FLIGHT SAFETY FOUNDATION

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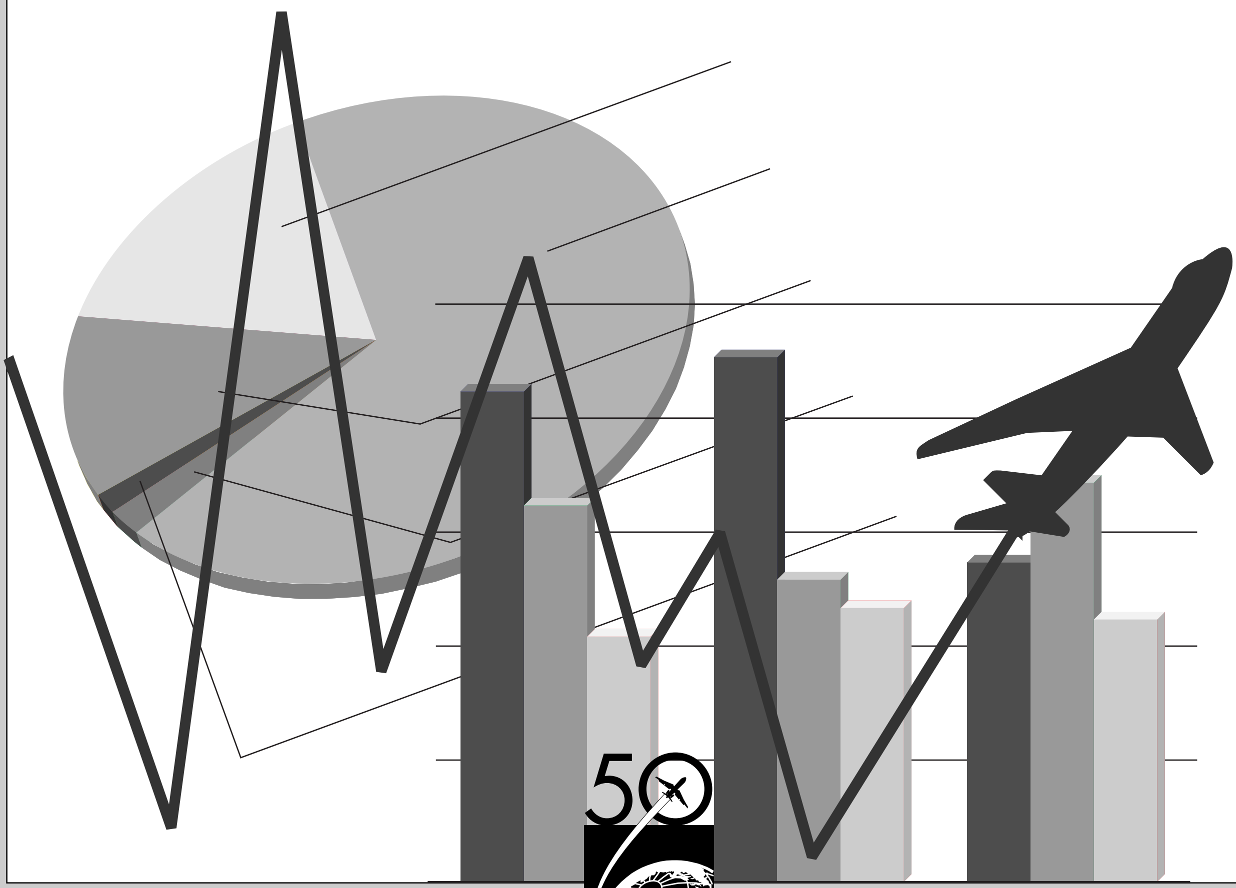
FLIGHT SAFETY
DIGEST

Safety and Statistics: What the Numbers Tell Us About Aviation Safety At the End of the 20th Century



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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.

Safety and Statistics: What the Numbers Tell Us about Aviation Safety at the End of the 20th Century

Technological developments offer many avenues for further improving the safety record of an already generally safe aviation system, despite rapidly growing traffic. But human factors–based errors and substandard facilities in some areas of the world present challenges that are not easily overcome.

—

Stuart Matthews
Chairman, President and CEO
Flight Safety Foundation

As this millennium draws to a close, commercial air travelers are, by and large, in good hands.

In the past 25 years, worldwide commercial large jet transport accident rates have fallen appreciably. Hull-loss accidents — those in which the aircraft is destroyed — have declined from 27 per million departures (PMD) to 1.5 accidents PMD. (All accident data and discussion in this article refer to worldwide commercial large jet airplanes, heavier than 27,216 kilograms [60,000 pounds] maximum gross weight, excluding those manufactured in the Soviet Union or the Commonwealth of Independent States [CIS]. Figures have been compiled from data by Flight Safety Foundation [FSF], Airbus Industrie, Boeing Commercial Airplane Group and McDonnell Douglas Corp.)

Most of this decline occurred in the early 1960s (Figure 1, page 2). Since 1970, the annual accident rate has been relatively constant and remains under five accidents PMD.

Nevertheless, these are accident *rates*, not the total *number* of accidents. If, as expected, airline traffic doubles in the next 12 years to 15 years, *the current low accident rate could yield double the number of accidents*.

That is a serious problem for the industry, because the public does not usually think about accident rates; the public usually relates to the *number* or *frequency* of accidents. We might well have a situation during the next decade in which commercial aviation will become more safe — fewer accidents PMD — but the public will perceive that flying is more dangerous simply because the number of accidents will have increased. Thus the commercial aviation industry cannot be satisfied with maintaining an already low accident rate, or even with reducing it slightly. *We must reduce the accident rate to such a degree that the actual number of accidents decreases.*

Aircraft operated outside North America (the United States and Canada for this discussion) have, in many areas, significantly higher accident rates than those operated within North America (Figure 2, page 3). Worldwide, the annual accident rate is 1.5 accidents PMD. Accident rates below 1.0 PMD are found in North America, Europe, Japan and Australia.

The highest accident rate is found in Africa: 13.0 accidents PMD is 26 times that of the United States and 8.67 times the world rate; next in order are South America, Southeast Asia, and China. Those areas are also where an increase in commercial airline departures could have its most dramatic effect on the number of accidents (Figure 3, page 3) unless the accident rates are improved.

Figure 4 (page 4) compares U.S. and non-U.S. hull-loss accident rates for aircraft that are currently in production and

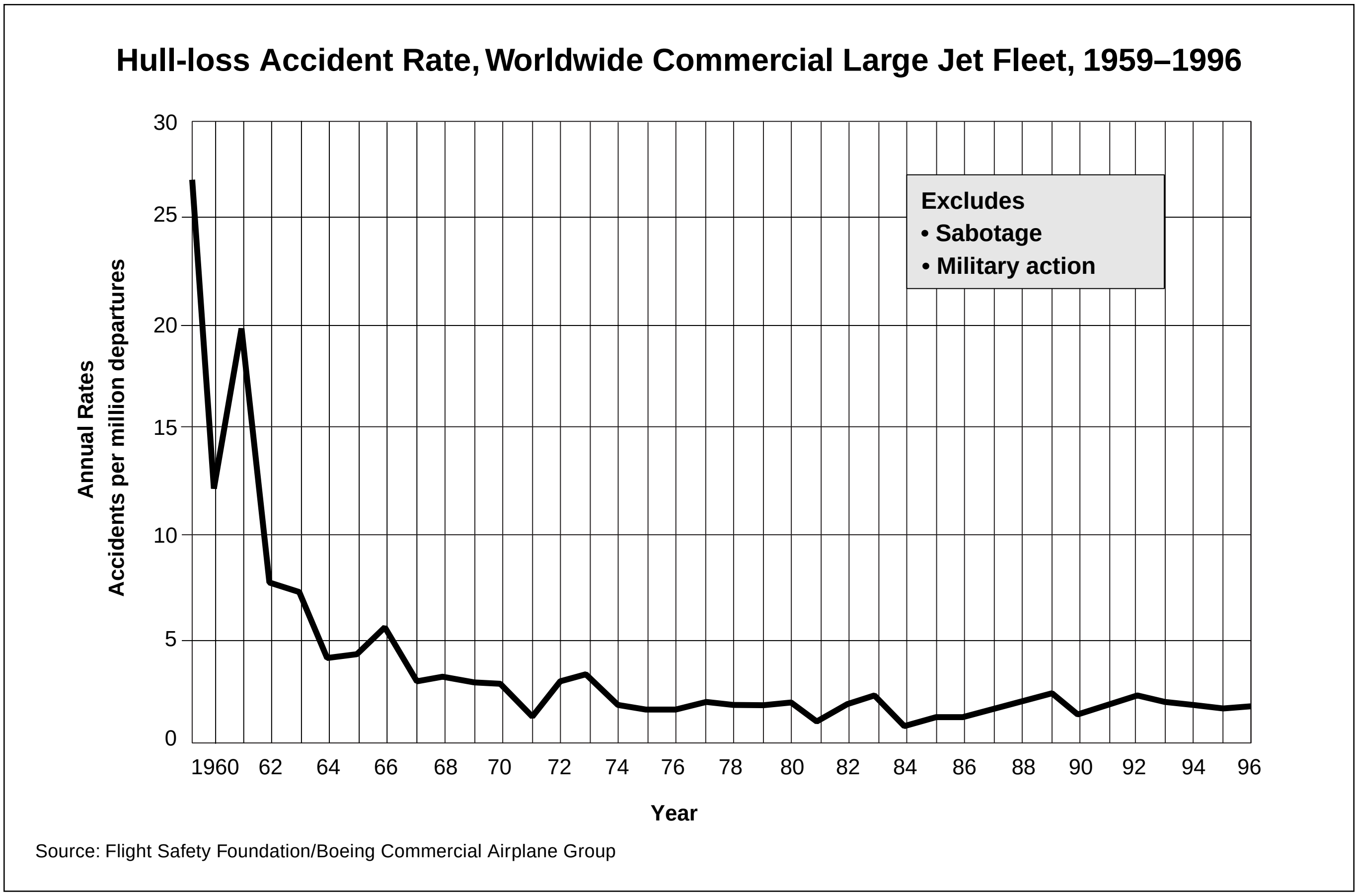


Figure 1

for those that are out of production. In both categories, the hull-loss accident rate is higher outside the United States.

The occurrence of accidents is not distributed uniformly among aircraft users. Sixteen percent of the carriers have 70 percent of the accidents (Figure 5, page 4).

Figure 6 (page 5) looks at the same data in another way. In the 1987–1996 decade, 600 airlines had no accidents and 148 airlines had at least one accident. Ninety-six airlines had one accident; 32 airlines had two accidents; 15 airlines had three accidents; and five airlines had four to seven accidents. Airlines differ vastly in their numbers of departures and flight hours, so the absolute numbers of accidents are not in themselves indicators of relative safety. *The most important fact about these data may be that 600 airlines had no accidents in a decade — a remarkable testament to the industry's safety record.*

If we are to make significant further progress in commercial aviation safety, the four areas to which we must devote the most attention are:

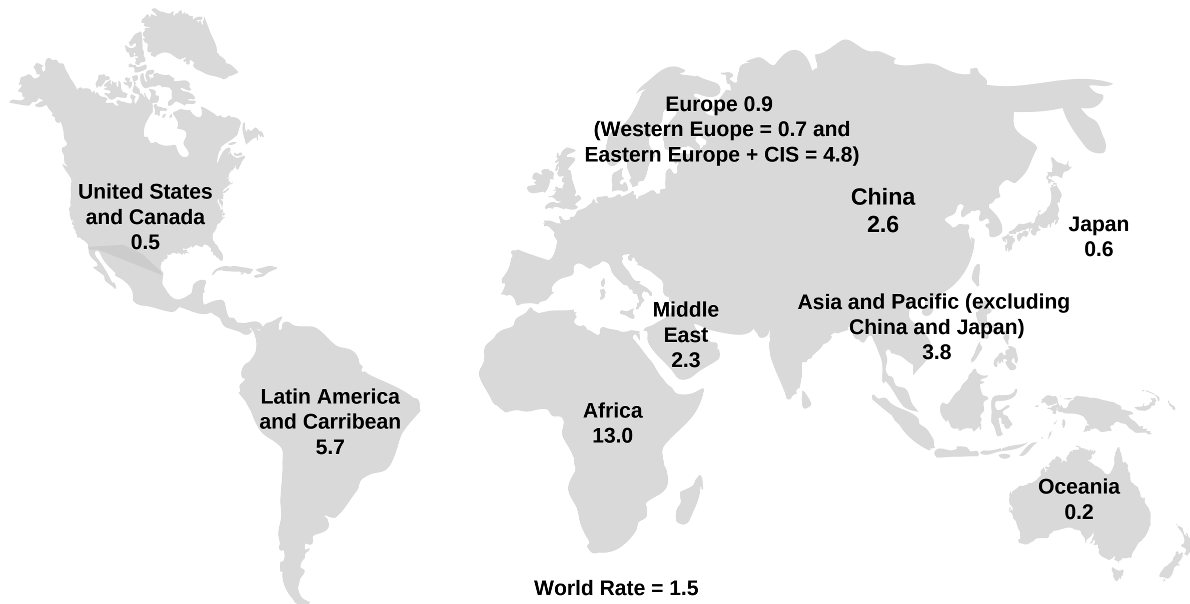
- **Human factors.** The leading cause of accidents in the aviation industry is human error. Figure 7 (page 5) shows the primary causes of aircraft hull-loss accidents divided into five categories: flight crew, airplane, maintenance, weather and airport/air traffic control (ATC). The flight crew is a primary factor in more accidents than all other categories combined.

