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Pilots Attribute Australia's Aviation Safety Record to Good Training, Favorable Weather, Low Traffic Density

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Pilots Attribute Australia's Aviation Safety Record to Good Training, Favorable Weather, Low Traffic Density — 1

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Number of Aircraft Accidents Decreases In Canada in 1999 — 20

Data show 340 accidents were reported, compared with 385 in 1998, and the 1999 accident rate was 8.3 accidents per 100,000 flight hours, compared with 9.6 accidents per 100,000 flight hours the previous year.

FAA Publishes Index of Aviation Medical Reports — 22

The publication lists documents published during nearly four decades and describes the research activities of the FAA Office of Aviation Medicine.

Emergency Escape Slide Falls From Airplane — 24

Pilots said that they felt a bump at 12,000 feet as the left off-wing emergency escape slide and the slide door separated.

Flight Safety Foundation is an international membership organization dedicated to the continuous improvement of aviation safety. Nonprofit and independent, the Foundation was launched officially 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 830 member organizations in more than 150 countries.

Pilots Attribute Australia's Aviation Safety Record to Good Training, Favorable Weather, Low Traffic Density

The nation's major air carriers have never had a fatal accident; nevertheless, flight crewmembers said that they are concerned about the risk of midair collisions, wind shear and microbursts.

Graham R. Braithwaite, Ph.D.

Australian airlines have not had a fatal accident involving a commercial jet aircraft or a hull-loss accident involving a regular passenger transport (RPT) jet. The country's pilots consider the aviation safety record largely a result of the nation's relatively mild weather. Nevertheless, a 1995–1996 survey showed that they also perceive threats to their flying safety, primarily weather phenomena — wind shear and microbursts — and midair collisions.

The survey questioned 2,600 people and received responses from 948 Australian flight crewmembers and air traffic controllers from the country's two major airlines, Ansett Australia and Qantas Airways; the Royal Australian Air Force (RAAF); Australian civil air traffic control (ATC); and RAAF ATC. The survey was intended to determine the factors that they believed were responsible for Australia's aviation safety record and the risks that they believed threaten aviation safety. One hundred forty flight crewmembers from a U.K.-based airline also responded to the survey; their responses are not discussed in this article.

Pilots Assess Risks to Flight

One question listed 14 factors that are considered risks to aviation safety and asked pilots and controllers to select "the top three factors you consider pose the greatest threat to your flying safety."

Crewmembers from Ansett and Qantas selected the same three factors — wind shear/microburst, midair collision and judgment error (by others) — but not in the same ranking.

Ansett crews (from the domestic sector only) ranked wind shear/microburst as the greatest threat to their safety (Figure 1, page 2), followed by midair collision and judgment error (by others). At the time of the survey, Ansett airplanes did not have traffic-alert and collision avoidance system [TCAS] equipment. (Since then, the equipment has been installed.)

Eighteen percent of Qantas crewmembers ranked the threat of midair collision as their greatest concern (Figure 2, page 2). Ranked second was an encounter with wind shear or an encounter with a microburst, cited by about 17 percent, and ranked third was judgment error (by others), cited by about 12 percent.

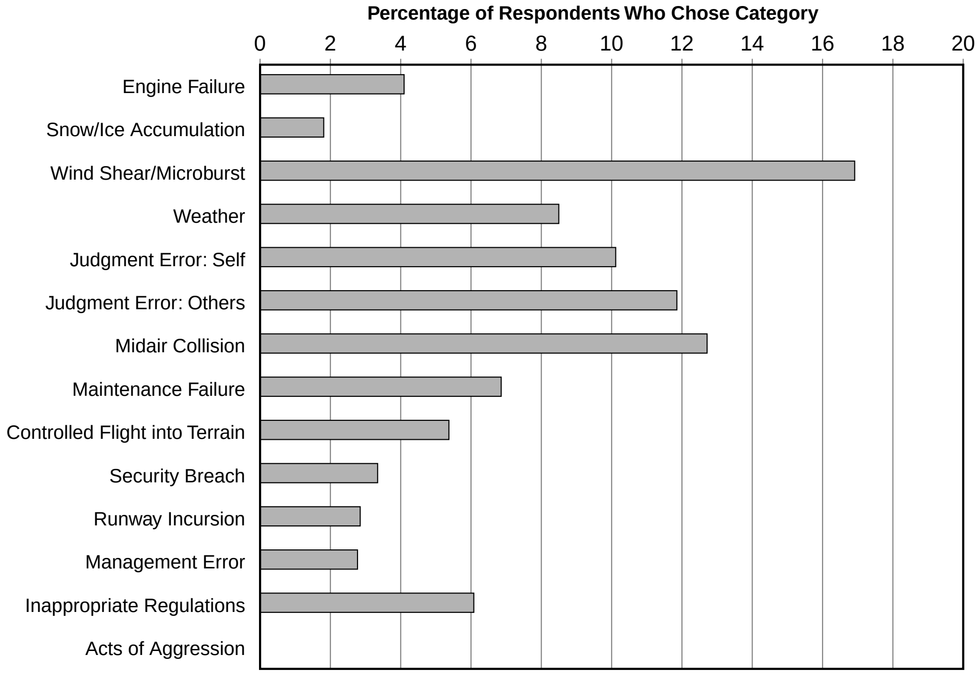
The results of the survey were divided to present the responses of Qantas domestic flight crews (Figure 3, page 3) and Qantas international flight crews (Figure 4, page 3) on whether an encounter with wind shear or a microburst is greater for flights operating outside Australia. Domestic flight crews used Boeing 737 (B-737) and Airbus A300 fleets; international flight crews used Boeing 747 (B-747) fleets. (The Boeing 767 [B-767] crews were excluded because the aircraft is operated on both domestic sectors and international sectors.)

