FLIGHT SAFETY FOUNDATION

MARCH 1999

FLIGHT SAFETY

DIGEST

Enhancing Flight-crew Monitoring Skills Can Increase Flight Safety

FLIGHT SAFETY
FOUNDATION
1947–1999

FLIGHT SAFETY FOUNDATION

For Everyone Concerned
With the Safety of Flight

Officers and Staff

Stuart Matthews
Chairman, President and CEO
Board of Governors

Robert H. Vandel
Executive Vice President

James S. Waugh Jr.
Treasurer

Carl Vogt
General Counsel and Secretary
Board of Governors

ADMINISTRATIVE

Nancy Richards
Executive Secretary

Ellen Plaugher
Executive Assistant–Corporate Services

FINANCIAL

Elizabeth Kirby
Controller

TECHNICAL

James Burin
Director of Technical Programs

Ann Hill
Manager of Seminars and Workshops

Robert H. Gould
Managing Director of Aviation Safety Audits
and Internal Evaluation Programs

Robert Feeler
Manager of Aviation Safety Audits

Robert Dodd, Ph.D.
Manager, Data Systems and Analysis

MEMBERSHIP

Joan Perrin
Director of Marketing and Development

Ahlam Wahdan
Assistant to the Director of Marketing
and Development

PUBLICATIONS

Roger Rozelle
Director of Publications

Mark Lacagnina
Senior Editor

Wayne Rosenkrans
Senior Editor

John D. Green
Copyeditor

Karen K. Ehrlich
Production Coordinator

Ann L. Mullikin
Production Designer

Susan D. Reed
Production Specialist

David A. Grzelecki
Librarian, Jerry Lederer Aviation Safety Library

Jerome Lederer
President Emeritus

Flight Safety Digest

Vol. 18 No. 3 **March 1999**

In This Issue

Cover image: Copyright ©1998 PhotoDisc Inc.

Flight Safety Foundation (FSF) is an international membership organization dedicated to the continuous improvement of flight safety. Nonprofit and independent, FSF was launched in 1947 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 700 member organizations in 80 countries.

Enhancing Flight-crew Monitoring Skills Can Increase Flight Safety

Safety problems can arise from insufficient monitoring by the flight crew. Monitoring can be degraded because of several factors, including preoccupation with other duties. Nevertheless, monitoring can be improved through policy changes and crewmember training.

Capt. Robert L. Sumwalt III
President, Aviatrends

A flight crewmember must carefully monitor the aircraft's flight path and systems, as well as actively cross-check the other pilot's actions, or safety can be compromised.

For example, concerning a 1995 accident involving an airliner's collision with trees on final approach to Hartford, Connecticut, U.S., the U.S. National Transportation Safety Board (NTSB) said in its official accident-investigation report, "If the first officer had monitored the approach on the instruments ... he would have been better able to notice and immediately call the captain's attention to the altitude deviation below the minimum descent altitude."[1]

An analysis by the International Civil Aviation Organization (ICAO) of controlled-flight-into-terrain (CFIT) accidents found that poor crew monitoring was a factor in half of the 24 accidents reviewed.[2]

An NTSB report on flight-crew-caused air carrier accidents said that 31 (84 percent) of the 37 accidents reviewed involved inadequate crew monitoring or challenging.[3]

"Monitoring the results of one's actions is an important ingredient in consistent, excellent performance of complex tasks," said the NTSB report. "In flying, self-monitoring allows a pilot to recognize inadequate performance, observe changes in the operational environment and take corrective action. Self-corrections may range from adjusting control inputs to reversing decisions.

"In air carrier operations, the monitoring task is shared by two or more crewmembers. … The flying pilot is responsible for monitoring his or her own procedures and control inputs. In addition, operational redundancy is provided by the nonflying crewmember, who is given the task of monitoring the flying pilot.

"Similarly, because captains are responsible for final decision making, the first officer (and flight engineer, if present) is given the task of monitoring the captain's decisions. In moving from only self-monitoring to monitoring another crewmember, whether monitoring a flying pilot's control inputs or a captain's decisions, the monitoring crewmember must also challenge the crewmember perceived to be making an error."

The NTSB report found that many of the errors that were not monitored or challenged played roles in the accidents' causation.

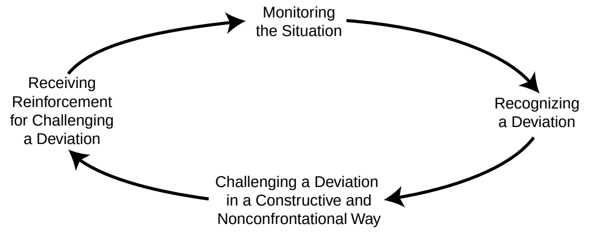
"Among all 37 accidents, 53 (76 percent) of the 70 monitoring/challenging errors failed to catch errors that [NTSB] had identified as causal to the accident," said the report. "An additional 12 monitoring/challenging failures (17 percent) were failures to catch errors that contributed to the cause of the accident."

Ron Howard, former chairman of GEC-Marconi Avionics, said, "Cross-monitoring between essentially independent crewmembers … corresponds to the fundamentally important use of redundancy in the 'engineering' sectors of an aircraft design, although implementing it successfully between crewmembers in the extremely variable flight-deck operational environment has always been much more difficult."[4]

Monitoring Must Precede Challenging an Error

Figure 1 shows the stages of effective monitoring and challenging. Challenging a perceived error (deviation) is critical, but is sometimes neglected. Nevertheless, there is ample evidence that increased attention must be given the first two steps, monitoring and recognizing errors; to be able to challenge an error, one must first monitor the situation to recognize a deviation. Improving the ability to challenge potential errors recognized through monitoring is best done by effective crew resource management (CRM) programs.[5]

Stages of Effective
Monitoring and Challenging



Source: Jentsch, F.; Martin, L.; Bowers, C. *Identifying Critical Training Needs for Junior First Officers.* A special technical report prepared at the request of the U.S. Federal Aviation Administration and the U.S. Naval Warfare Center Training Systems. May 1997

Figure 1

Capt. Steve Last said, "Recognition and recovery are critical to achieving error tolerance, and anything which inhibits error recognition and recovery is a major safety hazard."[6] Recognition of errors comes through effective monitoring, and improving crew monitoring can greatly increase flight-safety margins.

According to Howard, there are two subcategories of pilot errors: "skill errors" and "crew errors." Skill errors relate to failures in direct pilot operation of the aircraft in its total environment; and crew errors relate to failure of crew cross-monitoring and correction of skill errors.

"The rate of occurrence of pilot-skill errors which lead to hazardous situations is known to be very low, and it may not be possible to improve this to an extent which will significantly reduce the overall accident rate," said Howard. "The crew-error rate, on the other hand, appears to be relatively high, and is therefore likely to be the major contributor to overall pilot error. It is of some relevance that crew error could be open to significant reduction through changes in cockpit operational procedures."[2]

To improve understanding of problems associated with inadequate flight-crew monitoring, researchers at the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS)[7] recently conducted a study[8] to identify factors that contribute to monitoring errors and to offer operationally oriented recommendations for improving crew monitoring.

By design, incident reports submitted to ASRS involve incidents and information about perceived unsafe conditions and situations; accident reports cannot be submitted to ASRS. Although much can be learned from accident data, the researchers believed that a more complete understanding of monitoring errors could emerge from a study of incident data. Often, incident reports such as those submitted to ASRS are rich with information describing both what went wrong and details of the factors that prevented the incident from becoming an accident.

Study Defined Monitoring Error

The ASRS monitoring study defined a monitoring error as "a failure to adequately watch, observe, keep track of, or cross-check any or all of the following: (1) the aircraft's trajectory, i.e., taxi and flight path, speed management, navigation; (2) automation systems and mode status, i.e., flight management system (FMS) entries, mode control panel (MCP) settings/selections, awareness of automation mode; and (3) aircraft systems and components, i.e., fuel quantity, aircraft configuration, system status." The researchers evaluated 200 ASRS reports involving air carrier operations.

The study said, "While traditional [CRM] courses deal with improving the ability of crewmembers to challenge others when a situation appears unsafe or unwise, many of these courses provide little explicit guidance on how to improve monitoring. We feel that carefully developed procedures and guidelines to enhance flight-crew monitoring can make a significant contribution toward improving aviation safety."

In proposing a framework for improving crew monitoring, the study acknowledged that management shares the responsibility for improving crew monitoring. The study said, "[James] Reason[9] says that when trying to minimize human error in a complex system such as aviation, we must look not only at the actions of the 'front-line operators' (flight crews in this case), but we must also focus on the 'system' in which these errors occur. In keeping with this philosophy, our recommendations are anchored to two key points:

- "Management of air carriers and other aviation operations, as well as regulatory officials, must realize that it is incumbent on them to provide crews with clearly thought-out guidelines to maximize their monitoring of aircraft trajectory, automation and systems. Procedures that conflict with crew monitoring must be minimized or eliminated; [and,]

- "Flight crews must constantly exercise monitoring discipline and practice the operational guidelines designed to improve monitoring."