- **Approach and landing.** Figure 8 (page 6) shows phases of flight and the percentage of accidents that have occurred in each phase since the beginning of the jet transport era in 1959. The end of the flight is the most critical phase of flight; almost half of all the aircraft accidents chronicled during this period occurred during final approach and landing.

- **Controlled flight into terrain (CFIT).** Many end-of-flight accidents fall in the category of CFIT. Such accidents are defined as an otherwise serviceable aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew of the impending collision. During the period from 1959 to 1996, CFIT was responsible for 2,396 fatalities, more than half of all commercial aviation fatalities (Figure 9, page 7).

- **Loss of control.** A loss-of-control accident is one in which an aircraft loses aerodynamic stability and control

Accident Rates, by Region, Commercial Large Western-built Jets, 1987–1996 (Hull Losses per Million Departures)

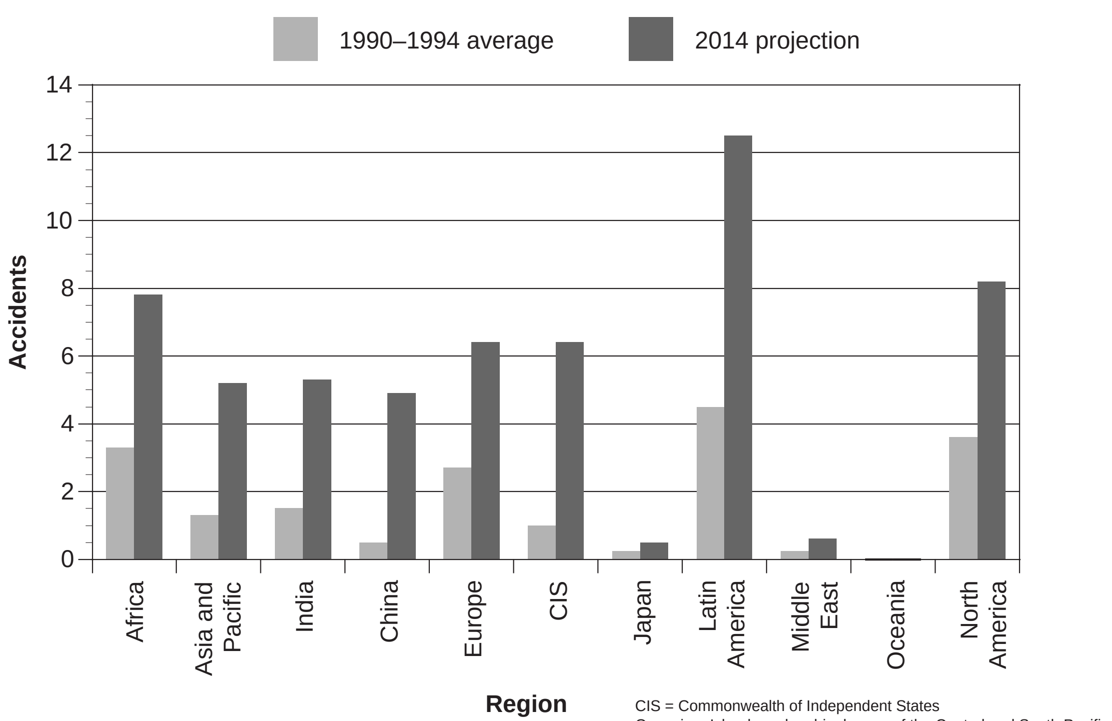


CIS = Commonwealth of Independent States
Oceania = Islands and archipelagoes of the Central and South Pacific

Source: Flight Safety Foundation/Boeing Commercial Airplane Group

Figure 2

Commercial Large Jet Accidents — Now and in the Future



CIS = Commonwealth of Independent States
Oceania = Islands and archipelagoes of the Central and South Pacific

Source: Flight Safety Foundation

Figure 3

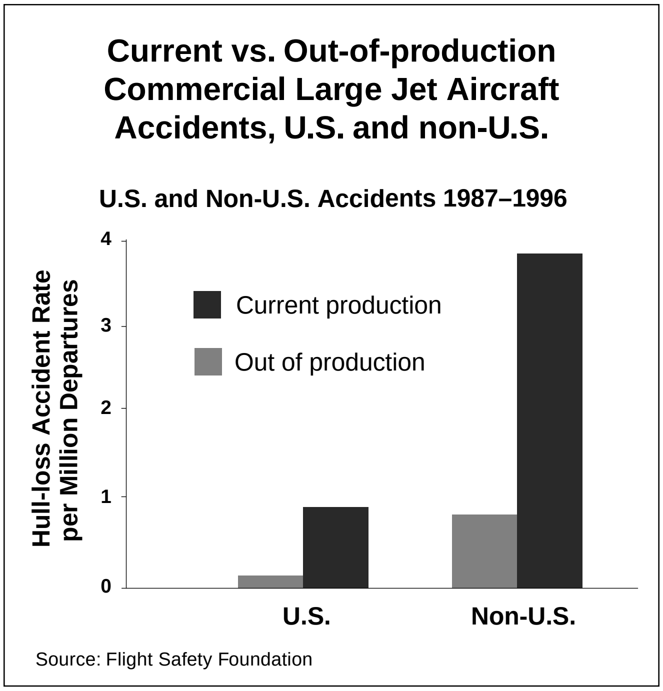


Figure 4

is not recovered by the crew. In some of these accidents, investigators believe that a recovery might have been possible if the crew had been trained to recover the aircraft from unusual attitudes.

What can be done to reduce the number of aircraft accidents? There are four primary areas where efforts to improve aviation safety can be aimed:

(1) The aircraft;

(2) The system;

(3) The ground facilities; and,

(4) The operator.

Current aircraft are safer and more reliable than those of previous generations. Figure 10 (page 7) defines the categories of first-, second- and third-generation aircraft and depicts their relative accident rates. Each generation has had a high accident rate immediately following introduction into service than in later years of service. The more recent the aircraft generation, the lower the accident rate.

The biggest differences are between first-generation aircraft and the other two generations. After 10 years of life, first-generation aircraft have an annual accident rate some five times greater than the annual accident rate for second- and third-generation aircraft; moreover, the annual accident rate has increased for first-generation aircraft following about 17 years of service. Nevertheless, the overall accident rate for all generations combined has improved.

About 95 percent of the 11,750 airplanes currently in the large commercial large jet fleet are relatively new second- and third-generation aircraft (Figure 11, page 8). There is only a small percentage of first-generation aircraft in use around the world.

Figure 12 (page 8) projects the future, extending the fleet forward in time. By 2015, the commercial large jet fleet will total about 23,000 aircraft — nearly twice the current size. About two-thirds of the airplanes will have been built since 1995 and one-third will have been built before 1995.

In other words, most of our current commercial large jet fleet will continue to be with us for a long time, and improvements to aviation safety will not come from radically new aircraft as much as from technological changes within the aviation infrastructure. This is because current aircraft already are extremely safe and are cited as the primary cause of less than 10 percent of accidents. It is difficult to envision any quantum leap in the practical design of future models that could provide more than incremental safety improvements. But such incremental improvements, when applied to a low baseline of accidents, could contribute to progress in reducing the current accident rate sufficiently enough in the future to reduce the number of accidents.

These improvements will include specialized equipment to address specific hazards, and other incremental safety improvements of new aircraft and, where possible, retrofitting these safety improvements in current aircraft.