The difference in responses from domestic crewmembers and international crewmembers was negligible for the category "wind shear/microburst," which was ranked as the greatest hazard by international crewmembers and the second-greatest hazard by domestic crewmembers. Nevertheless, domestic

(continued on page 4)

What Factors Pose "the Greatest Threat to Your Flying Safety?"

Responses from Ansett Australia Flight Crewmembers

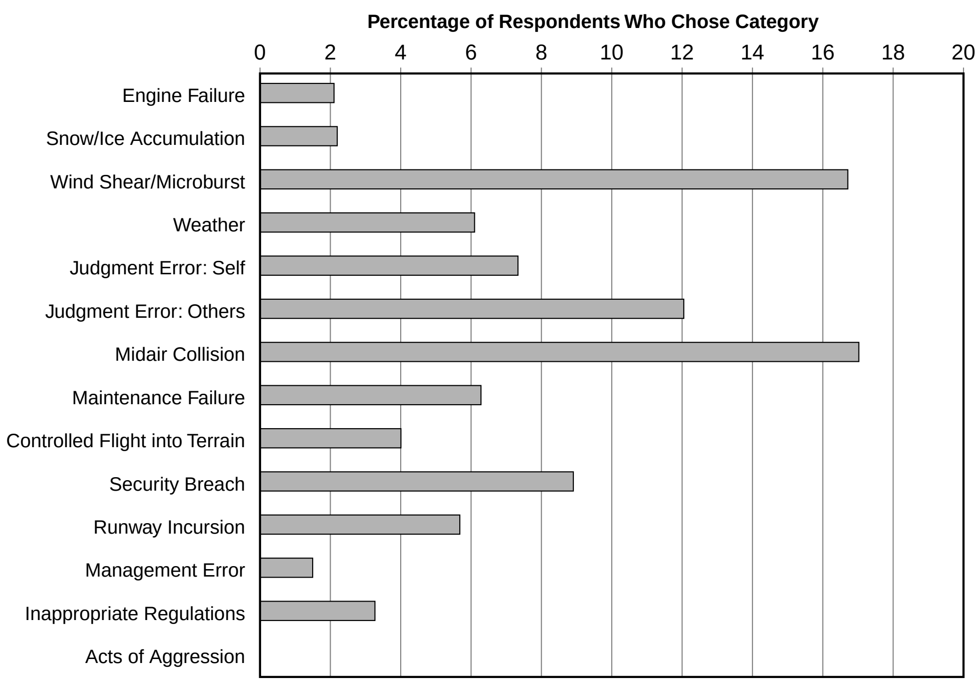


Source: Data reflect responses from 223 Ansett Australia flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 1

What Factors Pose "the Greatest Threat to Your Flying Safety?"

