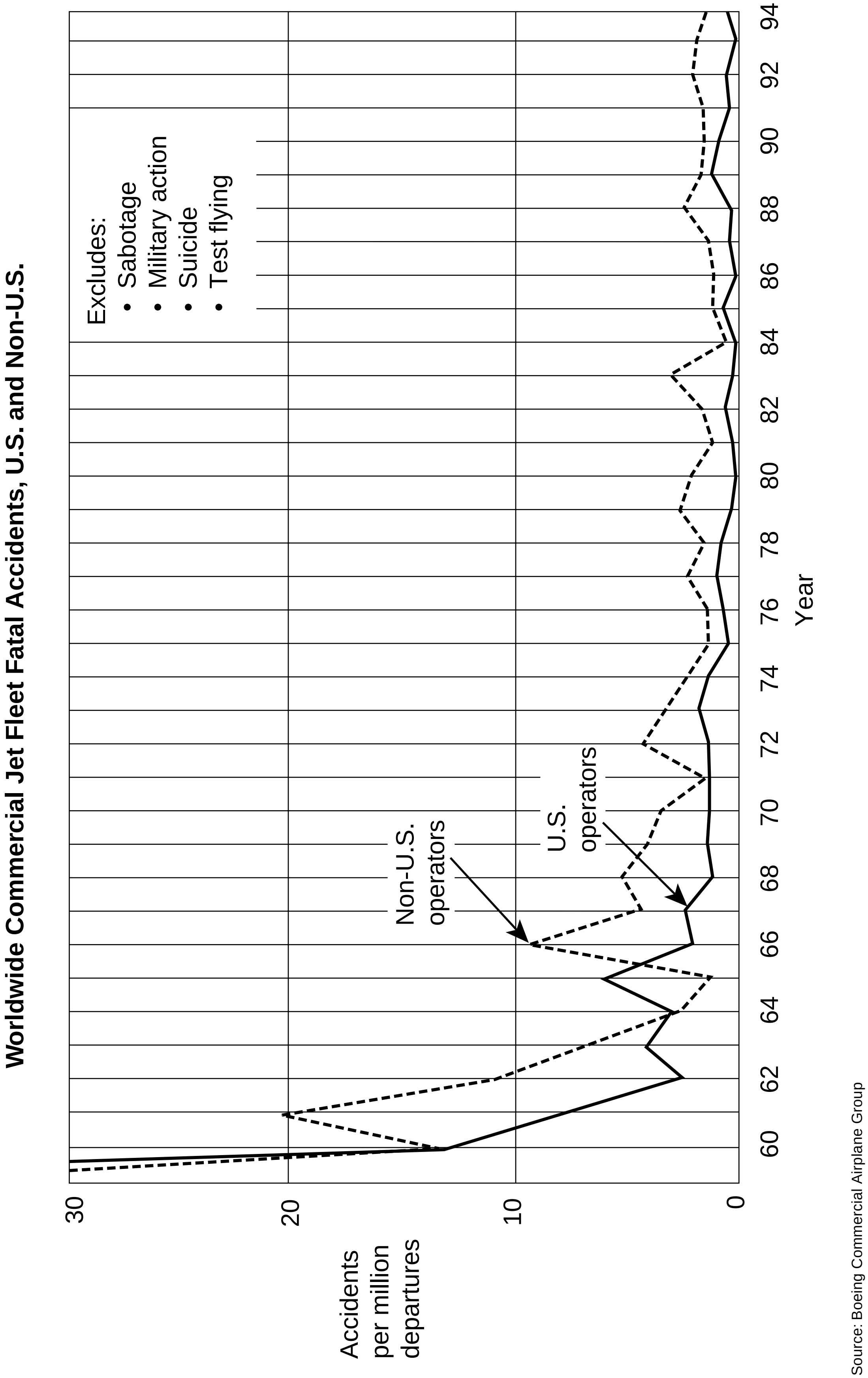

Worldwide Commercial Jet Fleet Fatal Accidents, U.S. and Non-U.S.
Accidents per million departures
30
20
10
0
60
62
64
66
68
70
72
74
76
78
80
82
84
86
88
90
92
94
Year
Excludes:
• Sabotage
• Military action
• Suicide
• Test flying
Non-U.S. operators
U.S. operators
Source: Boeing Commercial Airplane Group

Figure 3

Publications Received at FSF Jerry Lederer Aviation Safety Library

FAA Issues Guidance to Air Carriers For First-aid Training Programs

A recently published book describes current airline training methods, while considering the influence of technology on future training methods.