Monitoring Deteriorated During FMS Programming

The 200 incident reports included one submitted by an air carrier first officer, who said that his aircraft monitoring deteriorated while he was programming the FMS during an instrument approach in instrument meteorological conditions. The aircraft struck terrain during the approach, only to become airborne again and divert to an alternate airport.

The first officer's report said, "As the aircraft approached DFW [Dallas-Fort Worth (Texas, U.S.) International Airport], we received vectors for Runway 17R. Reported weather changed several times during vectors prior to localizer intercept. ATC [air traffic control] asked if we wished to land Runway 18L. ATC gave Runway 18L RVR [runway visual range] of better than 6,000 feet [1,828 meters]. ATC indicated that RVR to Runway 17R was less than 2,300 feet [701 meters] and getting worse. We elected to accept runway 18L.

"I began to reprogram the computer for Runway 18L in order to obtain improved situational awareness (vertical displacement in feet). This task was complicated by an inoperative 'execute' button on my CDU [control display unit]. The captain requested flaps 40 degrees. … I selected flaps 40 degrees and continued reprogramming the computer. Runway approach lights could be seen illuminating a thin layer of fog.

"I heard the ground-proximity warning system sound. I scanned the instruments and saw the captain begin raising the nose and advancing the thrust levers. Simultaneously the approach lights came into full view. I perceived that the aircraft was descending and I immediately advanced the thrust levers to 'firewall thrust' and forcefully pulled the aircraft yoke back. We touched the ground briefly and then the aircraft became airborne again. … After determining the aircraft was stabilized and flight-capable, we elected to fly to IAH [Houston (Texas, U.S.) Intercontinental Airport] to allow for visual inspection of main landing gear prior to landing."[10]

For each of the 200 incident reports, the researchers tallied the ways that safety was affected by insufficient monitoring. Some reports cited more than one adverse safety consequence. For example, one report described a significant deviation from desired speed, which led to a stall buffet. Table 1 summarizes the ways that safety was compromised.

Table 1
Safety Consequences of Monitoring Errors*

Safety Consequences	Percent
Altitude deviation	54
Course/heading/track deviation	17
Significant departure from assigned or desired speed	6
Controlled flight into terrain	4
System or equipment damage or shutdown (including engine shutdown and failure)	4
Runway incursion	3
Stall buffet or warning, or loss of aircraft control	3
Departure from taxiway or runway pavement	3
Other	6
Total	**100**

* As observed in U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) Monitoring Study (228 citations from 200 ASRS Reports).

Source: Sumwalt, R.L.; Morrison R.; Watson, A.; Taube, E. "What ASRS Data Tell About Inadequate Flight Crew Monitoring." In *Proceedings of the Ninth International Symposium on Aviation Psychology*, R.S. Jensen, L. Rakovan, eds. Columbus, Ohio, U.S.: Ohio State University, 1997.

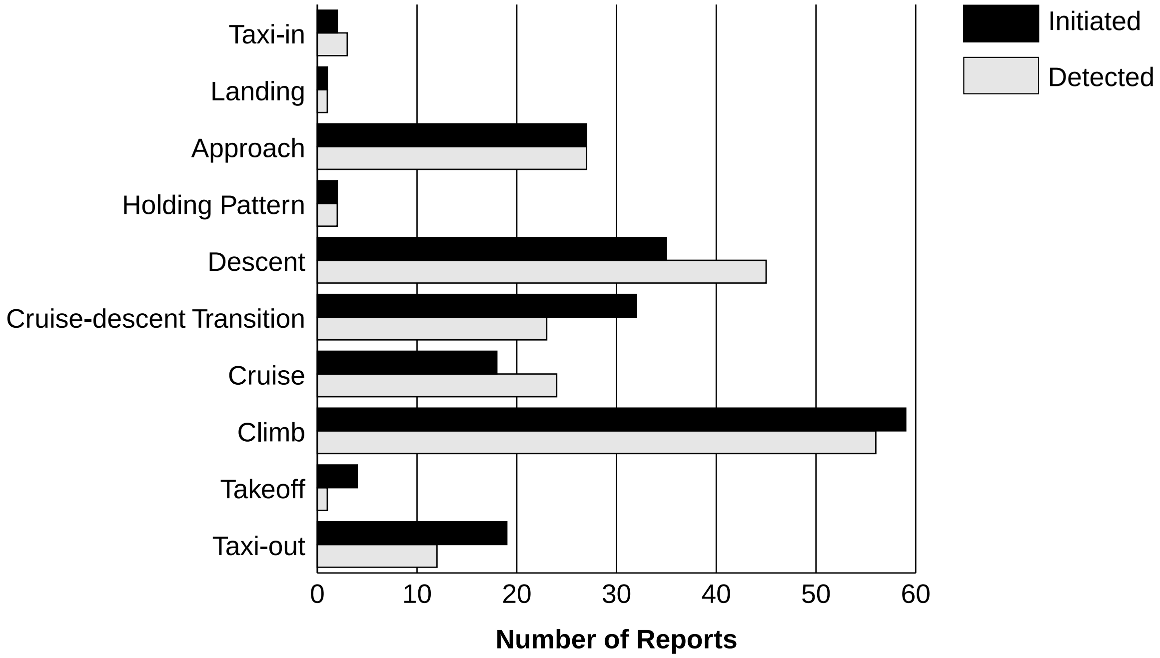
The study also identified the flight phases in which the monitoring errors were initiated and when they were detected (Figure 2, page 4). Seventy-six percent of the monitoring errors identified in the study were initiated when the aircraft was in a "vertical" phase of flight, such as climb, descent, approach or at the top-of-descent point (as the aircraft was transitioning from cruise to descent).

The study said, "Translating this finding into a healthy operational practice is straightforward: While the aircraft is climbing and descending, crews should plan to avoid activities such as searching for the next destination's approach charts, setting up … radio frequencies for destination ATIS [automatic terminal information service] and company radio, eating, paperwork and PA [public-address] announcements. Many of these activities can wait until the aircraft is level, which minimizes the chance of a monitoring error during these highly susceptible flight phases."

Effective Prioritization Aids Monitoring

Analysis of several accidents and incidents suggests that problems with ineffective monitoring likely arise from poor workload planning and prioritization. One accident, in December 1993, involved a Jetstream-31 operated by Express II Airlines/Northwest Airlink that was conducting a nighttime localizer back-course instrument approach to Runway 13 at Hibbing, Minnesota, U.S. The aircraft struck terrain 2.8 miles (4.5 kilometers) from the runway threshold, killing the aircraft's 18 occupants.

Flight Phase in Which Monitoring Errors Were Initiated and Were Detected in 200 Incident Reports



Source: Sumwalt, R.L.; Morrison, R.; Watson, A.; Taube E. "What ASRS Data Tell About Inadequate Flight Crew Monitoring." In *Proceedings of the Ninth International Symposium on Aviation Psychology*, R.S. Jensen, L. Rakovan, eds. Columbus, Ohio, U.S.: Ohio State University, 1997.

Figure 2

In its accident-investigation report, NTSB said that during the unstabilized approach the captain became involved with directing the first officer to select the common traffic advisory frequency (CTAF) and to illuminate the runway lights by clicking the aircraft microphone seven times.

NTSB said, "The captain gave the first officer a task that distracted both of them from altitude-monitoring duties — selecting the CTAF frequency and keying the microphone to turn on the runway lights. This task should have been covered in the approach briefing and should have been accomplished much earlier in the approach.

"[NTSB] concludes that the captain's actions of instructing the first officer to perform functions to turn on the runway lights late in the approach distracted the first officer from his duties of monitoring the approach, and caused the captain to become distracted at a critical phase of the approach."[11]

In 1997, researchers Jentsch, Martin and Bowers completed a special technical report that identified critical training needs for junior first officers.[12] Their study searched the NASA ASRS database for incident reports of events that occurred when a first officer described in a report as "junior," "new" or having "little or low experience" was the pilot not flying (PNF). In more than half of the 190 incident reports reviewed, researchers found that "the major problem was the first officer's failure to monitor and challenge the captain." In approximately one-third of the reports reviewed, the researchers found that first officers "failed to monitor errors, often because they had planned their own workload poorly and were doing something else at a critical time."

A recent NASA study of cockpit interruptions and distractions reviewed 107 ASRS incident reports to determine types of tasks that crews typically neglected at critical moments while attending to other tasks.[13]

"Sixty-nine percent of the neglected tasks involved either failure to monitor the current status or position of the aircraft, or failure to monitor the actions of the pilot flying or taxiing," said the study report. To avoid such problems, the report suggested that crews "schedule/reschedule activities to minimize conflicts, especially during critical junctions."