Responses from Qantas Flight Crewmembers

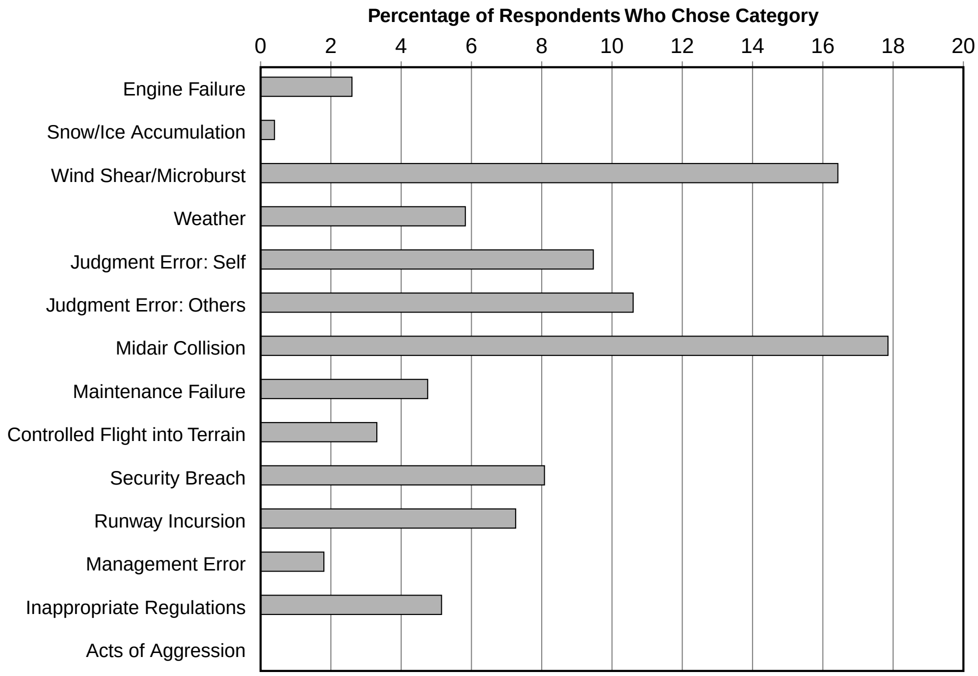


Source: Data reflect responses from 343 Qantas flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 2

What Factors Pose "the Greatest Threat to Your Flying Safety?"

Responses from Qantas Domestic Flight Crewmembers

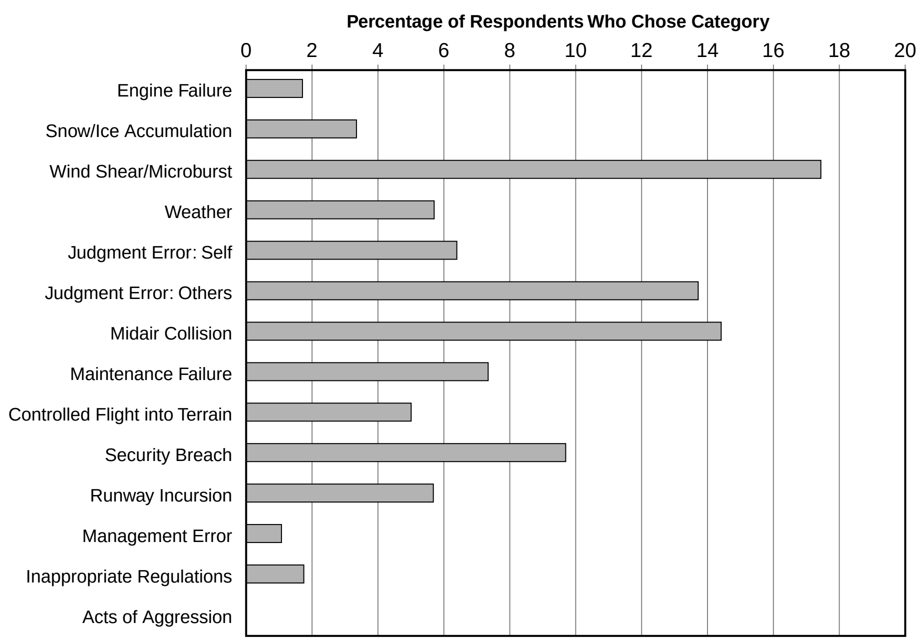


Source: Data reflect responses from 139 Qantas domestic flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 3

What Factors Pose "the Greatest Threat to Your Flying Safety?"

Responses from Qantas International Flight Crewmembers



Source: Data reflect responses from 204 Qantas international flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 4

crewmembers ranked midair collision as a slightly greater concern. (At the time of the survey, only the international fleet was equipped with TCAS. Since then, the equipment has been installed in the domestic fleet.) Both domestic crewmembers and international crewmembers ranked judgment error (by others) as the third-greatest hazard.

RAAF transport crewmembers who responded to the survey flew the Boeing 707, Dassault Falcon 900, Hawker Siddeley HS-748, de Havilland Caribou and Lockheed C-130 Hercules (Figure 5). Crewmembers (most of whom flew the turboprop-powered aircraft — HS-748, Caribou and C-130) ranked wind shear/microburst as the ninth-greatest threat to their flying safety, compared with the fourth-ranked "weather (other)" category. Judgment error (by others) was ranked the greatest hazard, followed by maintenance failure and judgment error (by self).