Editorial Staff

Advisory Circulars (ACs)

Air Carrier First Aid Program. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) No. 120-44A. March 1995. 7 p.; appendix.

This AC guides air carriers about resources, topics, equipment and regulations for first-aid training programs. According to the AC, air carrier crew-member first-aid training programs should include first-aid and emergency medical equipment; use of emergency and first-aid oxygen; handling of illness and injury (including information about protection of crew members from blood-borne pathogens); assistance from people on board and on the ground; and medical emergency landings. The appendix discusses blood-borne pathogens.

Positive Exchange of Flight Controls Program. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) No. 61-115. March 1995. 2 p.

This AC guides all pilots on the recommended procedure for pilots' exchange of flight controls while flying. The AC is geared to student pilots, flight instructors and pilot examiners. The AC recommends a three-step process in the exchange of flight controls between pilots and a preflight briefing that includes the procedure. When the instructor wants the student to take the controls, he or she says, "You have the flight controls." The student takes the controls and acknowledges, "I have the flight controls." The instructor repeats, "You have the flight controls." The same procedure is followed when the student returns the controls to the instructor, and the student stays on the controls until the instructor says, "I have the flight controls." The AC recommends that a visual check be made during this exchange.

Announcement of Availability: FAA-S-8081-11, Flight Instructor — Lighter-Than-Air (Balloon-Airship) Practical Test Standards. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) No. 61-116. March 1995. 2 p.

This AC announces the availability of FAA-S-8081-11, practical test standards for the certification of flight instructors for lighter-than-air aircraft (e.g., balloons and airships). Instructions for ordering FAA-S-8081-11, pricing and a Superintendent of Documents publications order form are included with this announcement.

Reports

Air Traffic Control: Status of FAA's Plans to Close and Contract Out Low-activity Towers. U.S. General Accounting Office. Report No. GAO/RCED-94-265. September 1994. 25 p.; appendices. Available through GAO.**

Between fiscal year (FY) 1994 and FY 1997, the U.S. Federal Aviation Administration (FAA) plans to close level 1 (low-activity) air traffic control towers that do not meet the FAA's benefit-cost criteria. The FAA will contract the operations of all remaining level 1 towers and relocate controllers from the closed towers to other FAA facilities. This report, to the U.S. House of Representatives Committee on Appropriations, Subcommittee on Transportation and Related Agencies, provides the U.S. General Accounting Office's (GAO's) assessment of the plan and its potential savings (a tower that is contracted out or closed does not receive federal funding, according to the report); identifies possible obstacles to the FAA's plan; and identifies ways for the FAA to enhance its reassignment strategy for controllers.

International Aviation: Airline Alliances Produce Benefits, But Effect on Competition Is Uncertain. U.S. General Accounting Office (GAO). Report No. GAO/RCED-95-99. 68 p.; illustrations; appendices. April 1995. Available through GAO.**

This report examines the effects that marketing alliances between U.S. and non-U.S. air carriers have on consumers, traffic flows and revenues, and it identifies issues surrounding such alliances that need to be addressed by the U.S. Department of Transportation (DOT).

The report says that there are not enough data to determine what effect the alliances have had on fares and whether alliances will reduce or increase competition in the long term. Nevertheless, it says that consumers are benefiting from conveniences allowed by the alliances, such as shorter layovers .

The report says that the DOT has not required U.S. and non-U.S. airlines to report data sufficient to fully monitor the effects of alliances on competition and the international competitiveness of U.S. airlines. Also, the DOT has not decided whether antitrust immunity should be available for other alliances in markets that allow for significantly increased access for U.S. airlines. According to the report, the DOT does not have rules that limit how often a flight can be listed in computer reservation systems; multiple listings of the same flight can give airlines in an alliance a competitive advantage.