For example, the report said, "When approaching or crossing an active runway, both pilots should suspend all activities, such as FMS programming and company radio calls, that are not related to taxiing until the aircraft has either stopped short of the runway, or safely crossed it. Crews can reduce their workload during descent by performing some tasks while still at cruise, e.g., obtaining ATIS, briefing the anticipated instrument approach and inserting the approaches into the FMS (for aircraft so equipped)."

Conversation Can Be Distracting

The report also urged pilots to keep in mind the distracting effects of conversation.

"Unless a conversation is extremely urgent, it should be suspended momentarily as the aircraft approaches an altitude or route transition, such as altitude level-off or a SID [standard instrument departure] turn," said the report. "Even in low-workload situations, crew should suspend discussion frequently to scan the status of the aircraft and their situation. This requires considerable discipline because it goes against the natural flow of conversation, which usually is fluid and continuous."

Concerning sustained monitoring during long flights, the ASRS monitoring study said, "While crews cannot be expected to remain 100 percent vigilant during low-workload portions of all flights (especially long-haul flights), this study points to two particular areas of the flight that need careful attention: vertical phases of flight and course-change points. These two areas accounted for nearly three-quarters of the safety consequences cited in this study. On long flights, we suggest that nonmonitoring tasks be scheduled around these two areas, so that proper monitoring can be particularly devoted to altitude and course changes."

A common finding among the studies was that many of the observed monitoring problems involved preoccupation with other duties. For example, the NASA study of cockpit interruptions and distractions said, "In 35 of the ASRS incidents we studied, the [PNF] reported that preoccupation with other duties prevented monitoring the other pilot closely enough to catch an error being made in flying or taxiing. In 13 of these 35 incidents (and 22 of the total 107 incidents), the [PNF] was preoccupied with some form of head-down work, most commonly paperwork or programming the FMS."

The ASRS monitoring study also found a relationship between monitoring errors and crews' preoccupation with nonmonitoring tasks. In 170 of the 200 ASRS reports in the study, the researchers identified the flight-related tasks that the crews were performing shortly before or during the initiation of the monitoring error (Table 2).

A large number of these tasks were being performed during climb or descent. For example, one ASRS report said, "The aircraft never stalled, but it was literally only a few seconds/knots from doing so. ... My failure to maintain an adequate scan was the primary cause of this near-stall incident. I relied too much on the autopilot and allowed myself to become distracted with my chart review. That should have been done

Table 2
Flight-Related Tasks or Functions Performed Shortly Before or during Monitoring Error*

Flight-related Tasks or Function	Number of Reports Citing These Items	Percent of 170 Reports
Cockpit automation/navigation (flight management system programming, mode control panel selections or settings)	76	45
Radio communications (air traffic control, company radio, obtaining automatic terminal information service)	72	42
Cockpit documentation (checklists, chart review, paperwork)	67	39
Aircraft systems (setting system components, system malfunctions)	42	25
Weather, terrain, or traffic-related activities (searching for traffic, responding to traffic-alert and collision avoidance system advisories)	38	22
Intracockpit communications (briefing actions or intentions)	32	19
Passenger-cabin related activities (public address announcements, cabin problems)	23	13
Totals	**350**	**205**

* As observed in U.S. National Aeronautics and Space Administration Aviation Safety Reporting System (ASRS) Monitoring Study (350 citations from 170 ASRS Reports).

Source: Sumwalt, R.L.; Morrison R.; Watson, A.; Taube, E. "What ASRS Data Tell About Inadequate Flight Crew Monitoring." In *Proceedings of the Ninth International Symposium on Aviation Psychology*, R.S. Jensen, L. Rakovan, eds. Columbus, Ohio, U.S.: Ohio State University, 1997.

at cruise, with the captain ‘covering’ for me while I had my head in the books. Also, the PNF might have noticed the low speed sooner if he’d made his PA announcement at level-off, not in climb.”

Using that ASRS report excerpt as an example, the ASRS monitoring study said, “We found it interesting that flight-related tasks/functions were referenced in such a high percentage (80 percent) of the reports in this study. On the one hand, it could be argued that because these functions are required for flight (radio communications, checklists, navigation, etc.), they would be mentioned in most of the reports. On the other hand, many report narratives suggested that crews were performing these tasks in lieu of the monitoring task.

“It appeared that crews became absorbed in these flight-related activities and just assumed that the aircraft or its systems would not deviate from desired parameters.”

FMS programming was cited more frequently than any other activity — in 52 (30 percent) of the 170 reports that mentioned flight-related activities. In 36 of these 52 reports, pilots indicated some difficulty in programming the FMS. One such ASRS report said, “I was so engrossed in the FMS entries that I had not noticed [the altitude deviation].”

Report Recommends Operator Review of Automation Policies

The ASRS monitoring study said, “This study of ASRS data suggests that the ability to effectively monitor the aircraft trajectory decreases when a pilot diverts his/her attention from the flight instruments and then begins making FMS entries.” The study recommended that operators carefully review their automation philosophies, policies and procedures to ensure that they are not conducive to monitoring errors.

The ASRS monitoring study reviewed automation-related procedures of several operators to determine how variations can either support or conflict with the monitoring function. The study noted that one large international air carrier specifies that when the aircraft is climbing or descending, FMS entries will be commanded by the PF, and be programmed by the PNF.

“Considering the number of reports in this study that involved problems in climbs and descents and those involving FMS programming, this procedure appears quite sound in terms of supporting the monitoring function,” said the ASRS monitoring study.

A review of scientific literature about supervisory control and monitoring behavior suggests that monitoring for errors that occur infrequently can be tedious, and over time may breed a complacent attitude toward continued monitoring.

“Serious errors by the [PF] or taxiing do not happen frequently, so it is very tempting for the other pilot to let monitoring wane in periods of high workload,” said the NASA study of interruptions and distractions.

Air Transport Association of America (ATA) reached the same conclusion in a report about cockpit automation.

“With the known high reliability of FMS navigation [and highly automated cockpits], PNF monitoring skills may go unchallenged — if deviations are very rarely detected, the motivation to search for them naturally declines,” said the ATA report. “But the PNF must be as alert as the PF, regardless of level of automation available in the aircraft. A low-probability, high-criticality error is exactly the one that must be caught and corrected.”[14]

Often carriers specifically define the duties of the PF, but not of the PNF. Delegating specific monitoring roles for both the PF and PNF can improve crew monitoring.

PNF Must Actively Monitor

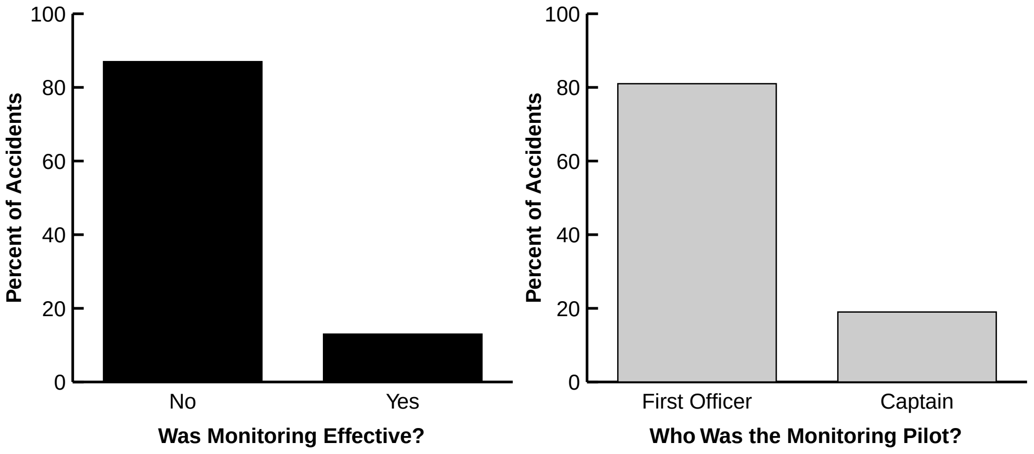
“Sometimes the PNF can get lulled into thinking that since he or she is not flying that particular leg, then he or she is essentially ‘on break’ from specific duties, other than perhaps operating the aircraft radios,” said Capt. Frank Tullo, chairman of the ATA Human Factors Committee.[15] Capt. Tullo said that Continental Airlines has changed the title of the PNF to the “monitoring pilot” (MP), to reinforce the notion that this pilot’s function is to monitor the aircraft. Regardless of activities the PF performs, this policy ensures that the aircraft will continue to be monitored by the MP.

Earl Wiener, Ph.D., a specialist in cockpit procedural design and error-intervention strategies, agrees with the policy. “The title of ‘MP’ tells you what the pilot does — monitoring — instead of what he does not do — not flying,” said Wiener.[16]

At least one large international air carrier is adopting a “monitoring responsibility” policy, which explicitly states that the primary responsibility of each pilot is to monitor the aircraft. According to this policy, the PF will be dedicated to monitoring/controlling the aircraft, regardless of the automation level employed. A key element of this airline’s new policy is that a primary monitoring responsibility is defined clearly for the PNF and states that the PNF will monitor the aircraft and back up the actions of the PF unless workload dictates otherwise.