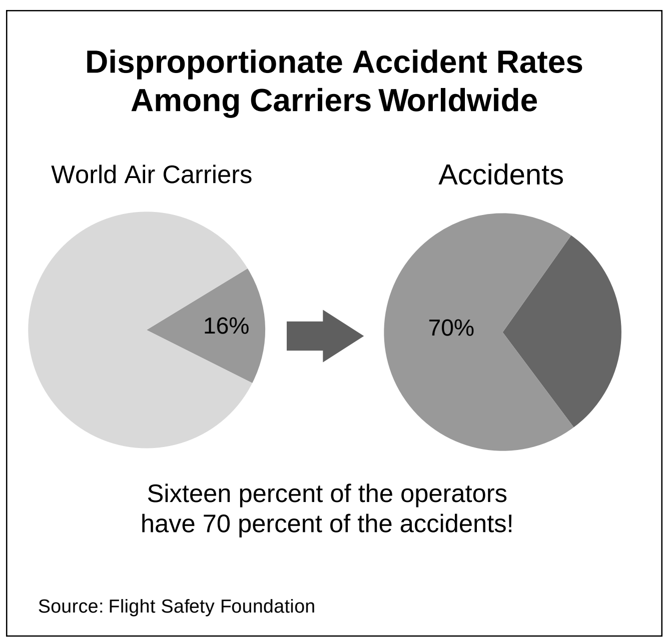


Figure 5

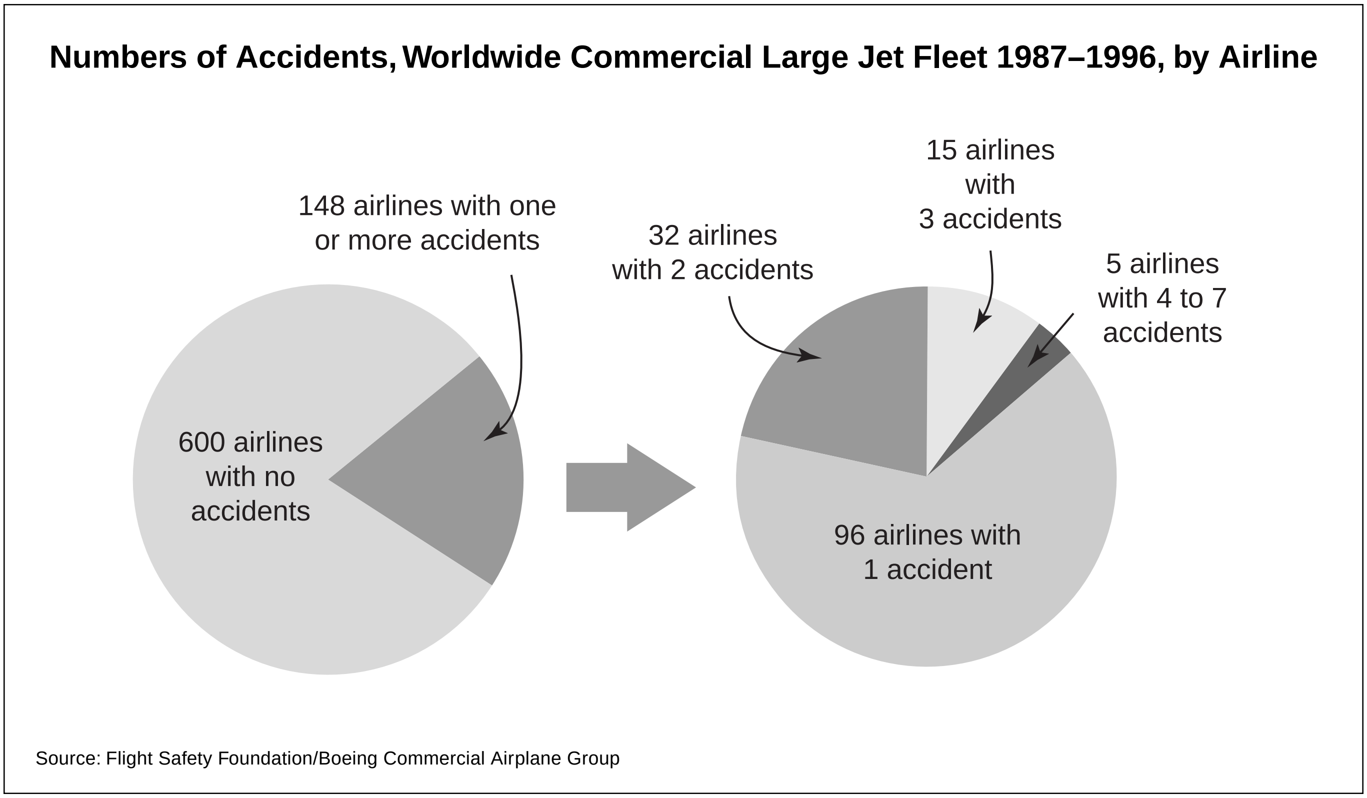


Figure 6

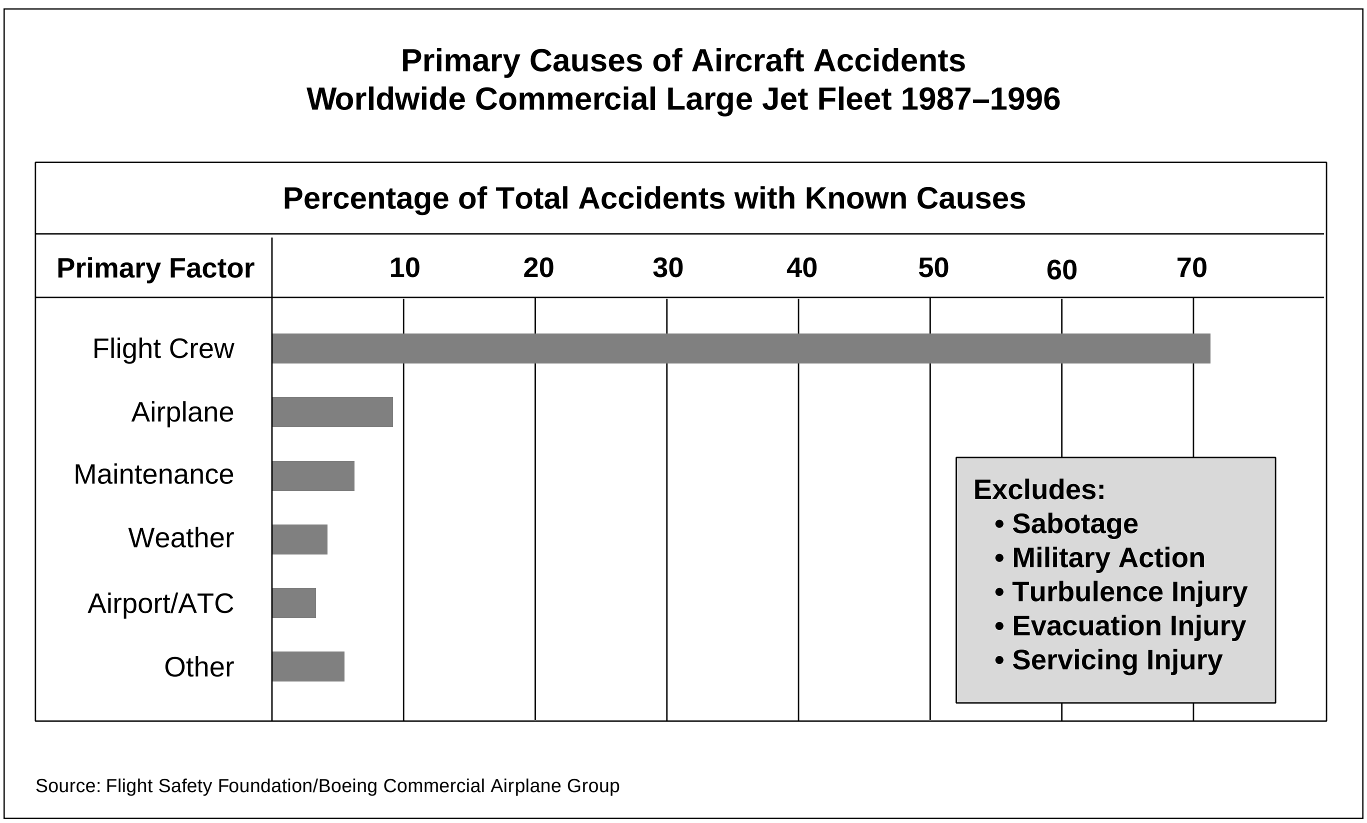


Figure 7

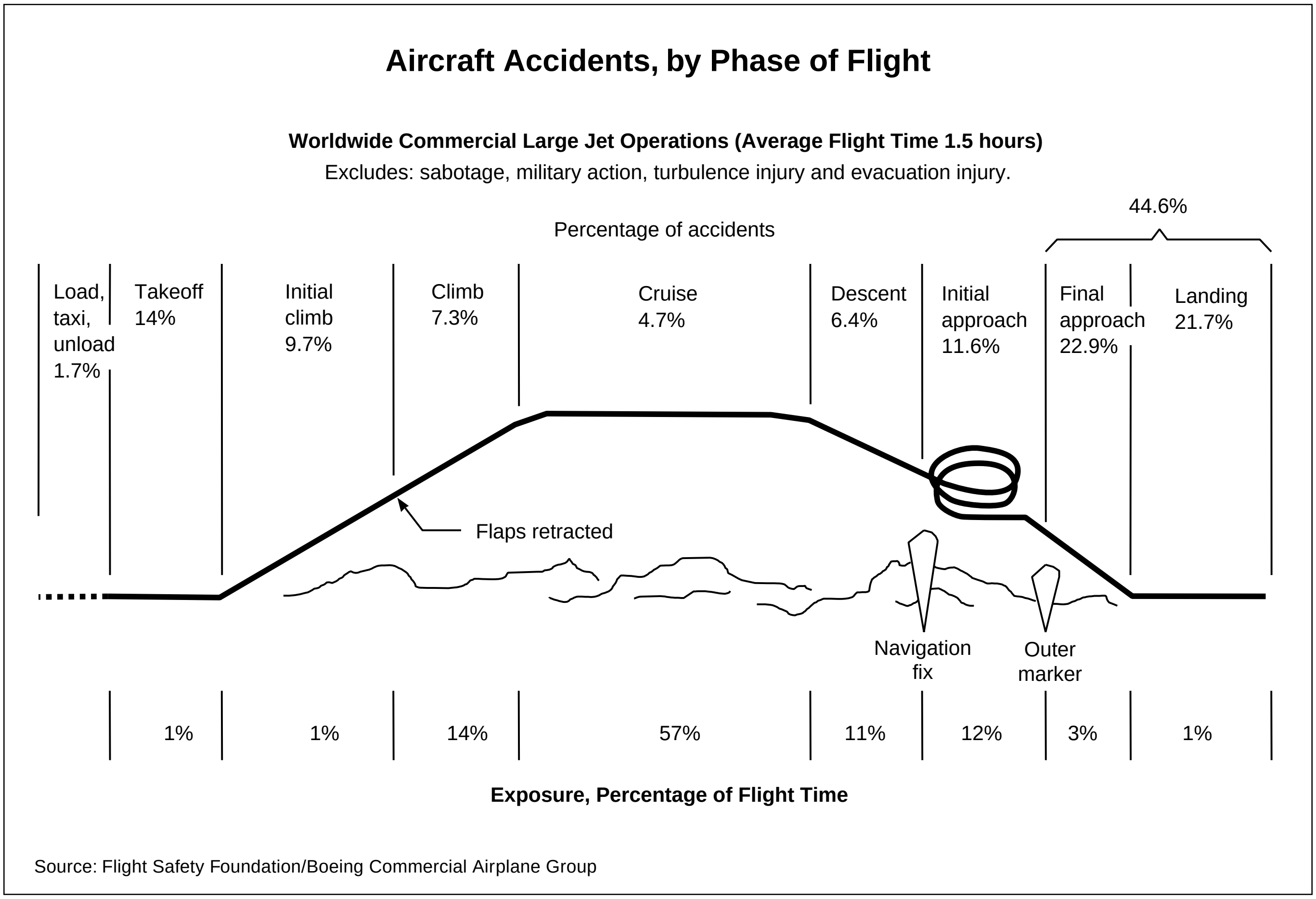


Figure 8

Three of the most promising improvements are the enhanced ground-proximity warning system (EGPWS), which uses computer-derived terrain maps and global positioning system (GPS) data to warn pilots of threatening terrain below and ahead of them; the traffic-alert and collision avoidance system (TCAS), designed to alert pilots to the presence of closing airborne traffic; and data link, which supplements air–ground spoken communication with printed communication, reducing the possibility of semantic confusion between pilots and ATC.

Improving the aviation system may be a less immediately solvable problem because the issues are broader and, in many situations, less tangible. Problems are more apparent in some developing nations that lack the infrastructure, regulatory authority and legal foundation necessary for safe operation of their air transport industries.

Absent or inadequate aviation facilities present problems in some developing nations. Handicaps include limited ATC and radar coverage; sparse navigation and approach-and-landing aids; and language problems between pilots and ATC. For example, the minimum safe altitude warning system (MSAWS) can help in reducing CFIT accidents by sounding an alarm at an ATC facility when an aircraft violates a “safety envelope” between the aircraft and terrain during an approach to landing.) Figure 13 (page 9) outlines how aviation facilities can be improved, and what aspect of aviation safety would be affected by the improvement.

Historically, civil aviation authorities have been reactive. After an accident, they have taken steps to determine the accident’s cause and what can be done to prevent a recurrence. Accident investigators have drawn on many sources for information: surviving flight crews and passengers; flight data recorders (FDRs); aircraft manufacturers; witnesses; and ATC personnel.

But this method has reached a point of diminishing returns. Significant improvements in the accident rate will require the industry to be proactive — take action before an accident occurs. The more sophisticated digital FDR (DFDR), fitted into many commercial aircraft, continuously monitors and records data from more than 100 parameters about the aircraft’s controls, attitude instruments, power settings, airspeed, angle-of-attack, moveable aerodynamic surfaces, engine temperatures and many other variables.

In the past, FDR data were used to reconstruct an accident. The FDR yielded information about the behavior of the airplane