Aircraft Accident Report: Stall and Loss of Control of Final Approach, Atlantic Coast Airlines Inc./United Express Flight 6291, Jetstream 4101, N304UE, Columbus, Ohio, January 7, 1994. U.S. National Transportation Safety Board (NTSB). Report No. NTSB/AAR-94/07. October 1994. 128 p.; appendices. Available through NTIS.*

This report is the official explanation of the crash of a Jetstream 4101 about 1.4 miles (2.25 kilometers) east of Runway 28L at Port Columbus International Airport, Columbus, Ohio, U.S. The aircraft was operated by Atlantic Coast Airlines, Sterling, Virginia, U.S., and doing business as United Express Flight 6291. The NTSB determined that the factors contributing to or causing the accident were: an aerodynamic stall; improper pilot response to the stall warning; flight crew inexperience in a "glass-cockpit" aircraft; the failure of the company to provide adequate stabilized approach criteria (and the U.S. Federal Aviation Administration's [FAA's] failure to require it); company failure to provide adequate crew resource management (CRM) training and the FAA's failure to require such training; and the unavailability of suitable training simulators, which precluded effective flight crew training.

Validation of the Federal Aviation Administration Air Traffic Control Specialist Pre-Training Screen. Broach, Dana; Brecht-Clark, Jan. Report No. DOT/FAA/AM-94/4. February 1994. 16 p.; illustrations; graphs; bibliographical references. Available through NTIS.*

<u>Keywords:</u>
1. Air Traffic Control Specialist
2. Selection
3. Validation
4. Tests
5. Ability
6. Job Analysis
7. Computer Administered Test

Two formal validation studies of the Air Traffic Control Specialist Pre-Training Screen (ATCS/PTS), a five-day computer-administered test battery, are described. The ATCS/PTS was designed to replace the nine-week U.S. Federal Aviation Administration (FAA) Academy ATCS Nonradar Screen program that served as the second major test in the ATCS selection system. Review of ATCS job analyses suggested that predictor tests such as the ATCS/PTS should assess cognitive constructs such as spatial reasoning and short-term memory, and require dynamic, concurrent performance. These studies validated the ATCS/PTS as a predictor.

The ATCS/PTS was implemented for actual employment decision making in June 1992. The U.S. controller selection system since that time has consisted of the four-hour written ATCS aptitude test battery followed, for applicants earning a qualifying score and depending on agency manpower requirements, by second-level screening on the ATCS/PTS. Additional research requirements as part of an aviation human-factors research program are also described.

Denver International Airport. Gryszkowiec, Michael. Testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U. S. House of Representatives. Report No. GAO/T-AIMD-95-184. May 11, 1995. 17 p.; appendices. Available through GAO.**

Michael Gryszkowiec, director, Planning and Reporting, Resources, Community and Economic Development Division, U.S. General Accounting Office (GAO) testified before the U.S. House of Representatives on the current state of Denver International Airport (DIA), addressing in particular three previously discussed issues: DIA's development; the automated baggage handling system; and airfield construction. Gryszkowiec pointed out that, in spite of repeated delays in DIA's opening date and various construction problems, the airport was designed and built in just over five years. The testimony concluded with several suggestions as to how future airport construction projects can avoid similar difficulties, including minimalizing changes in design, providing alternate or backup systems for new and untested technology, and implementing a vigorous quality control program.

Appendix I provides a graphic, time-line representation of DIA's development. Appendix II is a time-line representation of the automated baggage system's history. Appendix III summarizes DIA's total costs. Appendices IV and V list actual and proposed federal funds for DIA.

Bird Ingestion into Large Turbofan Engines. Banilower, Howard; Goodall, Colin. Report No. DOT/FAA/CT-93/14. February 1995. 127 p.; tables; references; appendices. Available through NTIS.*

Keywords:
1. Aircraft Engine Bird Ingestion
2. Aircraft Engine Damage
3. Species of Ingested Birds
4. Weights of Ingested Birds

This report contains the findings of a U.S. Federal Aviation Agency (FAA) study that examined 644 large, high-bypass turbofan–engine aircraft involved in bird-ingestion incidents during 1989–1991. Topics include aircraft types and engine models, ingestion rates, characteristics of the ingested birds, airports and analysis of ingestions that posed potential danger to the aircraft. Statistical methods are applied to determine the influence of flight phase, bird weight and bird numbers on overall engine damage, fan-blade damage, core damage and other threats to aircraft safety. The appendices provide summaries of all pertinent data from each ingestion incident.