The NTSB study of flight-crew-caused accidents made a significant discovery. The first officer was the PNF in 30 (81 percent) of the 37 accidents reviewed (Figure 3, page 7). Because, typically, half of airline flights are flown by the captain and the remaining half are flown by the first officer, NTSB said that this percentage was higher than expected.

“The pattern of error types observed in many of the accidents involving [the captain as the PF and the first officer as the



Relationship Between Ineffective Monitoring and the Monitoring Pilot or Pilot Not Flying in 37 Accidents

Source: Last, S. “Eliminating ‘Cockpit-caused’ Accidents.” Unpublished paper. October 1997.

Figure 3

PNF] indicated that improvements are needed in the monitoring/challenging function of crewmembers, especially as related to challenges by first officers of the errors made by captains,” said the NTSB study.

In their review of ASRS reports involving incidents with junior first officers, Jentsch, Martin and Bowers found that 54 percent of the first officers had difficulties with monitoring/challenging a captain who was the PF. Procedural problems, such as performing a technical or radio procedure correctly, were mentioned in only 28 percent of the reports.

Jentsch, Martin and Bowers said, “Junior first officers transitioning into the airline environment are currently better prepared for the role of the [PF] than for the role of the [PNF]. When [junior first officers are] acting as PNF, [their] errors … are significantly more often related to monitoring/challenging than to the execution of technical procedures.”

NTSB said that monitoring/challenging enhancements can be achieved through appropriate training.

LOFT Offers Opportunities to Practice Error Detection and Challenge

“One way to ensure that the [PNF] has an opportunity to practice monitoring/challenging is through the intentional introduction of a procedural or decision error by the [PF] in the LOFT (line-oriented flight training) scenario,” said the NTSB study of flight crew-caused accidents. “This technique would make certain that the [PNF] is confronted with the opportunity to detect and challenge the error made by the [PF].”

The ASRS monitoring study said, “Monitoring the aircraft must be considered the lifeblood of safe flight operations. The flow of attention to monitoring must not stop, or the consequences may be grave. Carefully thought-out philosophies, policies and procedures that are implemented by management after validation in line operations, combined with strong training emphasis, can transform into practices that minimize monitoring errors, resulting in safer flight operations.”♦

References and Notes

1. U.S. National Transportation Safety Board (NTSB). *Aircraft Accident Report: Collision with Trees on Final Approach, American Airlines Flight 1572, McDonnell Douglas MD-83, N566AA, East Granby, Connecticut, November 12, 1995*. Report no. NTSB/AAR-96/05. Washington, D.C., United States: NTSB, 1996.

2. International Civil Aviation Organization (ICAO). *Safety Analysis: Human Factors and Organizational Issues in Controlled Flight Into Terrain (CFIT) Accidents, 1984–1994.* Montreal, Quebec, Canada: ICAO, 1994.

3. NTSB. *Safety Study: A Review of Flightcrew-Involved, Major Accidents of U.S. Air Carriers, 1978 through 1990.* Report no. NTSB/SS-94/01. Washington, D.C., United States: NTSB, 1994.

4. Howard, R. “Analysing Pilot Error.” Royal Aeronautical Society, *Aerospace International* Volume 24 (October 1997): 28–30.

5. For more information concerning implementing a crew resource management (CRM) program, see U.S. Federal Aviation Administration (FAA) Advisory Circular 120-51C, *Crew Resource Management*. Oct. 30, 1998.

6. Last, Capt. Steve. "Eliminating 'Cockpit-caused' Accidents." Unpublished paper. October 1997.

7. The U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) is a confidential incident-reporting system. The ASRS Program Overview said, "Pilots, air traffic controllers, flight attendants, mechanics, ground personnel and others involved in aviation operations submit reports to the ASRS when they are involved in, or observe, an incident or situation in which aviation safety was compromised. … ASRS de-identifies reports before entering them into the incident database. All personal and organizational names are removed. Dates, times and related information, which could be used to infer an identity, are either generalized or eliminated."

   ASRS acknowledges that its data have certain limitations. ASRS Directline (December 1998) said, "Reporters to ASRS may introduce biases that result from a greater tendency to report serious events than minor ones; from organizational and geographic influences; and from many other factors. All of these potential influences reduce the confidence that can be attached to statistical findings based on ASRS data. However, the proportions of consistently reported incidents to ASRS, such as altitude deviations, have been remarkably stable over many years. Therefore, users of ASRS data may presume that incident reports drawn from a time interval of several or more years will reflect patterns that are broadly representative of the total universe of aviation-safety incidents of that type."

8. Sumwalt, R.L.; Morrison, R.; Watson, A.; Taube, E. "What ASRS Data Tell About Inadequate Flight Crew Monitoring." In *Proceedings of the Ninth International Symposium on Aviation Psychology*, R.S. Jensen, L. Rakovan, eds. Columbus, Ohio, United States: Ohio State University, 1997.

9. Reason, J. *Human Error*. Manchester, England: Cambridge University Press, 1990.

10. ASRS accession number 259087.

11. NTSB. Aircraft Accident Report: *Controlled Collision with Terrain. Express II Airlines, Inc./ Northwest Airlink Flight 5719, Jetstream BA-3100, N334PX, Hibbing, Minnesota, December 1, 1993*. NTSB/AAR-94/05. Washington, D.C., United States: NTSB, 1994.

12. Jentsch, F.; Martin, L.; Bowers, C. *Identifying Critical Training Needs for Junior First Officers*. A special technical report prepared at the request of the U.S. Federal Aviation Administration and the U.S. Naval Air Warfare Center Training Systems. May 1997.

13. Dismukes, K.; Young, G.; Sumwalt, R. "Cockpit Interruptions and Distractions: Effective Management Requires a Careful Balancing Act." *ASRS Directline* (December 1998):4–9.

14. Air Transport Association of America (ATA) Human Factors Committee, Automation Subcommittee. *Potential Knowledge, Policy, or Training Gaps Regarding Operation of FMS-Generation Aircraft*. Second Report.

15. Tullo, Capt. Frank. Personal correspondence to Sumwalt, Capt. Robert L. Columbia, South Carolina, United States, Nov. 3, 1998.

16. Wiener, E. "Error Intervention through Procedures." Paper presented at Ninth Annual US Airways/Air Line Pilots Association Air Safety Forum, Pittsburgh, Pennsylvania, United States. November 1998.

About the Author

Robert L. Sumwalt III is president of Aviatrends, a company that specializes in aviation safety research and consulting. In this capacity he has served the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) as a research consultant, where he was principal investigator on three major ASRS research projects, including the ASRS monitoring study referenced in this article. Sumwalt is also a captain for a major U.S. air carrier, where he has served as an airline check airman, instructor pilot and air safety investigator. He has published more than 65 articles and papers on aviation-safety issues, accident investigation and aviation human factors.

Australia Had No Accidents in Air-transport Categories in 1997

Since 1988, Australian aviation authorities have reported at least one accident per year in the high-capacity air-transport category and at least two accidents per year in the low-capacity air-transport category — except in 1989, when no accidents were reported in a low-capacity category formerly called the "supplementary airline/commuter" category.

FSF Editorial Staff

According to the Bureau of Air Safety Investigation (BASI) in Australia, in 1997 no aircraft accidents occurred in the high-capacity air-transport category, and no accidents occurred in the low-capacity air-transport category.[1] BASI has reported one accident to three accidents each year in the high-capacity air-transport category since 1988 (Table 1, page 10). From 1988 to 1997, the accident rate for this category ranged from 0.14 per 100,000 hours (1996) to 0.83 per 100,000 hours (1989, Table 2, page 10). No fatal accidents have occurred in Australia during the 10-year period in this category (Table 3, page 11).

In the low-capacity air-transport category (called the supplementary airline/commuter category before 1991), BASI has reported two accidents to eight accidents each year since 1988, except 1989, when no accidents were reported. The accident rate (other than 1989) for this category previously ranged from 0.81 per 100,000 hours (1996) to 4.41 per 100,000 (1988). BASI's statistics show that in the low-capacity air-transport category, the last fatal accidents (two) occurred in 1995. A total of 12 fatalities occurred during low-capacity air-transport operations in this 10-year period (Table 4, page 11).

"There was a reduction in the number of high-profile occurrences investigated in 1997–1998, continuing the trend registered in the previous year," BASI said in the bureau's annual report. "During 1997, 4,195 occurrences were reported to BASI. The occurrences were made up of 236 accidents and 3,959 incidents. Investigations were completed and public reports [were] released on 1,287 air-safety occurrences, 877 of which involved fare-paying passenger operations. This latter group of incidents involved Australian [-registered aircraft] and foreign-registered aircraft operating air-transport-category services. There were fewer of these incidents compared with those reported in the previous year."