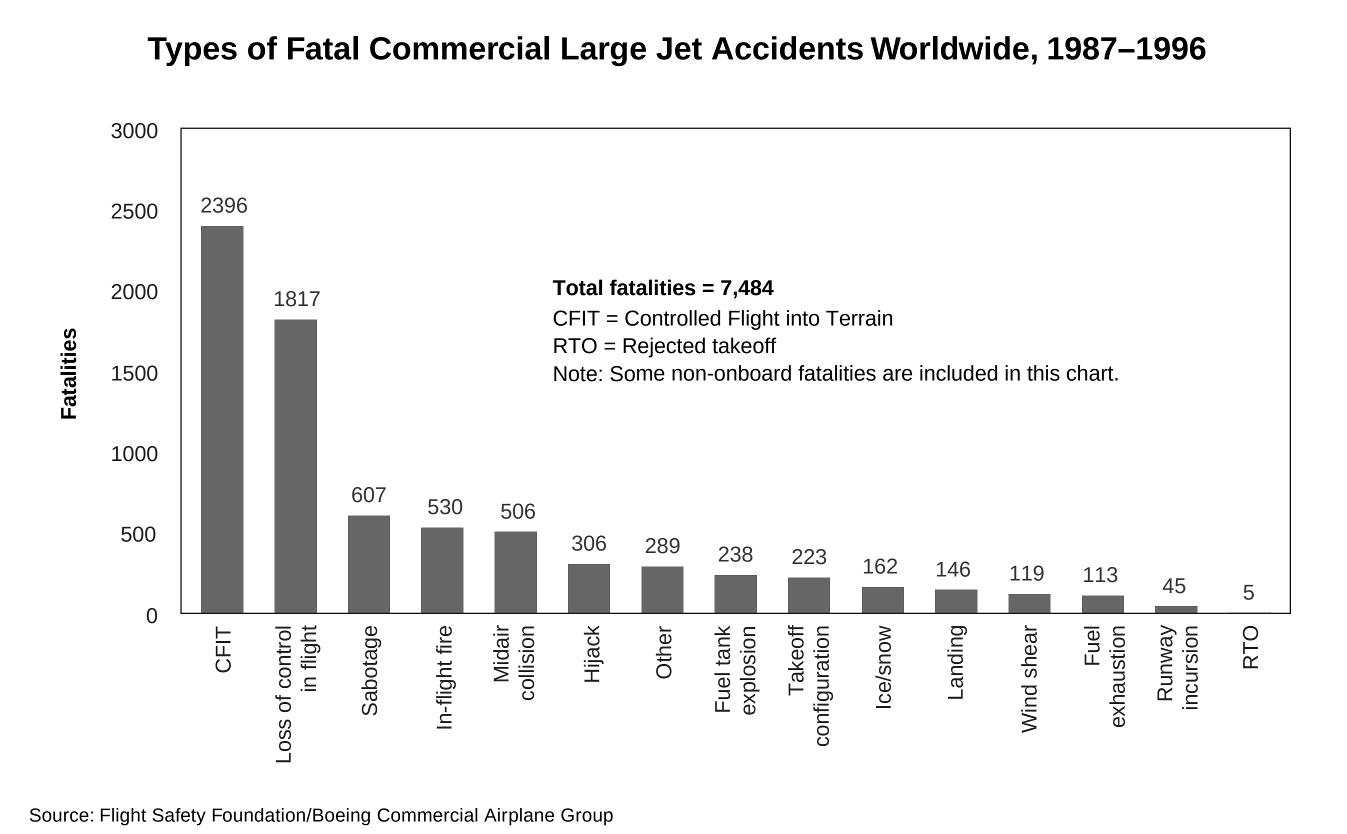


Figure 9

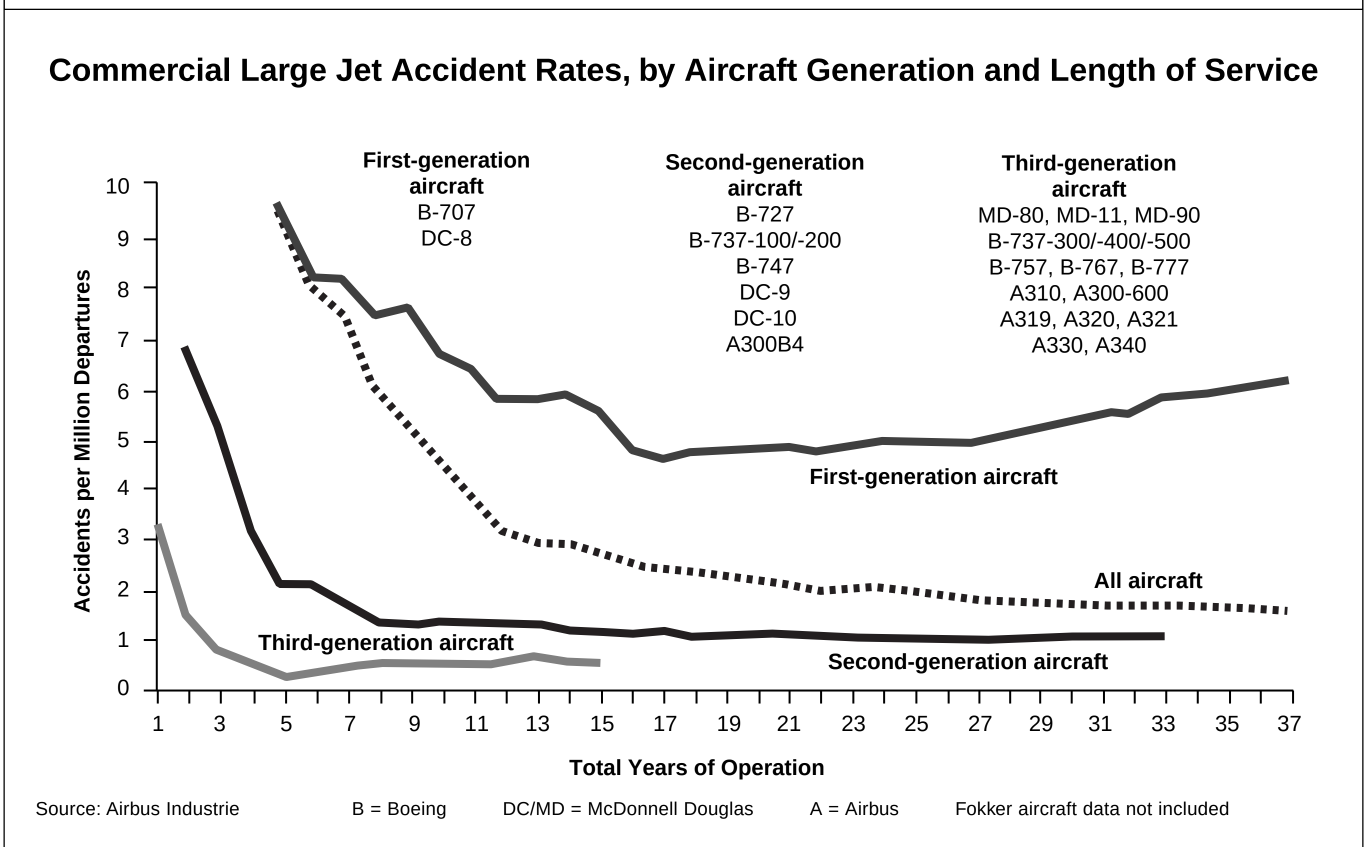


Figure 10

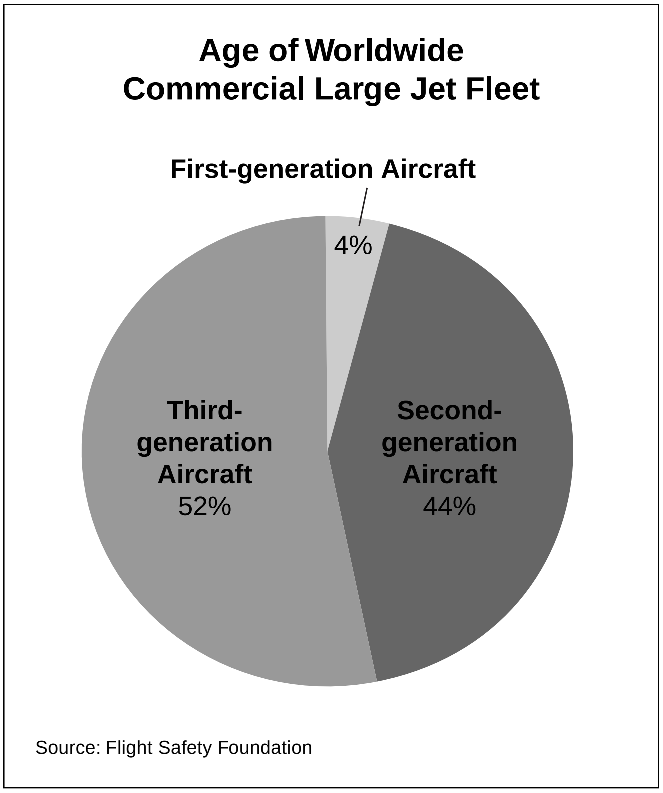


Figure 11

in an extraordinary circumstance; the data did not provide insight into the nature of normal flight operations.

Evaluation of DFDR information on a regular basis would identify baseline criteria for everyday operations and allow adverse *trends* to be identified and perhaps corrected before they lead to accidents. Used this way, the DFDR is an effective tool for *anticipating* accidents, especially if the data were combined with a confidential, nonpunitive system for pilots to report less serious problems and incidents that often lead to accidents.

This combined system, known as flight operations quality assurance (FOQA), is a proven method to prevent accidents, save lives and lower operating costs. FOQA programs are used extensively in some other parts of the world, but not significantly in the United States. The Foundation strongly recommends the adoption of FOQA programs by U.S. air carriers and calls for appropriate regulations and, if necessary, legislation to ensure that FOQA programs can be fully implemented in this country.

There is no single cause of most aircraft accidents. Aviation safety is much like a fabric. One thread may be broken without harm — even two threads or three threads. Beyond that, however, the fabric is in increasing danger of tearing.

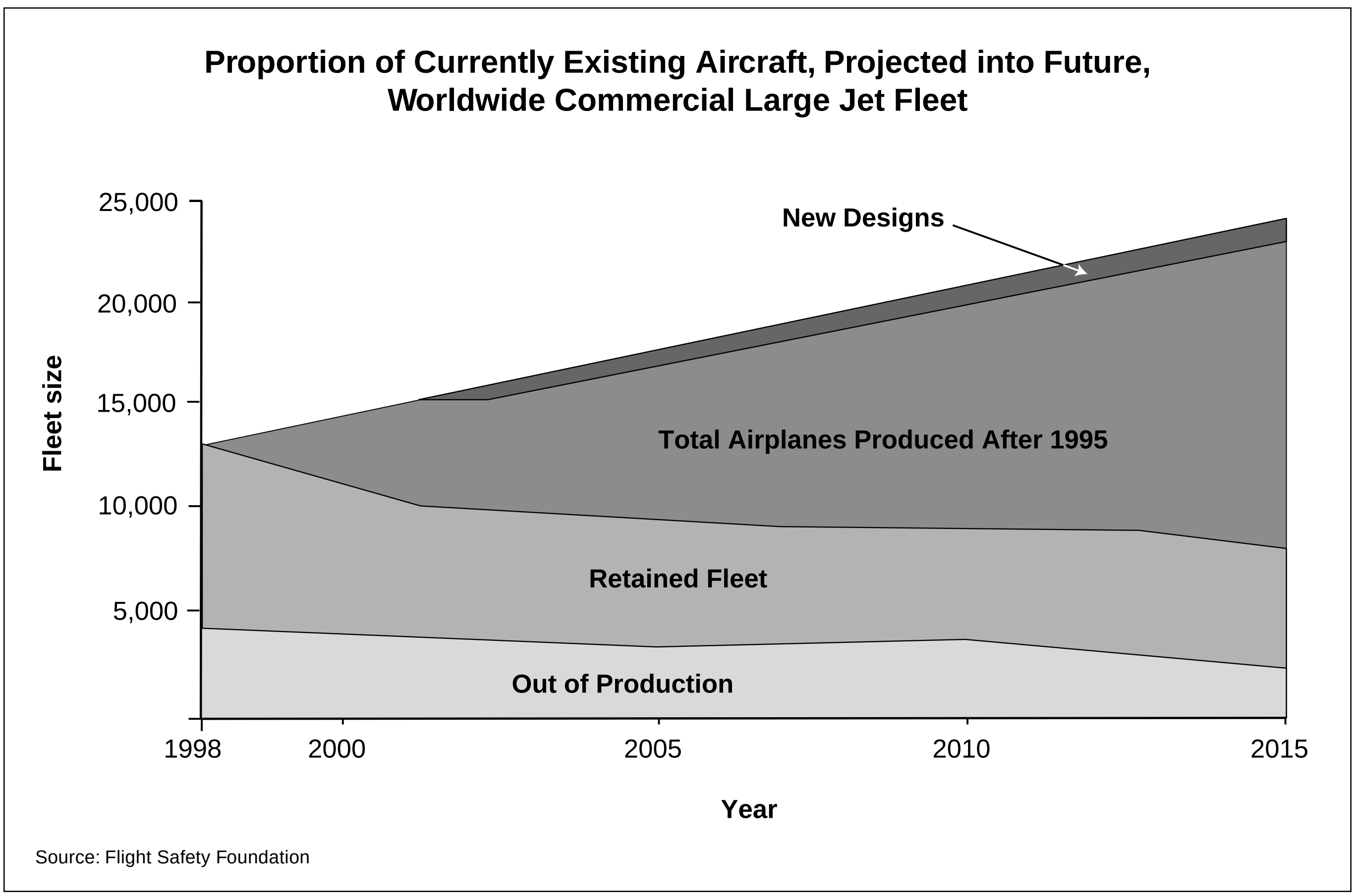


Figure 12

Improvements Generate Results

Improve	Desired Result
Air Traffic Control	Enhanced navigation/ separation
Minimum Safe Altitude Warning System	Prevention of controlled flight into terrain
Precision approach	Enhanced approach and landing
Runway signals and lighting	Prevention of runway incursions
Language proficiency	Prevention of miscommunication

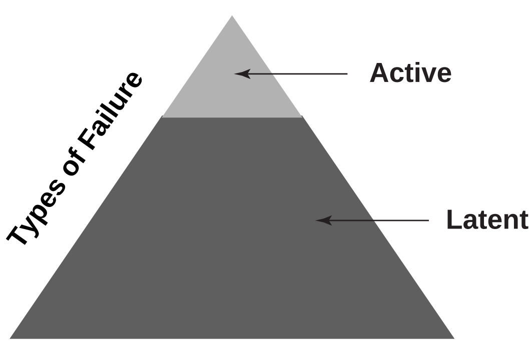
Source: Flight Safety Foundation

Figure 13

Two types of *failures* contribute to aircraft accidents (Figure 14). The failure of a flight crew to follow regulations or standard operating procedures is considered an active failure.

A latent failure (Figure 15) is an error or mistake often made by others in the organization or system. A latent failure may lie hidden — even for years — until it combines with other circumstances to cause an accident. Latent failures include poor planning, flawed procedures, inefficient scheduling, inadequate training, defective communications and improper allocation of resources.

System Failures That Contribute to Accidents



Addressing latent failures offers the greatest potential for safety improvements.

Source: Flight Safety Foundation

Figure 14

A latent failure involved two nondirectional beacons (NDBs) in Colombia. The beacons were 217 kilometers (135 miles) apart and had the same radio frequency and the same Morse code aural identification. The situation created no apparent problems until Dec. 20, 1995, when the conflict led to an active failure in the fatal accident of an American Airlines Boeing 757, as cited by the Aeronautica Civil of the Republic of Colombia.[1]

[While approaching Cali, Colombia, the flight crew programmed into their flight management computer a course to the ROMEO NDB, erroneously believing that they were selecting the ROZO NDB, a navigational fix on the arrival route. The aircraft turned on a heading toward ROMEO, and a subsequent turn back toward the Cali extended runway centerline led toward high terrain. A ground-proximity warning system warning sounded, but the pilots' escape maneuver failed to enable the aircraft to climb sufficiently to avoid striking terrain. The two flight crew members, six cabin crew members and 151 passengers were killed, and another passenger later died from injuries sustained in the accident; four passengers survived.]