Human Factors in Aviation Maintenance — Phase IV Progress Report. Shepherd, William T.; Galaxy Scientific Corporation. Report No. DOT/FAA/AM-95/14. May 1995. 169 p.; tables; illustrations; appendices; references. Available through NTIS.*

Keywords:
1. Human Factors
2. Aviation Maintenance
3. Hypermedia
4. NDI [Nondestructive Inspection] Performance
5. Computer-based Training
6. Ergonomics
7. Aircraft Inspection

This 10-chapter report provides an overview of Phase IV research on human factors in aviation maintenance. The field evaluation plan for the Performance Enhancement System (PENS), a computer-based tool designed to aid aviation safety inspectors in performing oversight duties, is described in Chapter 2. Chapter 3 describes the design of a portable computer-based work-card system. The development of an ergonomic audit program for visual inspection is discussed in Chapter 4. Chapter 5 examines a study on ergonomic factors related to posture and fatigue in the inspection environment. Chapter 6 reports on the development and expansion of the Office of Aviation Medicine Hypermedia Information System. Chapter 7 describes an investigation of individual differences in NDI performance. The results of an experiment to determine the effect of an Intelligent Help Agent on computer-based training effectiveness are described in Chapter 8. Chapter 9 reports on a joint U.K Civil Aviation Authority (CAA)/U.S. Federal Aviation Administration (FAA) investigation of reliability of aircraft inspection in the United Kingdom and the United States. Chapter 10 is a bibliographic overview of selected issues in computer-based training system design.

Enhancing the Effects of Diversity Awareness Training: A Review of the Research Literature. Myers, Jennifer G. Report No. DOT/FAA/AM-95/10. March 1995. 25 p.; figures; references. Available through NTIS.*

Keywords:
1. Diversity
2. Training
3. Attitudes
4. Experiential Learning

Projected changes in the demographic makeup of the workforce are the primary influence in the spread of diversity awareness training in both the public and private sectors. This report reviews training and experiential learning research literature to identify ways of enhancing diversity awareness training and minimizing the potential for backlash. Myers concludes that the effectiveness of training that focuses on altering attitudes to change behavior has not been clearly demonstrated. A combination of strategies before, during and after training, and evaluation and research programs to identify characteristics of effective training, are required to enhance the measurable benefits received from diversity awareness training in the long term.

Aviation Research: Perspective on FAA Efforts to Develop New Technology. Dillingham, Gerald L. Testimony before the Subcommittee on Technology, Committee on Science, U. S. House of Representatives. Report No. GAO/T-RCED-95-193. May 16, 1995. 10 p. Available through GAO.**

Gerald L. Dillingham, associate director, Transportation and Telecommunications Issues, Resources, Community and Economic Development Division, General Accounting Office (GAO) testified before the U.S. House of Representatives on the U.S. Federal Aviation Administration's (FAA's) recent reorganization of the research, engineering and development (RE&D) program. Dillingham's testimony reviews trends in the character of research conducted by the RE&D program, other sources of funds for research on problems in developing new technology and in reorganization. Dillingham also notes that funding for research mandated by the Aviation Safety Research Act has increased from 8.1 percent of the RE&D budget in 1988 to nearly 30 percent in 1995; considerable research, however, remains outside the RE&D program.

International Aviation: Better Data on Code-Sharing is Needed by DoT for Monitoring and Decisionmaking. Mead, Kenneth M. Testimony before the Subcommittee on Aviation, Committee on Commerce, Science and Transportation, U.S. Senate. Report No. GAO/T-RCED-95-170. May 24, 1995. 12 p. Available through GAO.**

Kenneth M. Mead, director of Transportation Issues, Resources, Community and Economic Development Division, General Accounting Office (GAO) testified before the U.S. Senate on international airline operations and the competitive impact of code sharing. Mead testified that bilateral agreements often restrict U.S. airlines' ability in foreign markets; however, code sharing is an effective strategy for airlines to access traffic to and from cities previously unserved, and will play a prominent role in future bilateral negotiations. To improve U.S. airlines' access to key foreign markets, Mead stressed the importance of placing the U.S. Department of Transportation (DOT) on equal footing with foreign counterparts and noted that data problems must be addressed for effective negotiation.