The total number of flight hours increased by 18,100 (2.5 percent) from 1996 to 1997 in the high-capacity air-transport category. The total number of flight hours increased by 26,200 (10.6 percent) from 1996 to 1997 in the low-capacity air-transport category (Table 5, page 11).

The number of 1997 charter-category accidents reported by BASI — 49 — was equaled once in the previous nine years (1994).

Total 1997 charter-category accidents exceeded the 1996 figure by 15 accidents. The accident rate in the charter category was 10.7 per 100,000 hours, an increase compared to the 1996 total of 7.03 accidents per 100,000 hours, which was the lowest rate in the 10-year period. Four fatal accidents occurred in the charter category during 1997, which compares to a range of two fatal accidents to six fatal accidents annually during the preceding nine years. In the charter category, the total number of flight hours increased by 3,400 (0.7 percent) from 1996 to 1997.♦

Note

1. Under Australian Civil Aviation Regulations, airline operations include all flying undertaken by operating agencies that hold an Australian Air Operators Certificate, high-capacity transport and low-capacity transport. This includes scheduled operations, nonscheduled operations and nonrevenue flying by operating agencies. A "high-capacity aircraft" is defined as an aircraft that is certified as having a maximum seating capacity exceeding 38 seats or a maximum payload exceeding 4,200 kilograms (9,259 pounds). The low-capacity air-transport category used for BASI accident statistics includes airline operations other than those involving a high-capacity aircraft. The charter category involves the carriage of passengers or cargo for hire or reward other than airline operations, aerial agriculture, flying training or other aerial work.

Table 1
Australian Civil Aircraft Accidents, 1988–1997

Accidents	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
High-capacity Air Transport	1	3	2	2	2	1	2	1	1	0
Low-capacity Air Transport	—	—	—	4	6	5	4	4	2	0
SAL/Commuter	8	0	7	—	—	—	—	—	—	—
Charter	37	43	39	32	37	44	49	42	34	49
Agricultural	36	45	38	25	28	24	16	29	33	29
Flying Training	24	38	33	30	25	36	28	36	26	38
Other Aerial Work	34	31	43	35	32	35	27	19	28	41
Private/Business	114	93	116	137	111	117	86	90	83	72
Total General Aviation	253	250	276	259	233	256	206	216	204	229

Note: In 1991, the term "low-capacity air transport" replaced the terms "supplementary airline" (SAL) and "commuter." Statistics prepared before 1991 treated such operations as sectors of the general aviation industry.

Source: Bureau of Air Safety Investigation, Australia

Table 2
Australian Civil Aircraft Accident Rate per 100,000 Hours, 1988–1997

Accident Rate per 100,000 hours	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
High-capacity Air Transport	0.24	0.83	0.48	0.41	0.38	0.18	0.33	0.15	0.14	0.00
Low-capacity Air Transport	—	—	—	1.88	2.69	2.20	1.68	1.65	0.81	0.00
SAL/Commuter	4.41	0.00	3.43	—	—	—	—	—	—	—
Charter	9.36	9.30	9.68	8.26	9.09	11.10	11.47	8.96	7.03	10.07
Agricultural	24.47	28.30	23.59	22.69	31.24	24.50	18.41	28.10	26.28	21.18
Flying Training	5.98	8.42	6.78	6.54	5.85	8.13	6.32	8.25	5.77	8.35
Other Aerial Work	11.65	10.02	14.23	12.07	12.12	12.23	8.75	6.13	9.57	13.03
Private/Business	21.59	17.01	20.11	27.24	24.01	24.34	18.77	20.31	18.56	16.15
Total General Aviation	13.01	11.77	12.93	14.81	14.11	15.02	12.08	12.26	11.34	12.45

Note: In 1991, the term "low-capacity air transport" replaced the terms "supplementary airline" (SAL) and "commuter." Statistics prepared before 1991 treated such operations as sectors of the general aviation industry.

Source: Bureau of Air Safety Investigation, Australia

Table 3
Australian Civil Aircraft Fatal Accidents, 1988–1997

Fatal Accidents	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
High-capacity Air Transport	0	0	0	0	0	0	0	0	0	0
Low-capacity Air Transport	—	—	—	0	0	1	0	1	0	0
SAL/Commuter	1	0	0	—	—	—	—	—	—	—
Charter	2	5	5	2	2	4	6	3	6	4
Agricultural	6	6	2	1	3	1	4	2	4	3
Flying Training	2	3	4	3	1	0	2	1	0	0
Other Aerial Work	5	3	9	1	1	3	4	4	4	3
Private/Business	13	7	10	14	18	14	9	12	9	7
Total General Aviation	29	24	30	21	25	22	25	22	23	17

Note: In 1991, the term “low-capacity air transport” replaced the terms “supplementary airline” (SAL) and “commuter.” Statistics prepared before 1991 treated such operations as sectors of the general aviation industry.

Source: Bureau of Air Safety Investigation, Australia

Table 4
Australian Civil Aircraft Fatalities, 1988–1997

Fatalities	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
High-capacity Air Transport	0	0	0	0	0	0	0	0	0	0
Low-capacity Air Transport	—	—	—	0	0	7	0	2	0	0
SAL/Commuter	3	0	0	—	—	—	—	—	—	—
Charter	11	16	18	3	2	8	22	8	13	8
Agricultural	6	6	2	2	3	1	4	2	4	3
Flying Training	7	7	6	4	2	0	4	1	0	0
Other Aerial Work	8	7	14	1	1	4	5	6	5	5
Private/Business	26	10	24	35	41	33	16	20	21	12
Total General Aviation	61	46	64	45	49	46	51	37	43	28

Note: In 1991, the term “low-capacity air transport” replaced the terms “supplementary airline” (SAL) and “commuter.” Statistics prepared before 1991 treated such operations as sectors of the general aviation industry.

Source: Bureau of Air Safety Investigation, Australia

Table 5
Australian Civil Aircraft Hours Flown, 1988–1997

Hours Flown (1,000s)	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
High-capacity Air Transport	424.3	361.5	412.9	483.5	526.8	561.7	613.2	667.0	711.1	729.2
Low-capacity Air Transport	—	—	—	212.8	223.4	227.7	238.3	243.1	246.2	272.4
SAL/Commuter	181.5	195.4	204.3	—	—	—	—	—	—	—
Charter	395.1	462.2	402.7	387.5	407.0	396.5	427.2	468.8	483.3	486.7
Agricultural	147.1	159.0	161.1	110.2	89.6	97.9	86.9	103.2	125.6	136.9
Flying Training	401.2	451.1	486.4	458.4	427.5	442.7	424.9	436.5	450.4	455.3
Other Aerial Work	291.8	309.3	302.2	290.0	264.0	286.1	308.4	309.7	292.5	314.6
Private/Business	528.0	546.8	576.7	502.9	462.7	480.7	458.2	443.2	447.3	445.7
Total General Aviation	1944.7	2123.8	2133.4	1749.0	1650.9	1704.0	1705.8	1761.3	1799.0	1839.3

Note: In 1991, the term “low-capacity air transport” replaced the terms “supplementary airline” (SAL) and “commuter.” Statistics prepared before 1991 treated such operations as sectors of the general aviation industry.

Source: Bureau of Air Safety Investigation, Australia

Publications Received at FSF Jerry Lederer Aviation Safety Library

FAA Flight-engineer Practical-test Standards Available in Print and Electronic Formats

Document will be useful to flight instructors, students and applicants.

FSF Library Staff

Advisory Circulars

***Announcement of Availability: FAA-S-8081-21, Flight Engineer Practical Test Standards for Reciprocating Engine, Turbopropeller, and Turbojet Powered Aircraft*.** U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) no. 60-29. Feb. 1, 1999. 1 p. Available through GPO.*

The U.S. Federal Aviation Administration (FAA) has published FAA-S-8081-2 to establish the standards for practical tests of flight engineers. Practical tests conducted by FAA inspectors, designated pilot examiners, and check airmen (examiners) must be in compliance with this standard. The document is also a valuable resource for flight instructors and applicants in preparing for practical tests.

This advisory circular announces the availability of FAA-S-8081-21, *Flight Engineer Practical Test Standards for Reciprocating Engine, Turbopropeller, and Turbojet Powered Aircraft*, and it provides information on electronic access to the document and on obtaining printed copies. [Adapted from AC.]

Change 3 to Airport Winter Safety and Operations. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) no.150/5200-30A. Nov. 30, 1998. 30 pp. Available through GPO.*

This change to Advisory Circular No.150/5200-30A provides guidance to assist airport operators in applying sand to runways under winter operational conditions, the use of runway-edge and taxiway-edge light markers, and reporting runway-friction measurements taken under winter operational conditions. [Adapted from AC.]

Renumbering of Airman Training and Testing Publications. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) no.60-29. Feb. 1, 1998. 1 p. Available through GPO.*

Within the advisory-circular system, airman training and testing publications are now listed in various sections of AC 00-2. The renumbered materials will list the airman training materials and airman testing materials in appendix 5, as they are revised, along with FAA practical test standards and FAA computerized testing supplements currently listed there. Listing airman training, testing, and standards publications in one area of AC 00-2 will make it easier to locate the necessary training and testing publications for airman certification.