Generally, identifying and rectifying latent failures has far greater potential for improving aviation safety than focusing on active failures. A single latent failure may, over time, spawn more than one active failure.

Moreover, regulators and civil aviation authorities are responsible for latent failures in their oversight of national airspace and their enforcement of minimum International Civil Aviation Organization (ICAO) international standards and recommended practices.

Latent Failures Lead to Active Errors

- Poor planning or scheduling
- Inadequate design/poor equipment
- Improper allocation/lack of resources
- Flawed procedures
- Defective communications
- Training deficiencies
- Inadequate selection procedures
- Neglect of known hazards
- Lack of motivation

Fixing a latent error can eliminate several active errors.

Source: Flight Safety Foundation

Figure 15

Management Attitudes Translate into Actions

Aircraft

- Well equipped
- Standardized
- Properly maintained

Standard Operating Procedures

- Carefully developed
- Fully implemented
- Strictly followed

Training and Checking Programs

- Proper work skills

Source: Flight Safety Foundation

Figure 16

Management Also Makes Errors

- They make few ACTIVE errors.
- Most are LATENT (hidden) errors.
- Latent errors can lie dormant for long periods.

Latent and active errors combine to create an accident.

Source: Flight Safety Foundation

Figure 17

Airlines are in business to carry passengers and cargo from one place to another; management bears responsibility for aviation safety. Safety is one aspect of profitability, in addition to being a moral imperative. Management sets safety policy and defines the safety culture within an organization. A strong, independent safety department, standardized operating instructions, well-maintained aircraft and thorough procedures for flight training and flight checking are good business.

A chief executive officer or company president who is actively concerned with aviation safety will find that his philosophy will permeate the organization (Figure 16).

Typically, management errors are latent failures (Figure 17). Reduction in latent failures, and the resultant safer flight operations, flow from management awareness of CFIT, unusual-attitude recovery training, crew resource management, confidential incident reporting systems and the use of DFDR data to identify aberrant trends in day-to-day operations.

Commercial aviation today is safe, by any reasonable definition, although safety can never mean a complete absence of risk. The safety level is not uniform worldwide, and the expected rapid growth of aviation traffic will put a greater strain on aviation safety. Nevertheless, risk can be further reduced by proactive efforts (Figure 18).

Implement Improvements for Greatest Success in Accident Prevention

Aircraft	• Install/Retrofit EGPWS.
Crew	• Adhere to SOPs. • Train to avoid CFIT. • Provide unusual attitude training. • Provide CRM training.
Management	• Develop safety culture. • Implement safety programs. • Implement FOQA. • Implement nonpunitive reporting.
Regulator	• Conform to ICAO standards. – For the greatest success in preventing commercial aviation accidents, help deliver these improvements — and others — to less-developed nations

EGPWS = Enhanced ground-proximity warning system
SOPs = Standard operating procedures
CFIT = Controlled flight into terrain
CRM = Crew resource management
FOQA = Flight operations quality assurance
ICAO = International Civil Aviation Organization

Source: Flight Safety Foundation

Figure 18

Moreover, safety measures directed toward airlines and nations that have relatively high accident rates should pay the greatest dividends in lowering worldwide accident rates and numbers.♦

References

1. *Controlled Flight into Terrain, American Airlines Flight 965, Boeing 757-223, N651AA, near Cali, Colombia, December 20, 1995.* Aeronautica Civil of the Republic of Colombia. July 1997.

Aviation Statistics

U.S. Aviation Incidents Generally Declined for Large Carriers and Commuter Air Carriers, 1990–1996

For commuter air carriers, the incident rate has continued to decline since 1991.

FSF Editorial Staff

Aviation accident statistics tend to be unrevealing because the comparatively small number of accidents does not provide enough data to make meaningful comparisons. There are, however, many more incidents than accidents. Because incidents involve factors that in combination or under other circumstances might lead to accidents, they are also system safety indicators, and their greater numbers add to their significance.

The most recently published U.S. Federal Aviation Administration (FAA) data for the 1990–1996 period (*FAA Aviation System Indicators: 1996 Annual Report*) show that U.S. large air carrier incident rates declined from 1990 through 1995, then rose slightly in 1996 (Figure 1, Table 1, page 12). For U.S. commuter air carriers, the incident rate for the period peaked in 1991 and declined thereafter (Figure 2, Table 2, page 13).

U.S. air taxi aircraft incident rates for the period declined between 1990 and 1992, rose through 1995 and fell in 1996 (Figure 3, Table 3, page 14).

The FAA defines an aircraft incident as "an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations and that is investigated and reported on FAA Form 8020-5." Excluded are near-midair collisions and pilot deviations.

The FAA calculated incidents in flight hours and departures for large and commuter air carriers, as shown in Figures 1–2 and Tables 1–2, but said, "The number of departures is generally considered the best normalizing variable."

U.S. large air carriers, operating under U.S. Federal Aviation Regulations (FARs) Part 121 or Part 127, experienced 8.19 incidents per 100,000 departures in 1990, declining to 4.61 incidents per 100,000 departures in 1996.

The rate per 100,000 departures for U.S. commuter air carrier aircraft (used in scheduled operations under FARs Part 135) reached 10.49 in 1991, but declined to 2.90 in 1996.

For U.S. air taxi aircraft (used in unscheduled operations under FARs Part 135), rates were calculated in terms of flight hours, with the caveat, "air taxi flight-hour values are imprecise." FAA statistics show that for the period, the incident rate per 100,000 flight hours was lowest in 1992 at 7.37 and highest in 1995 at 10.52.

Definitions from U.S. Federal Aviation Regulations and Other Sources

The following three definitions are derived from U.S. Federal Aviation Regulations (FARs) Part 119, and *FAA Aviation System Indicators: 1996 Annual Report*, and apply to the statistics in this article with the following exception: For data from 1996 and earlier, the commuter air carrier category includes aircraft with a maximum seating capacity of 30 or fewer passenger seats and the large air carrier category refers to aircraft with a maximum seating capacity of greater than 30 passenger seats.

Large Air Carrier: An air carrier conducting scheduled and nonscheduled operations under FARs Parts 121 or 127. This category includes aircraft with a maximum seating capacity of ten or more passenger seats and a maximum payload capacity of greater than 3,400 kilograms (7,500 pounds). A large air carrier is classified as domestic if it conducts operations within or between the 48 contiguous states of the United States or the District of Columbia; or entirely within any state, territory of possession of the United States; or from within the 48 contiguous states of the United States or the District of Columbia to any specifically authorized point elsewhere. A large air carrier is classified as a flag operator if it conducts operations between any point within either the State of Alaska or the State of Hawaii or any territory or possession of the United States to any point outside of that state, territory or possession; or between any point within the 48 contiguous states of the United States or the District of Columbia to any point elsewhere; or between any two points outside of the United States.

Commuter Air Carrier: An air carrier conducting passenger-carrying operations under FARs Part 135 on at least five round trips per week on at least one route between two or more points according to a published flight schedule. This category includes rotorcraft as well as airplanes (other than turbojet-powered airplanes) with nine or fewer passenger seats and a payload capacity of 3,400 kilograms or less.

Air Taxi – On-demand Air Charter: An air carrier conducting nonscheduled transportation of people, material goods or mail operating under Part 135 using rotorcraft or using airplanes (including turbojet-powered airplanes) with 30 or fewer passenger seats and a payload capacity of 3,400 kilograms or less. This category also includes scheduled passenger-carrying operations of less than five round trips per week on at least one route between two or more points conducted in either rotorcraft or in airplanes (other than turbojet-powered airplanes) with nine or fewer seats or a maximum payload capacity of 3,400 kilograms or less. All-cargo operations conducted with rotorcraft as well as those conducted with airplanes having a payload capacity of 3,400 kilograms or less are also included.

Because various definitions are used within the aviation industry, the following additional definitions are provided:

The following definitions are derived from FARs Parts 298 and 241.

Large Air Carrier: Defined in Part 241 as an air carrier operating aircraft designed to have a maximum seating capacity of more than 60 seats or a maximum payload capacity of greater than 8,165 kilograms (18,000 pounds), or that conducts operations where one or both terminals of a flight stage are outside the 50 states of the United States, the District of Columbia, the Commonwealth of Puerto Rico and the U.S. Virgin Islands.

Small Air Carrier: Defined in Part 298 as an air carrier providing air service within and between only the 50 states of the United States, the District of Columbia, the Commonwealth of Puerto Rico and the U.S. Virgin Islands, operating aircraft with a maximum seating capacity of fewer than 60 seats or a maximum payload capacity of less than 8,165 kilograms.

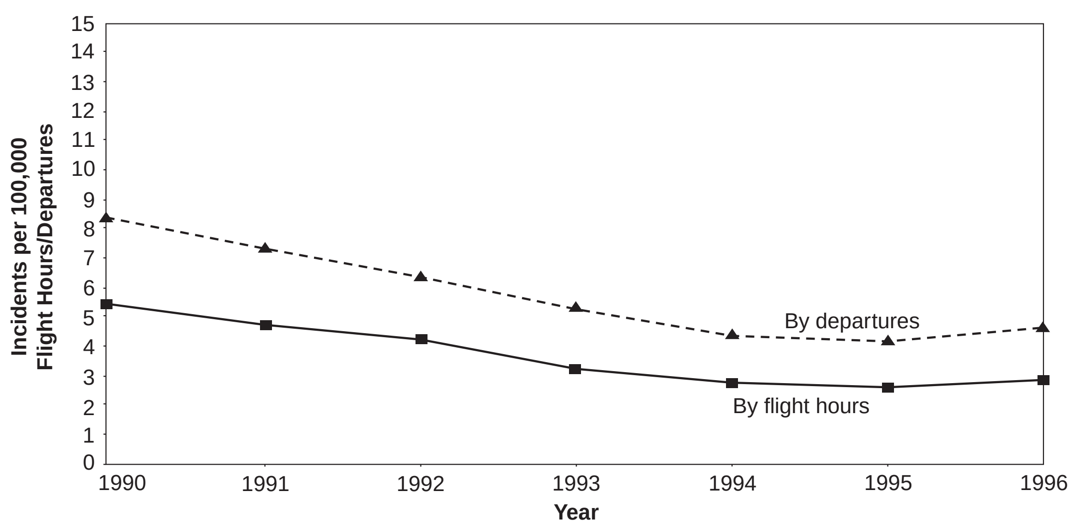
Air Taxi Operator: Defined in Part 298 as an air carrier that directly engages in the air transportation of persons, property or mail and that uses aircraft with a maximum seating capacity of less than 60 seats or a maximum payload capacity of less than 8,165 kilograms.

Table 1
U.S. Large Air Carrier Aircraft Incident Data

Year	Incidents	Flight Hours	Rate/100,000 Flight Hours	Departures	Rate/100,000 Departures
1990	663	12,150,116	5.46	8,092,306	8.19
1991	564	11,780,610	4.79	7,814,875	7.22
1992	503	12,359,715	4.07	7,880,707	6.38
1993	417	12,706,206	3.28	8,074,393	5.16
1994	361	13,122,221	2.75	8,242,903	4.38
1995	352	13,513,219	2.60	8,451,606	4.16
1996	394	13,683,000	2.88	8,554,000	4.61

Source: U.S. Federal Aviation Administration

U.S. Large Air Carrier Aircraft Incident Rates



Source: U.S. Federal Aviation Administration

Figure 1

Commuter Air Carrier: Defined in Part 298 as an air taxi operator that carries passengers on at least five round trips per week on at least one route between two or more points according to its published flight schedule.

The following definitions are derived from the U.S. Department of Transportation's Bureau of Transportation Statistics (BTS) *Air Carrier Traffic Statistics.* These air carrier groups are subsets of the large air carrier group as defined above under Part 241. They are classified as domestic operators if they conduct operations within and between the 50 states of the United States, the District of Columbia, the Commonwealth of Puerto Rico and the U.S. Virgin Islands. Some carriers' Canadian and Mexican transborder operations are also considered to be domestic. All other operations are classified as international.

Major Air Carrier: Defined as a large air carrier with annual operating revenues of greater than US$1 billion.

National Air Carrier: Defined as a large air carrier with operating revenues of US$100 million to $1 billion.

Large Regional Air Carrier: Defined as a large air carrier with operating revenues of US$20 million to $100 million.

Medium Regional Air Carrier: Defined as a large air carrier with operating revenues of up to $20 million.

The following definition is from the Regional Airline Association and is recognized within the U.S. aviation industry.