National Airspace System: Comprehensive FAA Plan for Global Positioning System Is Needed. U.S. General Accounting Office (GAO). Report No. GAO/RCED-95-26. May 1995. 24 p.; figures; appendices. Available through GAO.**

The U.S. Federal Aviation Administration (FAA) is augmenting the U.S. Department of Defense's (DOD) global positioning system (GPS) to develop its benefits to civil aviation. Once fully integrated as a navigational aid in the air traffic control system, GPS will be superior to ground-based navigation aids and will enable civil aircraft to fly more fuel-efficient routes. This report outlines the FAA plan and projects its development. Although the FAA has met all milestones to date, the agency will face difficulties in maintaining its schedule. The revised schedule may not give the FAA sufficient time to develop and implement its wide-area system for augmenting GPS by the current milestone date of 1997.

Appendix I describes civil air navigation requirements and the augmentation to GPS. Appendix II lists FAA changes to the GPS schedule.

Air Traffic Control: Status of FAA's Modernization Program. U.S. General Accounting Office (GAO). Report No. GAO/RCED-95-175FS. May 1995. 90 p.; appendix. Available through GAO.**

This is the sixth annual report on the status of the U.S. Federal Aviation Administration's (FAA's) efforts to modernize the U.S. air traffic control (ATC) system. This report provides information on the overall status of ATC modernization and includes changes in total modernization costs and the number of completed projects. Fifteen major modernization projects are discussed in detail with regard to cost and scheduling estimates. The FAA estimates that the total cost of ATC modernization will be US$37.3 billion between the initiation of the program in 1982 and its scheduled conclusion in 2003.

The appendix lists ATC modernization projects completed through 1994.

Developing of Coding Form for Approach Control/Pilot Voice Communications. Prinzo, O. Veronika; Britton, Thomas W.; Hendrix, Alfred M. Report No. DOT/FAA/AM-95/15. May 1995. 34 p.; tables; appendices. Available through NTIS.*

Keywords:
1. ATC-pilot Communications
2. Communication Taxonomy
3. Phraseology

This report examines the Aviation Topics Speech Acts Taxonomy (ATSAT), a tool that categorizes pilot/controller communications according to purpose and codifies communication errors. Using ATSAT's error codes, air traffic controllers' deviations from U.S. Federal Aviation Administration (FAA) Air Traffic Control Order 7110.65, and pilots' deviations from the Airman's Information Manual, can be identified and labelled. Results of a preliminary study to measure intercoder agreement reveals that novice coders are more dependent on the surface characteristics of the verbatim transcripts, but experts rely more on background knowledge and experience with ATC phraseology to code ATC communications. The authors recommend that any further research concerning ATSAT use coders who have received the same orientation and instruction before using ATSAT.

Aircraft Accident Report: Controlled Collision with Terrain. Transportes Aereos Ejecutivos, S.A. (TAESA) Learjet 25D, XA-BBA Dulles International Airport, Chantilly, Virginia, June 18, 1994. U.S. National Transportation Safety Board (NTSB). Report No. NTSB/AAR-95/02. March 7, 1995. 63 p.; tables; appendices. Available through NTIS.*

This report explains the accident involving the TAESA Learjet 25D that crashed near the threshold of Runway 1R at Dulles International Airport, Chantilly, Virginia, U.S., on June 18, 1994. The NTSB determined that the probable causes of the accident were the poor decision making, poor airmanship and relative inexperience of the captain in initiating and continuing an unstabilized instrument approach, leading to a descent below the authorized altitude without visual contact with the runway. Lack of a ground-proximity warning system (GPWS) on the airplane was cited as a contributory cause.

Safety issues discussed in this report include the weather at Dulles International Airport, flight-crew training, qualifications and performance, flight-crew fatigue, operations specifications, passenger seating and the GPWS.

Appendices A–D provide information on the investigation and hearing; the runway environment; ground track and approach profiles; and NTSB safety recommendations to the U.S. Federal Aviation Administration (FAA), respectively.

FAA Air Traffic Control Operations Concepts, *Volume VIII: TRACON Controllers* (1989) is a technical description of the duties of a TRACON (terminal radar control area) air traffic control specialist (ATCS). Developed by CTA Inc., it was originally formatted in User Interface Language, but has been recently restructured into a hierarchical formal sentence outline. To ensure that no crucial information was lost or altered during the conversion, the revised document has been reviewed by four subject-matter expert groups, each consisting of six TRACON controllers and four quality assurance managers.