This advisory circular announces the renumbering of airman training materials and airman testing materials published by the Airman Testing Standards Branch, AFS-630, Oklahoma City, Oklahoma, U.S. [Adapted from AC.]

Reports

A Survey of Pilots on the Dissemination of Safety Information. Rakovan, Lori.; Wiggins, Mark W.; Jensen, Richard S.; Hunter, David R. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report no. DOT/FAA/AM-99/7. March 1999. 70 pp. Available through NTIS.**

Keywords:
1. Pilots
2. Aircraft Pilots
3. Training
4. Survey
5. Aviation Safety

The research described in this report is part of a larger project to develop and disseminate aviation-related information to all U.S. pilots. This study's objective was to identify pilots' perceptions of safety-related information, its usefulness in the operational environment, and its role in accident causation and prevention, as well as to determine the best way to deliver the information. A questionnaire assessed use of aviation-safety information, seminars, computers and videocassettes, self-assessment, recent flying experience, demographic information, and stressful experiences. Also included were four optional, open-ended questions that allowed pilots to expand their remarks on stressful flying experiences and suggest possible ways to improve aviation safety. The questionnaire was sent to 6,000 pilots equally divided among private, commercial and airline-transport categories, groups that are likely to require different types of safety information.

The analysis suggests several ways to improve pilots' receptivity to safety-related information. Methods include ensuring that available safety-related training products are cost-effective, providing wider publicity for FAA seminars and developing strategies to encourage the use of safety-related resources among pilots in a target group (consisting of private-certificate holders and nonprofessional commercial-certificate holders). [Adapted from Introduction and Conclusion.]

Comparison of Buckle Release Timing for Push-Button and Lift-Latch Belt Buckles. Gowdy, Van; George, Mark; McLean, G.A. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report no. DOT/FAA/AM-99/5. February 1999. 11 pp. Figures, table. Available through NTIS.**

Keywords:
1. Push-button Buckles
2. Small-aircraft Restraints

Small-aircraft restraint systems most commonly use the lift-latch belt-buckle release mechanism. Release mechanisms such as push buttons are less common but are not prohibited by FAA regulations. This report is the result of a study to examine the human factors and safety aspects related to the operation of push-button buckles and egress from a seat. The study focused on the length of time it took passengers to release the belt buckle and get out of the seat.

The data indicated no major difference in the response times of the participants to release or egress from a three-point restraint with a push-button buckle, compared with a lift-latch buckle on a three-point restraint or a common lap-belt restraint. The report stresses that the findings apply to the use of push-button buckle restraint systems on small airplanes. Studying the use of push-button buckles on commercial aircraft would require collecting data on a broader range of human factors. [Adapted from Introduction and Results.]

Index to FAA Office of Aviation Medicine Reports: 1961 through 1998. Collins, William E.; Wayda, Michael E. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report no. DOT/FAA/AM-99/1. January 1999. 83 pp. Available through NTIS.**

Keywords:
1. Aviation Medicine
2. Research Reports
3. Office of Aviation Medicine
4. Civil Aeromedical Institute

This index includes Federal Aviation Administration (FAA) Office of Aviation Medicine reports and Civil Aeromedical Institute (CAMI) reports published from 1961 through 1998, listed chronologically, alphabetically by author and alphabetically by subject. The foreword outlines CAMI's aviation-safety-research efforts since 1961, describes how to use the index and explains how to obtain copies of technical reports published by the Office of Aviation Medicine. [Adapted from Introduction.]

Aviation Competition: Effects on Consumers from Domestic Airline Alliances Vary. Report to Congressional Requesters, January 1999. Report no. GAO/RCED-99-37. 68 pp. Figures, tables, appendixes. Available through GAO.***

Three sets of U.S. airline partners, Northwest and Continental, Delta and United, and American and US Airways announced their intentions in early 1998 to form three alliances. These six are the largest U.S. airlines and account for nearly 70 percent of domestic airline traffic. The partners could cooperate in a number of possible ways including limited marketing arrangements or more complex arrangements such as "code-sharing" or one partner's ownership of an equity share in the other partner's business.

The airlines maintain that these alliances will benefit consumers with expanded route networks and combined frequent-flyer programs. Those opposed say that the alliances will decrease competition, limit passenger choices and increase fares. This report presents information on the implications of the alliances. It describes the status of each alliance, examines each alliance in terms of the potential beneficial and harmful effects on consumers, and examines the authority of the Department of Justice and the Department of Transportation to review the alliances and the status of their reviews. [Adapted from Introduction and Results in Brief.]

Federal Aviation Administration: Issues Concerning the Reauthorization of Aviation Programs. Testimony before the Committee on Commerce, Science and Transportation, U.S. Senate, Jan. 20, 1999. Report no. GAO/RCED-98-246. 76 pp. Figures, appendixes. Available through GAO.***

Legislation reauthorizing programs for the U.S. Federal Aviation Administration (FAA) expired on March 31, 1999. This report contains testimony commenting on issues considered in proposed legislation to reauthorize FAA programs. Content covers aviation competition, FAA's air traffic control modernization program, FAA's efforts to make its computer systems ready for the year 2000, Airport Improvement Program (AIP) funding, and aviation safety and security. [Adapted from Introduction.]

Airport Improvement Program: FAA Complying with Requirement for Local Involvement in Noise Mitigation Projects. Report to the Honorable Adam Smith, U.S. House of Representatives, December 1998. Report no. GAO/RCED-99-41. 8 pp. Figure. Available through GAO.***

The U.S. Federal Aviation Administration (FAA), through its Airport Improvement Program (AIP), provides grants to airports to be used for mitigating the impact of aircraft noise. To receive AIP funds, airport owners must agree to spend the funds according to pertinent laws, regulations and administrative policies. One FAA policy calls for an airport owner requesting noise-mitigation grants to obtain written declarations that the project is consistent with local plans and has support from local communities, a policy that is not required by federal law or FAA regulations. This policy has been an issue at the Seattle-Tacoma (Washington, U.S.) International Airport, where there is opposition from local groups which point out that FAA did not require the airport to obtain written declarations of the project's local support.

This report examines whether FAA must enforce this policy as a condition of providing noise-mitigation grants to the Seattle-Tacoma International Airport. [Adapted from Introduction and Results in Brief.]

Air Traffic Control: Status of FAA's Modernization Program. Report to U.S. Congressional Requesters, December 1998. Report no. GAO/RCED-99-25. 96 pp. Figures, tables, appendixes. Available through GAO.***

The U.S. Federal Aviation Administration began a modernization program in late 1981 to replace and improve the National Airspace System's (NAS) equipment and facilities to meet the expected increase in traffic, to enhance safety, and to increase efficiency. Many potential benefits of the new equipment have been delayed because of problems meeting cost goals, schedules, and performance goals. Due to these ongoing problems, the FAA's modernization program was designated a high-risk information-technology initiative in 1995 and again in 1997.

This report presents information on the status of the overall modernization program, including its cost, the status of 18 key modernization projects, and challenges facing the program. [Adapted from Introduction and Results in Brief.]

Books

The Aviation Fact Book. Murphy, Daryl E., compiler and editor. New York, New York, United States: McGraw-Hill, 1998. 295 pp.

When compiler and editor Daryl Murphy was editor of *General Aviation News*, he created a personal database consisting of a wide variety of aviation-related information. That collection formed the basis for this 300-page aviation reference work. It contains data about the aviation industry and government aviation, and also presents a comprehensive history of aircraft, including makes and models, their speed records, and race results.

Other features include specifications and performance of contemporary aircraft, foreign, military, and commercial; organizational and government directories, with people and departments; and addresses, telephone numbers and fax numbers of airframe manufacturers, aviation organizations and aviation museums. Contains a bibliography and an index. [Adapted from Introduction.]

Culture at Work in Aviation and Medicine: National, Organizational and Professional Influences. Helmreich, Robert L., Merritt, Ashleigh C. Brookfield, Vermont, United States: Ashgate, 1998. 301 pp.

With a focus on airline pilots and operating-room teams, Helmreich and Merritt report on the results of ongoing research into the influences of culture in the professions of aviation and medicine. They show the effects of professional, national and organizational cultures on individual attitudes, values and team interaction. Contributions are presented from a variety of practitioners and researchers from Asia, Australia, Europe, North America and South America, and they include case studies and practical examples. The book is intended to be accessible both to practitioners and managers interested in improving their organizations, and to researchers seeking a greater understanding of the influences and types of cultures.

Contains References and an Index. [Adapted from Inside cover.]

IFALPA: The History of the First Decades: 1948-1975. Jackson, Charles C. Chertsey, United Kingdom: International Federation of Air Line Pilots' Associations, 1998. 528 pp.

This history covers the International Federation of Air Line Pilots' Associations (IFALPA) during nearly three decades of organizational growth. The book contains a historical account of the development of some of the most important IFALPA policies.