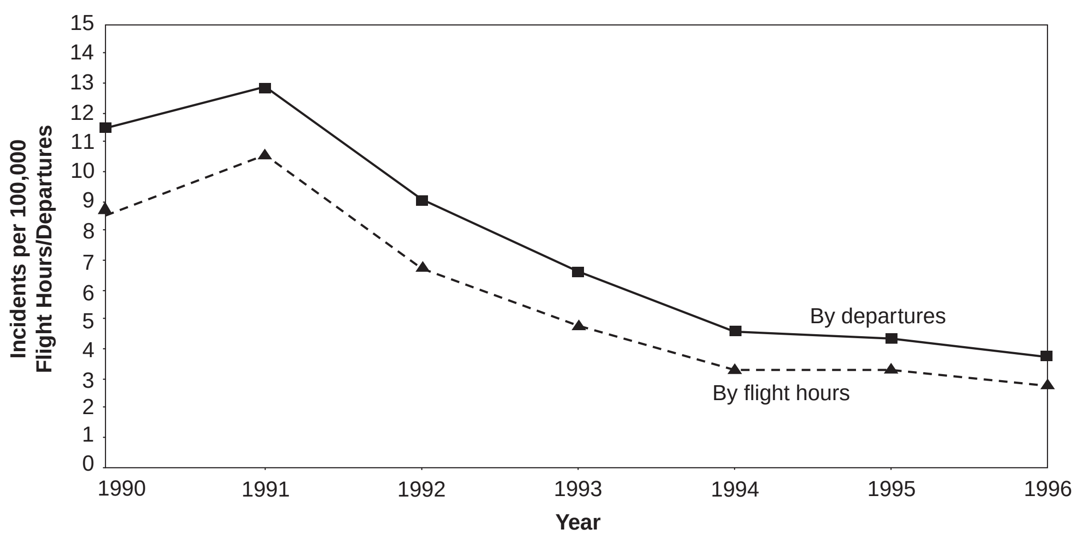
U.S. Regional Air Carrier: An air carrier that operates twin-engine, turbopropeller-powered and turbofan-powered aircraft, most with 70 passenger seats or fewer connecting small- and medium-sized communities with larger cities and hubs. ♦

Table 2
U.S. Commuter Air Carrier Aircraft Incident Data

Year	Incidents	Flight Hours	Rate/100,000 Flight Hours	Departures	Rate/100,000 Departures
1990	269	2,341,760	11.49	3,160,089	8.51
1991	296	2,291,693	12.92	2,820,440	10.49
1992	214	2,363,745	9.05	3,114,932	6.87
1993	177	2,641,268	6.70	3,601,902	4.91
1994	127	2,787,904	4.56	3,850,372	3.30
1995	107	2,478,872	4.32	3,216,900	3.33
1996	92	2,474,000	3.72	3,171,000	2.90

Source: U.S. Federal Aviation Administration

Commuter Air Carrier Aircraft Incident Rates



Source: U.S. Federal Aviation Administration

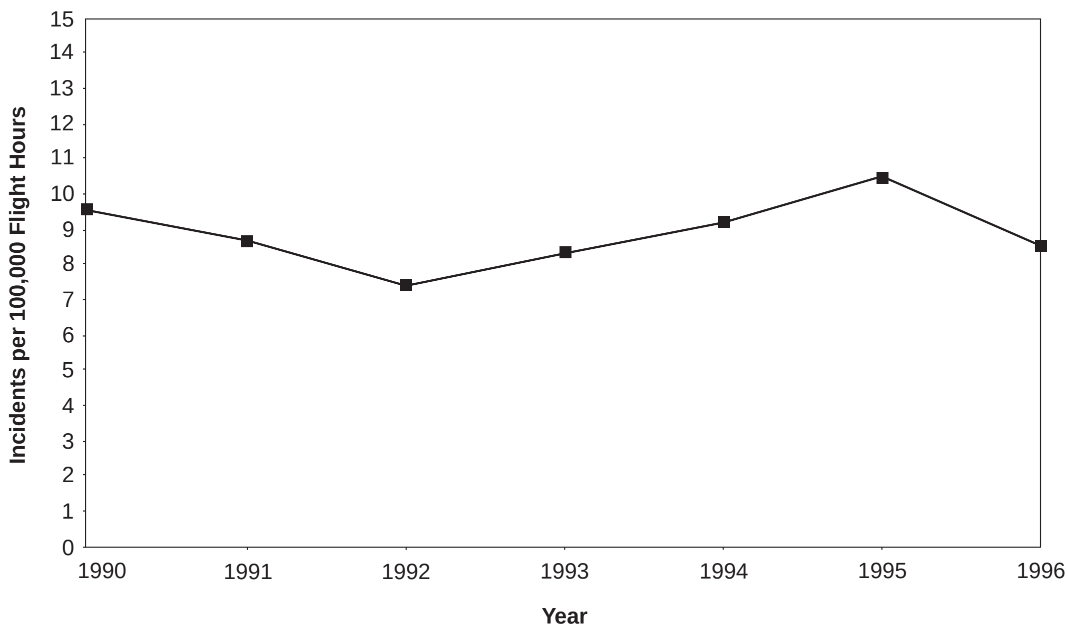
Figure 2

Table 3
U.S. Air Taxi Aircraft Incident Data

Year	Incidents	Flight Hours	Rate/100,000 Flight Hours
1990	217	2,249,000	9.65
1991	197	2,241,000	8.79
1992	148	2,009,000	7.37
1993	151	1,809,000	8.35
1994	182	1,993,000	9.13
1995	201	1,910,000	10.52
1996	163	1,902,000	8.57

Source: U.S. Federal Aviation Administration

U.S. Air Taxi Aircraft Incident Rates



Source: U.S. Federal Aviation Administration

Figure 3

Study of Personal Computer–based Aviation Training Finds Greatest Benefit in Introducing New Tasks

U.S. General Accounting Office report notes expansion of U.S. Federal Aviation Administration information available to the public.

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FSF Editorial Staff

Advisory Circulars (ACs)

Announcement of Availability: FAA-S-8081-19, Recreational Pilot Powered Parachute Practical Test Standard. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 61-127. June 2, 1997. 1 p. Available through GPO.*

The FAA has this standard for recreational-pilot certification practical tests for the powered-parachute category. The standard will take effect when the recommended change to U.S. Federal Aviation Regulations (FARs) Part 61 is approved, establishing a recreational-pilot certificate for the powered-parachute category. Practical tests conducted by FAA inspectors and designated pilot examiners will be conducted in compliance with this standard. Powered-parachute pilots exercising flight instructor privileges, as well as applicants, should find this standard helpful during training and preparing for practical tests.

This AC also contains information about obtaining copies of this AC either in printed or electronic forms. [Adapted from AC.]

Reports

Effects of Mild Hypoxia on Pilot Performances at General Aviation Altitudes. Nesthus, Thomas E.; Rush, Ladonna L.; Wreggit, Steven S. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/9. April 1997. 43 pp. Tables, figures, references, appendixes. Available through NTIS.**

Keywords:
1. Flight Performance
2. Hypoxia
3. Simulated Altitude
4. Simulated Flight
5. Supplemental Oxygen Requirement

Hypoxia (oxygen deficiency in the body sufficient to cause functional impairment) can compromise flight safety among general aviation (GA) pilots. Previous research has indicated significant physiological evidence of hypoxia during exposures to altitudes between 2,440 meters and 3,813 meters (8,000 feet and 12,500 feet). There is ambiguous evidence of task-performance impairment.

This study evaluated complex pilot performance using the Basic General Aviation Research Simulator (BGARS) and flight-following procedures involving GA pilots during a three-day, two-hour-per-day cross-country flight scenario. The report recommends that descents of GA flights of greater than two hours at these common altitudes should proceed with caution to allow for physical recovery before reaching the approach and landing phases of flight.

Appendix A contains an Experimenter's Checklist and ATC Script; Appendix B contains Descriptions of Subjective Measures. [Adapted from Introduction and Discussion.]

Evaluation of a Range of Target Blink Amplitudes for Attention-Getting Value in a Simulated Air Traffic Control Display. Milburn, Nelda J.; Mertens, Henry W. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/10. April 1997. 7 pp. Tables, figures, references. Available through NTIS.**

Keywords:
1. Air Traffic Control
2. Attention-getting
3. Blink
4. CRT display
5. Target

According to several studies, blinking targets are better at alerting than are steady targets, helping users find targets faster on visual displays. These previous studies recommended optimum parameters for target size, color, shape, brightness contrast, frequency of blink and the ratio of time the blink should be "on" relative to the time it is "off." No studies in the literature were found, however, that studied the most effective blink amplitude (the change in target brightness when measured against a standard).

This study is an effort to evaluate the effectiveness of a range of blink amplitudes when searching visually for aircraft and for identifying aircraft in a simulated air traffic control–situation display. If blink is used as an attention-getting method, blink amplitudes of less than 75 percent are not recommended by this study for situations where safety is critical. [Adapted from Introduction and Discussion.]

Transfer of Training Effectiveness of Personal Computer-Based Aviation Training Devices. Taylor, Henry L.; Lintern, Gavan; Hulin, Charles L.; Talleur, Donald; Emanuel, Tom; Phillips, Sybil. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/11. May 1997. 19 pp. Tables, figures, references. Available through NTIS.**

Keywords:
1. Applied Psychology
2. Flight Training
3. Instrument Flight
4. Personal Computer-based Aviation Training Devices
5. Psychology

Conventional flight training is costly. Personal computer (PC)–based aviation training devices (PCATDs) are training tools offering a low-cost alternative for instruction in flight tasks. But conclusive evidence is lacking that PCATD training will sufficiently prepare students for a broad range of flight tasks.

The objective of this study was to test the effectiveness of PC-based aviation training devices (PCATDs) in instrument training, to guide regulation and certification considerations by the FAA. Results showed that the benefit of PCATD training varied widely (from 15 percent to more than 40 percent) among instrument task tests. Generally, cost savings were the greatest when new tasks were introduced, eliminating part of the aircraft time that would otherwise be needed. [Adapted from Introduction and Discussion.]

Baseline Assessment of the National Association of Air Traffic Specialists/Federal Aviation Administration Partnership. Thompson, Richard C.; Hilton, Thomas F.; Behn, Lydia D. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/12. May 1997. 20 pp. Tables, figures, references, appendix. Available through NTIS.**

Keywords:
1. Organizational Change
2. Organizational Climate
3. Partnership

The National Performance Review, produced by the Clinton Administration in 1993, presented U.S. federal agencies with the task of reducing the federal workforce while at the same time cutting red tape, putting customers first, empowering employees and re-engineering core business programs. One such effort is a collaboration between the U.S. Federal Aviation Administration (FAA) Flight Service Station (FSS) and the management and leadership of the National Association of Air Traffic Specialists (NAATS).

NAATS and FAA Partnership (NFP) teams were established with the objective of promoting the involvement of employees in daily business decision making. The NFP arrangement consists of regional and facility-level teams of air traffic management and NAATS bargaining-unit representatives. This report presented the results of a baseline organizational climate survey that was conducted in 1995 to (1) assess readiness for change, (2) help identify potential barriers to implementing the NFP program, and (3) provide a baseline for assessing future change in the FSS organization.

Eight dimensions of organizational climate were assessed, including purpose, structure, leadership, helpful mechanisms, relationships, attitude toward change, partnership and environment/quality. Survey results indicated that respondents were satisfied with workplace relationships and understood the purpose of FSS, and that resources were available for them at work. And finally, the data indicated that FSS employees were open to change and desired greater participation in decision making.

Appendix A is "Item Analysis for the 1995 Organizational Culture Diagnostic Survey." [Adapted from Introduction and Discussion.]

Aviation Safety: Opportunities Exist for FAA to Refine the Controller Staffing Process. U.S. General Accounting Office (GAO) Report to Congressional Requesters, April 9, 1997. Report No. GAO/RCED-97-84. 63 pp. Tables, figures, appendixes. Available through GAO.***

This report discusses the results of a review of U.S. Federal Aviation Administration (FAA) efforts to address short- and long-term controller staffing needs. Among the impediments identified by FAA that hinder its ability to staff air traffic control (ATC) facilities were (1) generally not providing funding to relocate controllers until the end of the fiscal year, and (2) the limited ability of regional offices to recruit controller candidates locally to staff ATC facilities. As of April 1996, approximately 53 percent of ATC facilities were not staffed at levels specified by FAA staffing standards.

Estimates of air traffic growth and controller attrition are two key variables used by the FAA to project future controller staffing needs. GAO considers FAA air traffic growth estimates to be reasonable, but has determined that the FAA could be overstating retirements during fiscal years 1999 through 2002.

GAO makes three recommendations to the FAA: (1) Incorporate actual information on the age, years of service and retirement eligibility date of current controllers into its projections of future controller retirements; (2) use age and service data to determine when controllers dismissed following a strike in 1981 and rehired could retire and therefore would need to be replaced; and (3) monitor the costs of training for collegiate program graduates hired in fiscal years 1997 and 1998 to determine whether anticipated savings can be realized under the revised training program.