This report describes the methods used to effect this revision. Words, phrases and acronyms not commonly used by TRACON controllers as well as illogical sequencing of described duties were looked for and appropriate changes implemented by the subject matter expert groups; 671 changes were made to the document.

Appendix A provides the definition of verbs used in the TRACON Formal Sentence Outline Job Task Taxonomy. Appendix B is the Formal Sentence Outline Job Task Taxonomy.

A Human Factors Evaluation of the Operational Demonstration Flight Inspection Aircraft. Rodgers, Mark D. (editor). Report No. DOT/FAA/AM-95/18. May 1995. 22 p.; tables; figures; references. Available through NTIS.*

Keywords:
1. Human Factors
2. Flight Inspection
3. Anthropometry
4. Acoustics
5. Workstation Design

The four reports in this collection describe the data gathering and analysis conducted by the U.S. Federal Aviation Administration (FAA) Civil Aeromedical Institute's Human Factors Research Laboratory to assist the Office of Aviation System Standards (AVN) in the human factors evaluation of the Operational Demonstration (Ops Demo) candidate flight inspection aircraft (FIA). The reports include a survey of aircraft characteristic preferences in flight inspector pilots and technicians, an anthropometric familiarization for flight inspector pilots and technicians participating in the Ops Demo, an evaluation of aircraft-cabin noise levels and a human factors evaluation of the proposed flight inspection work station design for medium-sized, medium-range (MSR) aircraft.

Books

Smallwood, Tony; Fraser, Michael. *The Airline Training Pilot*. Brookfield, Vermont, U.S.: Ashgate Publishing. Co., 1995. 340 p.; illustrations; bibliographic references.

Keywords:
1. Air Pilots — Vocational Guidance
2. Aeronautics — Study and Teaching

This comprehensive guide addresses current airline training methods and considers the future of pilot training in an increasingly technologically advanced environment. Smallwood and Fraser discuss the techniques and challenges of preparing the next generation of skilled and safety-conscious pilots. The focus is on human factors. The authors examine the psychological aspects of what makes an effective instructor and address issues in motivation, student-teacher communication and how information is received and processed. Chapter headings include "The Basis for Good Instruction," "Dealing with Difficult Trainees," "The Process of Learning," "The Brain—Memory," "Line/Route Training," "Initial Command Training," "Pilot Selection" and "Training Trainers." Tom Wise's whimsical cartoons reinforce key points.

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U.S. Federal Aviation Administration (FAA) Regulations and Reference Materials

Advisory Circulars (ACs)

AC No.	Date	Title
150/5000-3R	3/13/95	*Address List for Regional Airports Divisions and Airports District/Field Offices* (cancels 150/1500-3Q, *Address List for Regional Airports Divisions and Airports District/Field Offices*, dated 9/29/93).
150/5360-12A	12/23/94	*Airport Signing and Graphics* (cancels 150/5360-12, *Airport Signing and Graphics*, dated 12/23/85).

Accident/Incident Briefs

B-737 Descent with Engines at Idle in Thunderstorm Results in Flameout

Gust, wet runway result in runway excursion by Saab turboprop.

Editorial Staff

The following information provides an awareness of problems through which such occurrences may be prevented in the future. Accident/incident briefs are based on preliminary information from government agencies, aviation organizations, press information and other sources. This information may not be entirely accurate.

Air Carrier

False Memory Results in Wrong Turn

Boeing 747-400. No damage. No injuries.

The international flight had departed an airport in Australia when the first officer, the pilot flying, initiated a turn to the left. Air traffic control (ATC) had assigned a right turn.

While the left turn was initiated, the captain was concentrating on the radios and correcting a mis-set radio frequency. When he looked up and saw that the airplane was in a left turn, he told the first officer that the assigned turn was to the right to a heading of 170 degrees.

An investigation determined that the captain and the first officer had not been to that airport in 45 days and that the first officer initiated the wrong turn because of a mistaken recollection from previous flights of the departure procedure. The airline recommended that the incident be used in training to emphasize the importance of a thorough review of departure procedures and a departure briefing.

Heavy Rain, Failure to Follow Procedure Cause Flameout

Boeing 737-300. Minor damage. No injuries.

The aircraft was descending with the throttles in flight idle when the No. 1 engine failed. The engine flamed out because of water ingestion after the B-737 penetrated a Level 5 thunderstorm and encountered heavy rain.