Chapter 1 sets the scene, and chapters 2, 3 and 4 present the development of administration and policy in detail. The subject matter is organized into three main sections: administration, industrial and social, and technical.

Contains an Epilogue, Appendixes, and an Index. [Adapted from Introduction.]

Max Karant: My Flights and Fights. Karant, Max with Charles F. Spence. New York, New York, United States: McGraw-Hill, 1999. 136 pp.

The late Max Karant was a leading proponent of private pilots' rights and general aviation's use of the skies and landing fields in the U.S. and abroad. He was the first senior vice president of the Aircraft Owners and Pilots Association (AOPA) and the founding editor of *AOPA Pilot*. During a career that spanned more than 40 years, Karant took on the bureaucrats in the U.S. Congress, the U.S. Federal Aviation Administration, and the big airlines, all of whom wanted to restrict private pilots' use of airspace. This memoir tells the tale of a man known for frankness, bluntness and dedication to the rights of every pilot who wanted to be safe and to fly without excess bureaucratic interference. The book also recounts Karant's flying stories and airborne adventures while logging more than 11,000 flying hours. [Adapted from Inside cover.]

Military Aviation Disasters: Significant Losses Since 1908. Gero, David. Sparkford, near Yeovil, Somerset, United Kingdom: Haynes Publishing, 1999. 176 pp.

Accidents involving military aircraft rarely receive the same level of media coverage as civil-aircraft accidents, unless the collision occurs in a heavily populated area and there are casualties on the ground. This volume presents a detailed record of hundreds of losses of military aircraft. Nevertheless, it is limited to the major disasters involving significant loss of life, whether civilian or military personnel. All types are included, from those involving single-seat aircraft in populated areas, to collisions between troop-carrying helicopters, giant World War I airships coming down in the North Sea, and modern turboprop transports brought down by surface-to-air missiles. Event details include the aircraft involved, the operator, route, loss of life, location and reasons for the accident, when known.

Author and television director David Gero has also published *Aviation Disasters*, which covers major civil aviation accidents since 1950, and *Flights of Terror*, which details incidents of aerial hijacking and sabotage since 1930. Gero has amassed more than 5,000 reports on incidents of all kinds. Contains an index. [Adapted from Inside cover.]♦

Sources

* Superintendent of Documents
U.S. Government Printing Office (GPO)
Washington, DC 20402 U.S.

** National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161 U.S.
Telephone: +(703) 487-4600

*** U.S. General Accounting Office (GAO)
P.O. Box 6015
Gaithersburg, MD 20884-6015 U.S.
Telephone: +(202) 512-6000; Fax: (301) 258-4066

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

Advisory Circulars (ACs)

AC No.	Date	Title
61-111A	Dec. 15, 1998	*Announcement of Availability: FAA-S-8081-4C, Instrument Rating Practical Test Standards for Airplane, Helicopter, Powered Lift.* (Cancels AC 61-111, *Announcement of Availability: FAA-S-8081-4B, Instrument Rating Practical Test Standards,* dated Nov. 23, 1994.)
183.29-1GG	Dec. 22, 1998	*Designated Engineering Representatives Consultant Directory.* (Cancels AC 183.29-1FF, *Designated Engineering Representatives Consultant Directory,* dated Dec. 18, 1997).
121-24B	Feb. 1, 1999	*Passenger Safety Information Briefing and Briefing Cards.* (Cancels AC 121-24A, *Passenger Safety Information Briefing and Briefing Cards,* dated May 9, 1989).
61-118A	March 1, 1999	*Announcement of Availability: FAA-S-8081-14, Private Pilot Practical Test Standards for Airplane - with Change 1.* (Cancels AC 61-118, *Announcement of Availability: FAA-S-8081-14, Private Pilot Practical Test Standards for Airplane,* dated April 21, 1995.)

International Reference Updates

Joint Aviation Authorities (JAA)

Date	
Feb. 1, 1999	Revision to JAA Administrative and Guidance Material — Section One: General Guidance and Reference Material.
Feb. 1, 1999	Revision to JAA Administrative and Guidance Material — Section Two: Maintenance.
Feb. 1 1999	Revision to JAA Administrative and Guidance Material — Section Three: Certification.
Feb. 1, 1999	Revision to JAA Administrative and Guidance Material — Section Four: Operations.
Feb. 1 1999	Change 1 to JAR-OPS 3: Commercial Air Transportation (Helicopters)
March 15, 1999	Addition to the Feb. 1, 1999, revision to JAA Administrative and Guidance Material — Section 1: General Guidance and Reference Material.
March 15, 1999	Revision to JAA Administrative and Guidance Material — Section One: General Guidance and Reference Material.

Airclaims

Supplement No.	Date	
111	Nov. 26, 1998	Updates "Major Loss Record."
112	Jan. 27, 1999	Updates "Major Loss Record."
113	Nov. 26, 1998	Updates "World Aircraft Accident Summary."
114	February 1999	Updates "World Aircraft Accident Summary."

Aeronautical Information Publication (A.I.P.) Canada

Amendment No.	Date	
1/99	Jan. 28, 1999	Updates the General, Communications, Meteorology, Rules of the Air and Air Traffic Services, Facilitation, Aeronautical Charts and Publications, and Airmanship sections of the A.I.P.

Accident/Incident Briefs

Pilot's Reliance on Aerodynamic Braking Leads to Runway Over-run

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.

FSF Editorial Staff

Air Carrier

Crew Elects Not to Use Autobrakes, Reverse Thrust

Boeing 737-300. Minor damage. No injuries.

While briefing the captain for a night landing at a European airport, the first officer (the pilot flying) said that he would not use the autobrakes or reverse thrust, but would hold the nose landing gear off the runway to decelerate the airplane with aerodynamic braking. The first officer also said that he would let the airplane roll to the end of the runway, then reverse course in the turnaround area and back-taxi on the runway.

The captain approved this plan. Nevertheless, the aircraft operating manual allows a long roll-out without the use of the autobrake system only if the roll-out is planned with idle or normal reverse thrust. The aerodynamic-braking technique is not described in any of the operator's documentation.

The weather was clear, and the crew conducted a visual approach to the 11,475-foot (3,500-meter) runway. The airplane touched down in the runway touchdown zone at 134 knots (reference speed). The first officer kept the aircraft's nose up, no reverse thrust was selected and, initially, no brakes were used.

The first officer lowered the nose wheels onto the runway at approximately 100 knots. The report said that the pilots were looking for the turn-around area at the end of the runway and did not observe runway-light color changes indicating that the airplane was nearing the end of the runway.

The pilots received few visual clues of speed and position in relation to the runway's end from the surrounding terrain because of darkness and absence of illuminated structures.

Passing approximately 50 knots, the captain got a feeling of discomfort and called, "Stop." The first officer applied the wheel brakes, but was unable to stop the airplane on the remaining 413 feet (216 meters) of runway. The airplane was stopped with the nose wheels on the grass overrun and was slightly damaged while being pushed back onto the runway by a ground vehicle. No one was injured.

Tail Strike on Touchdown Follows Unstabilized Approach

Lockheed L-1011-100. Substantial damage. No injuries.

The airplane was outside the final approach fix for an instrument landing system (ILS) approach to an airport in the United States when runway visibility decreased below minimums. The crew accepted an offer by air traffic control to transition to the ILS approach to the parallel runway, where visibility was above minimums.

The crew did not review the ILS approach chart, did not complete all checklists and did not observe instrument indications showing that the wing leading-edge slats had not extended with the flaps. (Maintenance records showed that the slats had locked 12 times in the preceding two years.)

The approach was not stabilized at 500 feet. The operator's procedures required a go-around unless an approach is stabilized at 500 feet.

The airplane was at landing reference speed and the autoland system was engaged when the tail struck the runway during the flare for landing. Damage was substantial, but none of the 262 occupants was hurt.

Rejected Takeoff Ends with Burning Tires, Evacuation

Boeing 747-400. Minor damage. Three serious injuries, 19 minor injuries.

During the takeoff roll at an airport in Japan, the captain suspected an engine problem when the airplane began to turn right and the acceleration rate decreased. When the first officer called V_1 at 151 knots, the no. 4 engine N_1 (low-pressure compressor speed) began to decrease.

The takeoff was rejected at approximately 160 knots. The flight crew decelerated the airplane and brought it to a full stop on a taxiway. Cabin crewmembers informed the flight crew that the no. 4 engine was emitting gray smoke and fuel was leaking from the right wing. ATC informed the flight crew that the tires on the main landing gear were burning. The captain ordered an evacuation.

Three of the 333 passengers suffered serious back injuries, and 19 passengers sustained minor injuries during the evacuation.

A pressure sensor had separated, causing the no. 4 engine to lose power. The smoke was caused by excess fuel entering the no. 4 engine. The fuel leak was caused by fuel that entered the wing-tip surge tank during the deceleration and then exited from the vent pipe.