Military air traffic controllers and civil air traffic controllers were asked a similar question to determine whether their perception of the hazards differed significantly from the perception of the pilots (Figure 6, page 5).

Civil air traffic controllers ranked wind shear/microburst fifth, following judgment error (by others), maintenance failure, engine failure and weather (other than wind shear/microburst).

Military controllers ranked wind shear/microburst ninth; their top three rankings were judgment error (by others), weather (other than wind shear/microburst) and maintenance failure (Figure 7, page 5).

Weather Cited as Greatest Influence on Safety

The Australian flight crewmembers and air traffic controllers also were asked to describe how Australia "has managed to achieve the record of zero hull losses for jet RPT operations."

Favorable weather was the pilots' most frequent response, given by 58 percent of respondents, followed by the good quality of the nation's flight crews, cited by about 40 percent, and low traffic density, cited by 33 percent (Figure 8, page 6).

The nation's air traffic controllers had a different perspective. Forty-five percent cited "luck" (defined by the *Oxford English Dictionary* as "supposed tendency of chance to bring a succession of favorable events or good fortune") for the aviation safety record, about 42 percent cited low traffic density, and about 33 percent cited favorable weather (Figure 9, page 6).

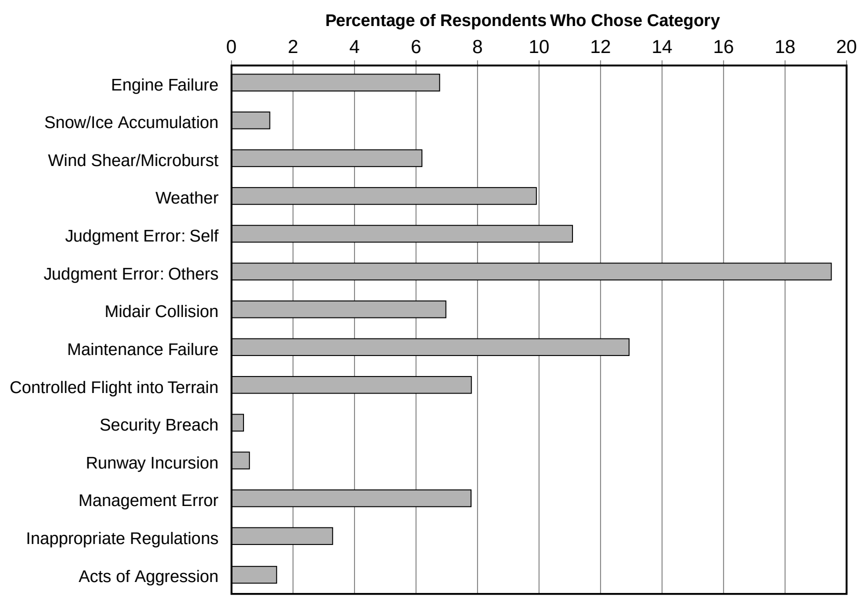
The existence of luck cannot be proved and is, therefore, inadmissible as a scientific notion. The term may be used to evaluate an outcome but not to explain the process. Luck may be a convenient way of explaining the unknown — which in turn may be a result of a number of factors, including naiveté, ignorance, misapprehension or mistake.

When the question was phrased differently, asking pilots and controllers to choose which of 17 factors had been "highly significant in Australia's safety record for commercial RPT

(continued on page 7)