Appendix I is "Explanation of the Model We Used to Estimate Future Controller Retirements"; Appendix II is "FAA Regional Offices, Air Traffic Control Facilities and NATCA [National Air Traffic Controllers Association] Representatives Contacted for Our Review"; and Appendix III is "Major Contributors to This Report." [Adapted from Executive Summary.]

Airport Development Needs: Estimating Future Costs. U.S. General Accounting Office (GAO) Report to Congressional Committees and the National Civil Aviation Review Commission, April 1997. Report No. GAO/RCED-97-99. 38 pp. Tables, figures, appendixes. Available through GAO.***

There is general agreement that ongoing capital investment is required to uphold the integrity of the nation's airport system. The estimates of just how much investment is needed vary widely. Airport representatives estimate costs at US$10 billion annually, airline representatives estimate $4 billion annually, and the U.S. Federal Aviation Administration (FAA) estimates $6.5 billion annually. Based on discussions with U.S. House of Representatives and Senate aviation subcommittees, this review has three objectives: (1) Compare the estimated capital development needs made by airport and airline groups and the FAA to determine why they differ; (2) provide an up-to-date range of estimates of what airport capital development needs are likely to be for the five-year period from 1997 through 2001; and (3) identify the key factors that affect airport capital development needs and determine how these factors are likely to affect such needs during the next five years. The authors of the report believe that a range of estimates for future airport capital needs is more useful because of the various perspectives it provides for policymakers to consider.

Appendix I is "Calculation, Comparison, and Reconciliation of the Estimates of Airport Capital Development Needs" and includes the airports' estimate, airlines' estimate, the FAA's estimate, a comparison of the estimates of airport capital development needs, and a reconciliation of the various estimates. Appendix II contains the regression model and results. [Adapted from Executive Summary.]

National Airspace System: Issues in Allocating Costs for Air Traffic Services to DOD and Other Users. U.S. General Accounting Office (GAO) Report to Congressional Committees, Executive Agencies and the National Civil Aviation Review Commission, April 1997. Report No. GAO/RCED-97-106. 78 pp. Tables, figure, appendixes, glossary. Available through GAO.***

The U.S. Federal Aviation Administration (FAA) anticipates funding shortfalls reaching several billion dollars during the next several years, based on current estimates about future air traffic growth and costs. This will occur in an environment of increasing demand for FAA services and of limited U.S. federal resources. Contributing to the funding shortfalls are pressures to finance additional safety and security improvements along with the FAA effort to modernize air traffic control (ATC).

This report identifies the one key issue that policymakers still need to decide: whether all of the government's costs of air traffic services, including those of the U.S. Department of Defense (DOD), should be covered by user fees. Discussed are two distinct issues: (1) how cost allocations for ATC services should be made across user groups, and (2) how any costs that may be assigned to DOD could be funded. No recommendations are made by the report.

This report contains seven appendices: (I) "Users Have Raised Concerns about the Management of Special-Use Airspace"; (II) "Objectives, Scope, and Methodology"; (III) "FAA and DOD Provide ATC Services"; (IV) "Assessing Options for Allocating ATC Costs Involves Conceptual and Policy Issues"; (V) "Overview of GRA's (formerly Gellman Research Associates') Model of Cost Allocation"; (VI) "Comments from the Department of Defense"; and (VII) "Major Contributors to This Report." There is also a "Glossary of Cost Terms." [Adapted from Executive Summary.]

Domestic Aviation: Barriers to Entry Continue to Limit Benefits of Airline Deregulation. Statement of John H. Anderson Jr., director, Transportation Issues, Resources, Community and Economic Development Division, U.S. General Accounting Office (GAO), Before the Subcommittee on Aviation, Committee on Commerce, Science and Transportation, U.S. Senate, May 13, 1997. Report No. GAO/T-RCED-97-120. 12 pp. Figure, appendix. Available through GAO.***

Deregulation of the U.S. airline industry in 1978 was intended to provide lower fares and better service for most air travelers. These benefits were to be brought about by increased competition resulting from new airlines entering the industry and from established airlines entering new markets. Some airports, primarily in the eastern and midwestern U.S., have not realized the expected benefits of lower fares and better service. Previous reports have outlined certain industry operating limits such as restrictive gate-leasing arrangements, impeded entry and perimeter rules that continue to block entry at some airports. Marketing strategies such as travel agent incentives and frequent flier programs also give advantages to established carriers, allowing them to dominate certain markets.

The GAO has recommended that the U.S. Department of Transportation (DOT) create a pool of available airport "slots" by periodically withdrawing a small percentage from the major incumbents at each airport, and distributing them in such a way as to promote competition. The DOT is still considering this proposal, but disagreed with a suggestion that the FAA consider an airport's efforts to make gates available to new competitors when making federal airport grant decisions. The testimony concludes that based on the lack of progress in the last seven years, the GAO believes that its recommendations, in addition to suggestions for possible congressional action, will indeed promote competition and the potential benefits of deregulation.

Appendix I is "Percentage of Domestic Air Carrier Slots Held by Selected Groups." [Adapted from Executive Summary.]

Aviation Safety: FAA Has Begun Efforts to Make Data More Publicly Available. Report by the U.S. General Accounting Office to the Honorable Ron Wyden, U.S. Senate, April 25, 1997. Report No. GAO/RCED-97-137. 15 pp. Table, figures. Available through GAO.***

The U.S. Congress and some groups in the U.S. public have expressed an interest in airline-specific safety data being published by the U.S. Federal Aviation Administration (FAA). In July 1996, U.S. Senators Ron Wyden and Wendell Ford requested that the FAA work with the aviation community to recommend the best way to educate and inform the public about commercial aviation safety, while maintaining the safety and integrity of the system. In response, this report reviews the following questions: (1) What actions has the FAA taken to make aviation safety information more accessible to the public? (2) What has been the public demand for the FAA's information on aviation safety? (3) What are the FAA's plans to expand the aviation safety information available to the public?

The FAA has taken a number of steps to provide aviation safety–related information to the public since July 1996. Its strategy involved a three-part effort: (1) Establishing an aviation safety information web site linked to the FAA's Internet World Wide Web site (http://www.faa.gov/); (2) publicizing significant enforcement actions against airlines; and (3) initiating a public education campaign on aviation safety.

By April 1997, the FAA Web site consisted of four databases, including information on aviation accidents; other safety-related incidents; air traffic data (such as numbers of departures) reported by large commercial air carriers; and the safety recommendations made by the U.S. National Transportation Safety Board (NTSB) to the FAA. Data indicate a steady increase in users accessing the Web site, with users spending more time using the site. The FAA plans to expand the number of databases that it posts to its Web site, to include additional information on airlines such as the types and ages of aircraft in each airline's fleet as well as other aviation-safety information such as data on near-midair collisions. [Adapted from Introduction and Results in Brief.]

Books

Flying the Commercial Pilot Flight Test: Maximum Performance Maneuvers. Fowler, Ron. Ames, Iowa, United States: Iowa State University Press, 1997. 105 pp.

Ron Fowler is a certified flight instructor with 28 years of experience and more than 12,000 instructor hours. This book is intended for those seeking certification as commercial pilots or to enhance their abilities as private pilots. It reviews the skills necessary for each phase of flight from takeoff to climbout, level-off, cruise flight, descent and landing.

The author concentrates on mastering the maximum-performance maneuvers of the commercial flight test: the steep 720-degree power turns, chandelles, steep spirals, lazy eights and eights on pylons. Each chapter contains a flight-test guide offering operational tips as a reminder of the visual aids to use and pitfalls to avoid when flying each maneuver.

Includes a bibliography of suggested reading and an index. [Adapted from Summary and Preface.]

Aviation Industry Quality Systems: ISO 9000 and the Federal Aviation Regulations. Dreikorn, Michael J. Milwaukee, Wisconsin, United States: ASQC Quality Press, 1995. 337 pp.

This book is written for the aviation professional in the field, the quality auditor, the aviation organization manager and anyone else interested in the changing requirements of aviation quality systems. It shows how to develop a quality system in compliance with both the American National Standards Institute (ANSI)/International Organization for Standardization (ISO)/American Society for Quality Control (ASQC) Q9000 series quality standards and the applicable regulations of the U.S. Federal Aviation Administration (FAA).

The book is organized into 21 chapters including "History of Aviation Quality Systems," "Management Responsibility," "Contract Review," "Corrective and Preventive Action," "Internal Quality Audits" and "Training, Servicing and Statistical Techniques" and outlines each of the major requirements of the ISO 9000 quality standards. Non-U.S. aircraft manufacturers and suppliers will also find this monograph a useful reference guide to help with compliance and understanding of U.S. aviation requirements.

Appendix A contains matrices helpful when cross-referencing each set of quality standard requirements including those of the FAA Aircraft Certification System Evaluation Program (ACSEP). The book also includes illustrations, a bibliography, a glossary, and an index. [Adapted from Summary and Preface.]♦

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.
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*** U.S. General Accounting Office (GAO)
P.O. Box 6015
Gaithersburg, MD 20884-6015 U.S.
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Updated U.S. Federal Aviation Administration (FAA) Regulations and Reference Materials

Advisory Circulars (ACs)

AC No.	Date	Title
00-2.10	08/15/97	*Advisory Circular Checklist and Status of Other FAA Publications.* (Cancels AC 00-2.10 dated Aug. 15, 1996.)
20-110J	05/30/97	*Index of Aviation Technical Standard Orders.* (Cancels AC 20-110H, *Index of Aviation Technical Standard Orders,* dated May 6, 1993.)
150/5360-8B	06/29/97	*Announcement of Availability of Information on Foreign Airport Planning, Design, Construction, and Trade Opportunities.* (Cancels AC 150/5360-8A, *Announcement of Availability of Information on Foreign Airport Planning, Design, Construction, and Trade Opportunities,* dated Oct. 26, 1984.)
150/5320-15	04/22/97	*Change 1 to Management of Airport Industrial Waste.*

Federal Aviation Regulations (FARs)

Part	Effective Date	Change	Subject
13	09/04/97	Change 5	Investigative and Enforcement Procedures. (Incorporates Amendment 13-29, "Organizational Changes and Delegations of Authority," adopted Aug. 25 and effective Sept. 4, 1997).

Defective Fuel Regulator Leads to Fire in Tail Engine of Lockheed L-1011

Fairchild SA-227C experiences double engine flameout on approach.

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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 reports and other sources. This information may not be entirely accurate.

Air Carrier

Unstabilized Engine Start Results in Fire

Lockheed L-1011. Substantial damage. No injuries.

After a normal pushback for the scheduled flight, the flight crew started the L-1011 TriStar's no. 2 (tail) engine using the aircraft's auxiliary power unit (APU). The engine start appeared normal. The no. 3 engine failed to rotate on the first start attempt, so the no. 1 engine was started.

About this time, the control tower reported smoke and flames coming from the tail of the airplane. Preoccupied with starting the other engines, the flight crew had failed to observe that the no. 2 engine had not stabilized, and that the turbine gas temperature for engine no. 2 had fallen from the normal starting temperature of 408 degrees C (767 degrees F) to 232 degrees C (450 degrees F).

The airport fire service extinguished the engine fire with foam. Investigation determined that the failure of the no. 2 engine to stabilize was caused by a faulty fuel regulator.

Wake Turbulence Causes Uncommanded 50-degree Roll

Boeing 737-500. No damage. No injuries.

The B-737 was descending from 2,400 meters (8,000 feet) to 2,100 meters (7,000 feet) in preparation for an approach to a major European airport. The aircraft was under the control of the flight-management computer. Neither pilot had his feet on the rudder pedals, although the captain had his hands resting lightly on the control column.

When an executive of the operating company entered the cockpit to talk with the flight crew, both pilots turned in their seats to face him, and the captain took his hands off the control column.

Shortly thereafter, the airplane made a sudden uncommanded roll of about 30 degrees to the left. Both pilots turned in their seats, and the captain immediately disconnected the autopilot and assumed manual control of the airplane. The first officer estimated that the bank angle reached a maximum of 50 degrees before the airplane stopped rolling.

Investigation of the radar trace showed that the incident airplane was trailing a Boeing 767 at a distance of 10 kilometers (6.2 miles), and that the B-737 was slightly downwind and 60 meters (200 feet) vertically below the flight path of the B-767. Although the B-737 was beyond the required minimum lateral separation of eight kilometers (five miles), the B-737 was in an optimum location to encounter wake turbulence from the B-767. Post-incident analysis by the governing civil aviation authority indicated that wake turbulence had caused the upset.

Following this incident, the operating company instituted an instruction that while on autopilot, the handling pilot must physically monitor the flight controls below 3,050 meters (10,000 feet) above ground level.