The engine suffered over-temperature damage to the turbine section during a subsequent windmilling start. It was determined that the captain had elected to descend in precipitation with the engines at idle, despite a warning from the first officer that an idle descent was contrary to recently published procedures to a maintain a minimum of 45 percent N_1 RPM. The dangers of precipitation-induced flameout have caused the U.S. Federal Aviation Administration (FAA), manufacturers and operators to publish correct procedures.

Fatal Crash Narrowly Averted After Poor Approach

Boeing 737-200. Minor damage. No injuries.

The aircraft was making a night very high frequency omnidirectional radio range (VOR) distance measuring equipment (DME) approach to a South American airport when it made slight contact with terrain four nautical miles from the runway threshold.

After the contact, the captain initiated a go-around and the aircraft completed an uneventful landing. None of the 52 passengers on board were injured. An investigation determined that the flight crew had ignored published descent procedures, including decision-height and safety-altitude minimums.

Gust Causes Directional Control Loss

Saab 340. Minor damage. No injuries.

The twin-engine turboprop Saab was on a daylight instrument landing system (ILS) approach to a European airport in moderate turbulence and a strong, 20-knot crosswind. On short final, the aircraft encountered a strong gust.

During the landing roll, directional control was lost and the aircraft left the runway laterally before overrunning the runway end by 164 feet (50 meters). No mechanical defects were found. The runway was determined to have been damp at the time of the overrun.

Ground Agent Injured by Propeller

BAe Jetstream 31. Minor damage. One serious injury.

The twin-engine turboprop Jetstream was at the ramp at dusk when a ground agent attempted to retrieve his signal wands and walked into a rotating propeller. The agent had just finished placing chocks in front of the nose wheel.

An investigation determined that the agent, who was seriously injured in the accident, lacked ramp experience and that ramp safety procedures had not been followed.

Wind Shear Whacks Commuter on Final

Cessna 208 Caravan. Substantial damage. One minor injury.

The single-engine turboprop Caravan was on final approach at night during thunderstorm activity when it encountered strong turbulence and the airspeed jumped from stall to redline. Despite flap and power adjustments, the aircraft became uncontrollable and impacted terrain on final. The pilot received minor injuries. An investigation determined that another aircraft had reported wind shear during final approach shortly before the accident.

Low Approach Ends on Hilltop

Beech 100 King Air. Aircraft destroyed. Two serious injuries.

The twin-engine turboprop aircraft was making a nondirectional beacon (NDB) approach to an uncontrolled airport at night in instrument meteorological conditions (IMC) when it crashed.

The airport elevation was 941 feet (287 meters) mean sea level (MSL) and the NDB was located 1.8 nautical miles (2.5 kilometers) from the airport. A minimum descent altitude (MDA) of 1,540 feet (470 meters) was to be maintained until the runway was in sight. About four miles (6.4 kilometers) from the airport, the aircraft struck the top of a hill at 990 feet (302 meters) MSL. The aircraft was destroyed by impact and a postcrash fire. Weather at the time of the accident was reported as 300 feet (91.5 meters) overcast and one mile (1.6 kilometers) visibility in fog and rain.

An investigation determined that the pilots had failed to follow proper instrument flight rules (IFR) and had failed to maintain a safe altitude on the approach.

Mis-set Fuel Selector Downs Twin on Go-around

Beech 55 Baron. Substantial damage. One serious injury.

The twin-engine, piston-powered Baron was second for a night visual landing on Runway 03 about 0.5 mile (0.8 kilometer) from touchdown when air traffic control (ATC) asked for a go-around to allow the first aircraft to clear the runway.

The pilot initiated the go-around and then reported a dual engine malfunction during the climb out. The pilot was then cleared to land on any runway. As the pilot turned to line up for Runway 21, the aircraft struck a small grove of trees about 1,110 feet (336 meters) left of the extended centerline for Runway 21.

A postaccident examination of the aircraft revealed that the pilot had placed the fuel selector valves in the auxiliary position. A placard on the fuel selector stated: “Use auxiliary tanks and crossfeed for level flight only.” Both engines suffered from fuel starvation. No mechanical problems were found.

Other General Aviation

Mountain Cuts Short Night Approach

Piper PA-31. Aircraft destroyed. Four fatalities.