Air Taxi Commuter

Cracked Cabin-altitude Selector Causes Rapid Depressurization

Learjet 24. Minor damage. No injuries.

After a freight-delivery flight in England, the airplane was being flown through 30,000 feet when the cabin depressurized rapidly. The crew was not able to restore cabin pressure. They conducted an emergency descent and returned to the departure airport.

The plastic case on the cabin-altitude controller was cracked. The resulting air leak caused the pressurization system to malfunction. Cabin pressure exceeded maximum differential pressure, and the cabin safety valve opened to depressurize the cabin.

Airport Provides No Notice Of Partially Plowed Runway

Beech B100 King Air. Substantial damage. No injuries.

During their preflight weather briefing, the pilots were advised of thin, loose snow on the runway at the destination airport. The airport had not filed a Notam (notice to airmen) that the runway had been only partially cleared of snow. The runway was 5,600 feet (1,708 meters) long and 100 feet (31 meters) wide. The full length of the runway had been cleared, but only 23 feet (seven meters) on each side of the centerline had been cleared.

The pilots tried unsuccessfully to obtain an airport advisory on Unicom before landing at dawn. They landed in low visibility with the runway lights visible. After touchdown, the left main landing gear contacted a berm or snow bank on the left side of the plowed area, and the pilots were unable to maintain directional control. The airplane turned 180 degrees, and the nose landing gear collapsed. None of the five occupants was injured.

Corporate Executive

Tire Failure Occurs during Rejected Takeoff

Rockwell Sabreliner 80. Substantial damage. No injuries.

The wind was from 330 degrees at six knots when the takeoff roll was begun on Runway 21. The captain rejected the takeoff when the airplane was halfway down the 10,000-foot (3,050-meter) runway at approximately 120 knots. The report did not say why the captain rejected the takeoff.

The captain then heard a loud noise and felt a severe vibration. The airplane ran off the end of the runway and was substantially damaged when the nose landing gear collapsed. None of the five occupants was injured.

Both tires on the left main landing gear had failed because they were overdeflected. Overdeflection is caused by operating the tire overloaded or underinflated.

MU-2 Strikes Snow Bank During Missed Approach

Mitsubishi MU-2B-6. Substantial damage. One minor injury.

The pilot conducted an ILS approach on a dark night. The reported weather was ceiling 100 feet, sky obscured and visibility 0.25 mile (0.4 kilometer).

The airplane struck a snow bank off the right side of the runway. The pilot stated that he was just beginning the missed approach when the accident occurred. One occupant sustained minor injuries; two occupants were not hurt.

Anti-skid System Malfunction Contributes to Landing Accident

Israel Aircraft Industries Astra. Substantial damage. No injuries.

The anti-skid braking system was engaged when the airplane landed. At 90 knots, the airplane began drifting left. Differential braking, full right rudder and nose-wheel steering failed to correct the ground track. The airplane collided with two taxiway signs, the nose landing gear was sheared off and the nose-gear strut penetrated the pressure vessel.

Postaccident tests showed that the right brake became inoperative when the antiskid system was engaged. Further examination showed that the right inboard antiskid-generator connector was corroded, causing the system to falsely sense a locked brake and automatically release the brake.

Other General Aviation

Blocked Fuel-vent Lines Cause Wing Deformation in Flight

Cessna 441 Conquest II. Substantial damage. No injuries.

The airplane was at Flight Level 240 when the pilot observed that the wing deice boots were inflated fully. The pilot had not manually activated the boots. He consulted the pilot operating handbook, but was unable to cycle the boots.

The airplane was descending through 5,000 feet when the pilot heard a loud bang and felt a jolt. The pilot noticed that the right wing had imploded or caved in. He also noted that aileron control had been affected.

The pilot declared an emergency and landed at the nearest airport. Examination of the airplane showed that wasp nests (mud) had blocked the engine bleed-air control-valve overboard lines and both main fuel vents. Both fuel-cap flutter valves were defective. The secondary fuel vents in the fuel-filler caps were partially blocked by paint.

Ice Covers Windshield, Blocks Static System

Piper Dakota. Airplane destroyed. One minor injury.

The pilot did not obtain a weather briefing before departing on a night, cross-country flight and did not activate the airplane's pitot-heat system. The airplane encountered freezing rain at 5,000 feet, and the windshield was covered with ice.

The pilot said that the altimeter stuck at 4,000 feet during the descent to the destination airport. The pilot continued the descent until colliding with the ground at 3,000 feet. The airplane was destroyed. The pilot, the sole occupant, sustained minor injuries.

Ice-laden King Air Descends Below Glide Slope, Hits Trees

Beech C90 King Air. Substantial damage. Two minor injuries.

The weather forecast included advisories for moderate to severe icing conditions below 7,000 feet. One passenger said that she observed ice forming on the airplane's horizontal stabilizer. Severe icing conditions were reported.

While executing the ILS approach to the destination airport, the pilot was unable to maintain the proper glide path even with the application of full power. The pilot maintained marginal control of the airplane during the descent until impact with trees and the terrain about 10 miles west of the airport. The occupants said that the airplane shuddered and vibrated before impact. Two of the 10 occupants sustained minor injuries.

Rotorcraft

Overlooked Masking Material Causes Power Loss on Takeoff

Aerospatiale AS-350B. Substantial damage. Five serious injuries.

A maintenance technician failed to remove a roll of masking material from the canopy after repainting the upper corners of the windshield. The pilot did not notice the material while conducting a preflight inspection of the helicopter. During initial climb, approximately 13 feet (four meters) of masking material became wrapped around the main rotor mast, and approximately five feet (1.5 meters) of material entered the engine inlet.

The helicopter lost power at 150 feet and descended out of control. The five occupants were seriously injured in the accident.

R22 Loses Main-rotor Speed During Steeply Banked Turn

Robinson R22. Substantial damage. Two minor injuries.

The density altitude was approximately 4,000 feet when the pilot made a high-speed pass over the runway and then began a steep climbing turn. A witness said that the helicopter's bank angle was nearly vertical.

The helicopter then descended and struck the ground. The pilot reported that he recalled hearing the low-rotor [speed] warning horn before impact.

Pilot Fails to Notice Tie-down Chains before Attempting Takeoff

Bell 206B. Substantial damage. One minor injury.

The pilot said that during his preflight inspection of the helicopter, he did not look at the skids or notice that tie-down chains were installed. He said that he did not normally tie down the helicopter at night. Ramp personnel had tied down the helicopter because of high winds.

When the pilot attempted to fly the helicopter, it rolled over and struck the ground. A three-foot section of a main rotor blade separated and penetrated a building. No one inside the building was hurt. The pilot sustained minor injuries.♦

BLANK
INSIDE
BACK
COVER

Mark the Date!

Enhancing Safety in the 21st Century

Hosted by
Embraer
Lider
TAM
Transbrasil
Varig
VASP

RIO de Janeiro, Brazil

November 8–11, 1999

A Joint Meeting of the
52nd FSF annual International Air Safety Seminar,
29th IFA International Conference and IATA

International Federation of Airworthiness

Flight Safety Foundation

International Air Transport Association

For information, contact Ahlam Wahdan or Joan Perrin at +(703) 739-6700 or e-mail: jperrin3@compuserve.com.

Visit our World Wide Web site at http://www.flightsafety.org

FLIGHT SAFETY DIGEST

Staff: Roger Rozelle, director of publications; Mark Lacagnina, senior editor; Wayne Rosenkrans, senior editor; John D. Green, copyeditor; Rick Darby; editorial consultant; Karen K. Ehrlich, production coordinator; Ann L. Mullikin, production designer; Susan D. Reed, production specialist; and David A. Grzelecki, librarian, Jerry Lederer Aviation Safety Library.

Subscriptions: US$95 (U.S.-Canada-Mexico), US$100 Air Mail (all other countries), twelve issues yearly. • Include old and new addresses when requesting address change. • Flight Safety Foundation, 601 Madison Street, Suite 300, Alexandria, VA 22314 U.S. • Telephone: +1(703) 739-6700 • Fax: +1(703) 739-6708

We Encourage Reprints

Articles in this publication, in the interest of aviation safety, may be reprinted, in whole or in part, in all media, but may not be offered for sale or used commercially without the express written permission of Flight Safety Foundation's director of publications. All reprints must credit Flight Safety Foundation, *Flight Safety Digest,* the specific article(s) and the author(s). Please send two copies of reprinted material to the director of publications.

What's Your Input?

In keeping with FSF's independent and nonpartisan mission to disseminate objective safety information, Foundation publications solicit credible contributions that foster thought-provoking discussion of aviation safety issues. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Flight Safety Digest*, please contact the director of publications. Reasonable care will be taken in handling a manuscript, but Flight Safety Foundation assumes no responsibility for material submitted. The publications staff reserves the right to edit all published submissions. The Foundation buys all rights to manuscripts and payment is made to authors upon publication. Contact the Publications Department for more information.