Aircraft Overshoots Runway in High Winds

Boeing 757. Substantial damage. Minor injuries.

A B-757 overshot the runway, coming to rest with its nose on the ground. A landing-gear fire broke out but was extinguished immediately. Four of the 205 passengers on board were treated for minor injuries. Gale-force winds were reported to be a possible factor in the accident.

Engine Failure on Runway Causes Aborted Takeoff

Boeing 747-Combi. Minor damage. No injuries.

Following an engine failure, a B-747-Combi carrying 238 passengers and 13 crew members aborted takeoff. Sixteen wheels, as well as the no. 2 engine, required replacement. Airport sources also indicated that repairs were required for the no. 3 engine.

Electrical Fault Causes In-flight Fire

Boeing 747. Minor damage. No injuries.

An emergency landing was required because of a fire in the cargo compartment of the B-747, which was carrying more than 300 passengers. An electrical fault caused the fire. The pilot used the aircraft's emergency systems to extinguish the fire. After landing, passengers were rerouted to their destination aboard other aircraft.

Night Approach, Dense Fog and Strong Winds Lead to Rice-paddy Landing

Fokker F-28. Aircraft Destroyed. 55 minor injuries.

The F-28 landed off-airport after several previous attempts to land the aircraft during poor visibility and high winds. The flight ended in a rice paddy three kilometers (1.9 miles) from the runway, where the aircraft broke into pieces but did not catch fire. Of the 85 passengers and four crew members aboard, more than 55 were injured, none seriously. The pilot said that he lost control of the aircraft when it was pushed by stormy winds, just after he announced the upcoming landing.

Foreign Object Damage Causes Engine Failure

McDonnell Douglas DC-10. Minor damage. No injuries.

Having just cleared hills beyond the end of the runway, the DC-10 suffered an engine stall apparently caused by foreign object damage. The engine failure occurred after the passengers heard what they described as strange noises and an explosion. After circling over a nearby island, the aircraft returned to the departure airport and executed an uneventful landing. None of the 151 passengers or 13 crew members were injured.

Takeoff Aborted Unsuccessfully

Beechcraft 1900D. Substantial damage. Minor injuries.

Following an apparently normal daylight takeoff run on Runway 33, the aircraft lifted off. Four seconds later, the stall-warning horn sounded and the captain aborted the takeoff.

The aircraft reportedly touched down safely on the remaining runway but the crew lost directional control. The aircraft veered left and struck a snowbank, causing the nose gear to collapse. Both propellers struck the ground, and three of the four blades from the right propeller penetrated the fuselage.

The takeoff was flown by the copilot, who had been briefed for a "no-flaps takeoff." The weather at the time was: ceiling, 91 meters (300 feet); visibility, 1.6 kilometers (one mile) in moderate falling snow; temperature, minus seven degrees C (20 degrees F). The accident occurred at 0932 hours local time; the aircraft had been deiced between 0912 and 0917.

Takeoff Accident Injures Pilot

De Havilland DHC-2 Beaver. Aircraft destroyed. One injury.

The DHC-2 Beaver struck the runway and burned shortly after takeoff from a Canadian airport. The injured pilot was taken to the hospital.

A field investigation found that the cables running from elevator bellcrank to the elevator torque tube lever were crossed, causing a reverse movement of the elevator. The cable reversal remained undetected prior to the flight, including during maintenance release.

Engines Flame Out Simultaneously

Fairchild SA-227C. Aircraft destroyed. Minor injuries.

The aircraft had a crew of two and 19 passengers on board. The pilot attempted a localizer-only instrument approach, but during the approach the weather dropped below landing minimums.

The flight diverted to its alternate, about 240 kilometers (150 miles) away. During the approach, both of the aircraft's engines flamed out simultaneously.

The pilot made a forced landing in an area of rough ground about 2.4 kilometers (1.5 miles) south of the airfield.

Unexplained Sudden Descent Causes Tail-first Landing

Shorts 330-200. Aircraft destroyed. No injuries.

The light-haul commuter aircraft was diverted from its original destination because of fog. Weather at the alternate airport was generally clear with winds of eight knots; the aircraft made a localizer/DME (distance measuring equipment) approach in darkness. After crossing the runway threshold at an altitude of about nine meters (30 feet), the aircraft's rate of descent increased sharply.

The pilot tried to arrest the descent by pulling back on the control column, but he was unsuccessful, and the aircraft touched down very hard, tail first. The impact caused the right main landing gear to collapse. The aircraft veered to the right and, after traveling about 300 meters (984 feet) ran off the runway into grass. At the time of the accident report, the cause of the sudden increase in the aircraft's rate of descent had not been determined.

Corporate Executive

Runway Overrun Occurs in Bad Weather

Learjet 35. Aircraft destroyed. No injuries.

The aircraft made an instrument approach in darkness to Runway 03. The weather was overcast at 31 meters (100 feet) with visibility of less than 1.6 kilometers (one mile) in rain. The runway was 1,541 meters (5,052 feet) long and had a grooved asphalt surface.

The aircraft landed long, overran the runway and collided with two parked airplanes (a Cessna 152 and a Piper PA-28) and a hangar before finally coming to rest.

Fuel Supply Ends before Flight

Beechcraft B90 King Air. Aircraft destroyed. One minor injury.

The aircraft was being ferried after undergoing maintenance and had made an en-route fuel stop.

The aircraft approached the destination airport at night in visual meteorological conditions. Both engines stopped, apparently because of fuel exhaustion on final approach. During an emergency landing on a road, the aircraft skidded into a nearby yard.

Multiple Failures Survived

Cessna 650 Citation III. Unknown damage. Three minor injuries.

While descending from 3,050 meters (10,000 feet) at night in visual meteorological conditions, the aircraft suffered multiple system failures with circuit breakers opening, cockpit displays going blank and warning lights illuminating.

The crew communicated with difficulty to air traffic control (ATC). The crew then smelled "electrical" smoke and saw haze in the cabin.

The flight continued to its destination airport and was cleared with light signals to land on Runway 23. After a safe landing, the aircraft was taxied to the normal parking area. An inspection revealed that leaking hydraulic fluid had fed a fire that originated in the vicinity of the top right side of the aft fuselage above the right-engine pylon.

Loss of Control During Final Approach Results in Fatal Accident

Beechcraft Super King Air 200. Aircraft Destroyed. One fatal injury, three serious injuries.

The medium-range executive transport was on a nighttime instrument landing system approach to Runway 34R at a major western airport. Weather was marginal, with a ceiling of 335 meters (1,100 feet), visibility of 0.8 kilometer (0.5 mile) in rain, outside air temperature of 1 degree C (34 degrees F) and wind of 340 degrees at 18 knots. There were no pilot reports (PIREPs) of wind shear or icing.

Surviving passengers reported that on final approach the aircraft suddenly rolled to the left, recovered, and then rolled rapidly back to the left again, despite the pilot's movement of the control yoke to the right. The passengers also reported hearing a warning horn.

U.S. Federal Aviation Administration (FAA) radar data showed that the aircraft drifted about 0.4 kilometer (0.25 statute mile) to the left of the localizer course, turned back briefly, then turned left again and began losing altitude rapidly. FAA data also showed that the aircraft's ground speed dropped from 349 kilometers per hour (kph) (189 knots) to 131 kph (71 knots) during the approach, which is below the aircraft's reported stalling speed of 154 kph (83 knots) indicated airspeed in approach configuration.

The aircraft crashed about 2.4 kilometers (1.3 nautical miles) (nm) short of the runway. The King Air had been following at a distance of 10 kilometers (5.4 nm) behind a Boeing 757 on approach.

Other General Aviation

Unoccupied Airplane Taxis into Trees

Bellanca 7ECA. Substantial damage. No injuries.

The pilot planned a local pleasure flight. When he arrived at the airport hangar, he discovered that there was a Bellanca 7ECA in front of his airplane, blocking his exit. He entered the Bellanca and tried to start the engine so that he could move the airplane. Failing at that, he tried hand-cranking the propeller.

The engine started, and the unoccupied aircraft began to move forward. The pilot went under the wing and tried to grab the plane's door handle, but he lost his grip and fell. The unoccupied Bellanca continued across the apron, between two hangars, then struck trees and nosed over.

Nose Gear Extends Fully at Last Moment

Piper Seneca II. No damage. No injuries.

In preparing for a landing, the pilot of the Piper Seneca II lowered the landing gear normally.

The nose gear did not fully extend and the pilot was unable to lower the gear manually. During the landing, the pilot held back on the yoke. When the nose wheel finally touched, the plane bounced abruptly back up into the air, and the nose gear snapped into the proper position, which allowed an otherwise routine landing.

Attempt to Avoid Danger Creates a New Danger

Piper PA-30. Substantial damage. No injuries.

The pilot, seeing a Boeing 727 in the holding bay at the end of the active runway, decided to perform the engine runup on the ramp.

While taxiing to the area where he wanted to perform the runup for an early morning flight, the pilot was temporarily blinded by the B-727's taxi light. As a result, he steered his aircraft off the hard surface. The nose gear and right-main landing gear fell into a deep ground depression, damaging the propeller.

Mountain Sightseeing Tour Results in Overturned Aircraft

Cessna 180. Damage Unknown. No Injuries

The pilot of a Cessna 180 had been considering a landing on a remote forestry airstrip located in mountainous terrain. During a low flying check of the snow conditions, the aircraft's wheels snagged on the airfield surface causing the airplane to flip over. After the crash, the pilot activated the emergency locator transmitter. He and his young son were rescued three hours later by searchers. No injuries were suffered by the aircraft's occupants.

Cardboard Tube Brings Down Helicopter

McDonnell Douglas 369E. Substantial damage. No injuries.

The helicopter was two minutes into a routine, daylight postmaintenance check flight with a pilot and three passengers aboard. At an altitude of 92 meters (300 feet), the engine failed. An emergency landing was made, but the force of the landing caused the main-rotor blades to sever the tail boom.

Investigation revealed that a makeshift tool (a cardboard tube) had likely been used to hold open the engine-bypass and was unflagged; that there had been a change of maintenance personnel midway through the inspection; that the second mechanic had not seen the tube during his work or when he inspected for foreign objects; and that there had been no procedure to ensure that all tools were removed and accounted for on completion of an inspection. Furthermore, the flight was at an altitude of 92 meters over a forest, an unnecessarily low altitude for a check flight.

The engine of the helicopter flamed out when the makeshift tool partially blocked the engine compressor. The pilot extended the glide in an attempt to clear the woods and reach a road; as a result, rotor revolutions per minute (RPM) decayed, causing the hard landing.

Approach to Mountain Helipad Ends in Collision with Ground

Bell 206B. Aircraft destroyed. Three injuries.

In attempting to land at a remote helipad in mountainous terrain in daylight, the Bell 206B encountered a sharp downdraft on final approach. The pilot turned downslope in an effort to avoid terrain, but the helicopter struck high vegetation, impacted the ground and rolled downslope before catching fire.

The airline transport pilot and one passenger received minor injuries; the other passenger received serious injuries.

Weather was clear with 16 kilometers (10 miles) visibility. But a SIGMET (significant meteorological information) forecast severe turbulence in the area below 4,575 meters (15,000 feet) at the time. The SIGMET said, "Strong updrafts and downdrafts over mountains and also low-level wind shear expected."

Lighting Conditions Hide Electrical Transmission Wire

Hiller UH-12E. Substantial damage. Minor injury.

In early morning daylight, the helicopter struck an electrical transmission wire and sustained substantial damage. The airline pilot said that he knew the position of the power line, but that he had trouble seeing it in the light conditions caused by the overcast sky.

General weather was visual meteorological conditions, with 915 meters (3,000 feet) overcast and 11 kilometers (seven miles) visibility.

Visual Flight in IMC Ends in Fatal Accident

Bell 206B3. Aircraft destroyed. One fatal injury, one serious injury.

The helicopter was preparing to return from a routine visit to a mountaintop radio relay site. There were four persons aboard.

Instrument meteorological conditions (IMC) included near-zero visibility in clouds and rain, and winds of 30 knots gusting to 50 knots. Prior to takeoff, the front-seat passenger had wiped the outside of the cockpit windscreen in an effort to improve visibility; and, on departure, he left his shoulder harness unfastened so that he could reach forward to wipe mist off the windscreen.

The rear right-hand-side passenger put his arm out the window so he could hold the pilot's door open, enabling the pilot to look down and keep the ground in sight.

The survivors said that the pilot's plan was to "hover down the mountain" until the aircraft was clear of the clouds. Shortly after the helicopter became airborne, however, the pilot stated that he did not believe the plan was going to work, and that he was going to try to return to their takeoff site. The aircraft flew into ridge line at about the 610-meter (2000-foot) level and was destroyed.

The survivors reported that at no time had the terrain ahead of them been visible. The passenger on the right side of the aircraft said that he also lost sight of the ground below the aircraft just before impact.♦

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