The twin-engine Piper encountered strong winds over the mountains during a night flight under visual flight rules (VFR) and the pilot diverted to a nearby airport to refuel.

The pilot contacted air traffic control and reported that he intended to make an unscheduled fuel stop. The pilot requested, and was issued, radar vectors to the diversion airport. Although it was a dark night and the pilot-controlled airport lighting was never activated, the pilot reported the airport in sight and was cleared for the visual approach. Radar contact was lost about three minutes later.

The aircraft wreckage was found the following morning on a mountainside east of the airport. Impact had occurred at 9,100 feet (2,776 meters) about six miles (9.7 kilometers) east of the 5,622-foot (1,715-meter) elevation airport. Minimum safe altitude was 12,400 feet (3,782 meters).

Twin Strikes Truck in Low-pass Maneuver

Britten-Norman Islander. Substantial damage. No injuries.

The twin-engine piston-powered Islander was preparing to land at a rural Canadian airport when the pilot spotted a co-worker leaving the hangar area in a pickup truck. The pilot executed a low-pass maneuver in an attempt to get the co-worker’s attention and to obtain a ride into the nearby town.

During the low pass, the aircraft’s main landing gear struck the rear of the pickup truck’s cab. The pilot maintained control of the aircraft and landed without further incident. Neither the pilot nor the truck’s driver was injured. The aircraft and the truck were substantially damaged. Transport Canada was informed and was considering criminal charges against the pilot.

Rotorcraft

Wire Strike During Aerial Application Kills Pilot

Hiller UH-12E. Aircraft destroyed. One fatality.

The Hiller, engaged in aerial application work, struck a wire while maneuvering and impacted terrain. The helicopter was destroyed and the pilot was killed.

Weather at the time of the daylight flight was reported as visual meteorological conditions (VMC) with 5,000 feet (1,525 meters) scattered, 8,000 feet (2,440 meters) broken and nine miles (14.4 kilometers) visibility.

Mechanical Failure Leads to Hard Landing

Bell 47G. Substantial damage. No injuries.

The helicopter was flying at 50 feet (15.3 meters) above ground level (AGL) and was in the initial phase of a turnaround maneuver when the engine failed. The aircraft landed hard and the main rotor blades severed the tail boom.

A subsequent investigation determined that the power loss was caused by the failure of the oil-pump drive gear in the accessory case. Weather at the time was reported as visual meteorological conditions (VMC) with clear skies, 10 miles (16 kilometers) visibility and winds at three knots.

Check Ride Goes Awry

Schweizer 269C. Substantial damage. One minor injury.

The pilot reported that he was demonstrating touchdown autorotations for his helicopter flight instructor’s practical test to a U.S. Federal Aviation Administration (FAA) examiner, when he allowed the main-rotor RPM to decay while turning base.

The pilot continued the touchdown, but landed hard. The FAA examiner received minor injuries. The pilot was not injured. The helicopter suffered substantial damage.

Safety is not a cost. It's a benefit!

Flight Safety Foundation (FSF) and Transport Canada will conduct at Airshow Canada on Aug. 10, 1995, a Risk Management Seminar that will examine how an aviation safety program can improve profitability. The important role of company management, which is increasingly being held responsible for the success of aviation safety programs, will be discussed in detail.

Topics will include well-analyzed problems and their solutions; skillful cost-benefit analysis as the cornerstone of an effective and efficient safety program; the obligation to establish a safety program in the same way that a company introduces a new aircraft to the fleet; and the importance of creating a clear and comprehensive accident/incident response plan. No fee will be required for admittance to the seminar.

Airshow Canada will be held Aug. 9–11 [industry-only days; public days will be held Aug. 12 & 13.] in Abbotsford, British Columbia, Canada. Free preregistration is available before July 7 for industry-only days. In addition to the FSF/Transport Canada seminar, there will be a variety of other conferences and symposia during the Airshow. The Canadian Business Aircraft Association will be conducting its annual convention in Vancouver, while its tradeshow exhibits and static displays will be combined with Airshow Canada at Abbotsford. For more details, contact Airshow Canada. Telephone: (604) 852-3704 and Fax: (604) 852-4600.

Flight Safety Foundation/Transport Canada
Risk Management Seminar
Airshow Canada

Aug. 10, 1995

Contact Ed Peery, FSF. Telephone: (703) 522-8300 Fax: (703) 525-6047

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