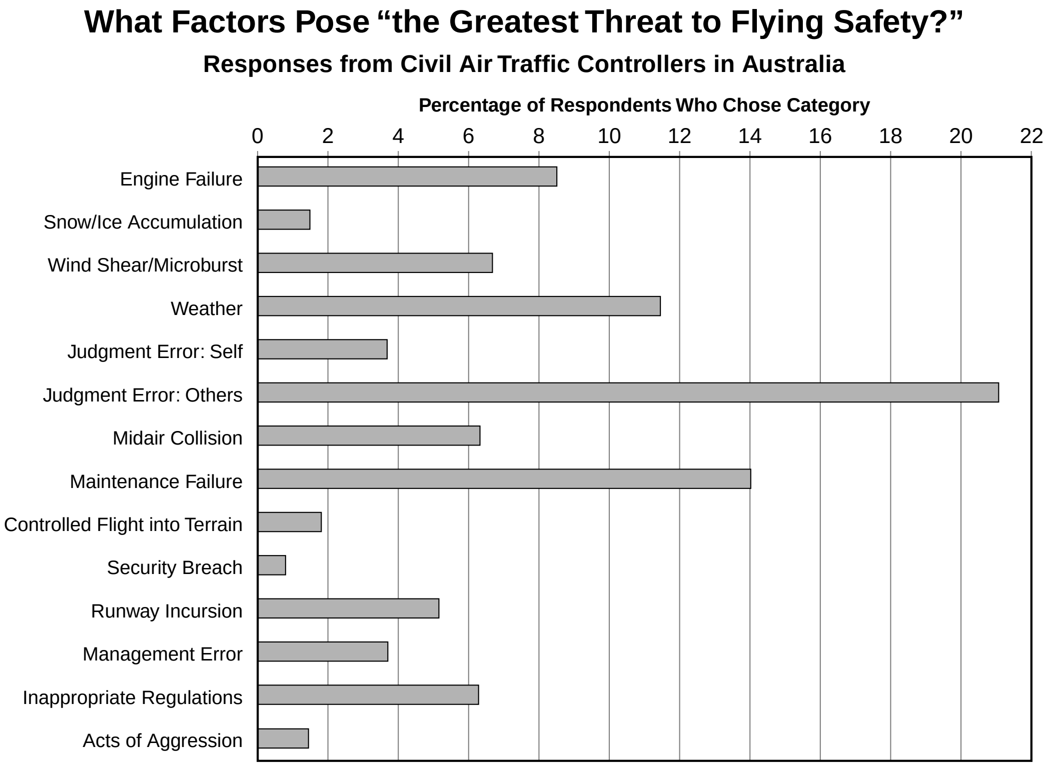
What Factors Pose "the Greatest Threat to Your Flying Safety?"

Responses from Royal Australian Air Force (RAAF) Flight Crewmembers



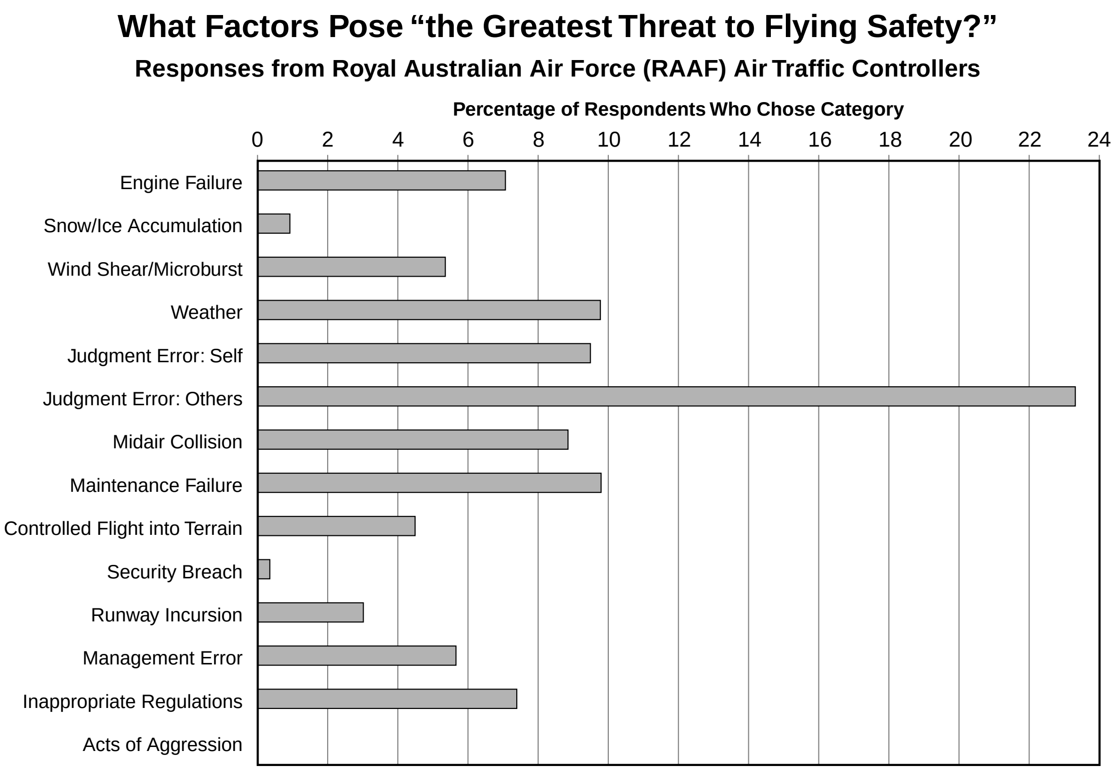
Source: Data reflect responses from 133 RAAF flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 5



Source: Data reflect responses from 121 Australian civil air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 6

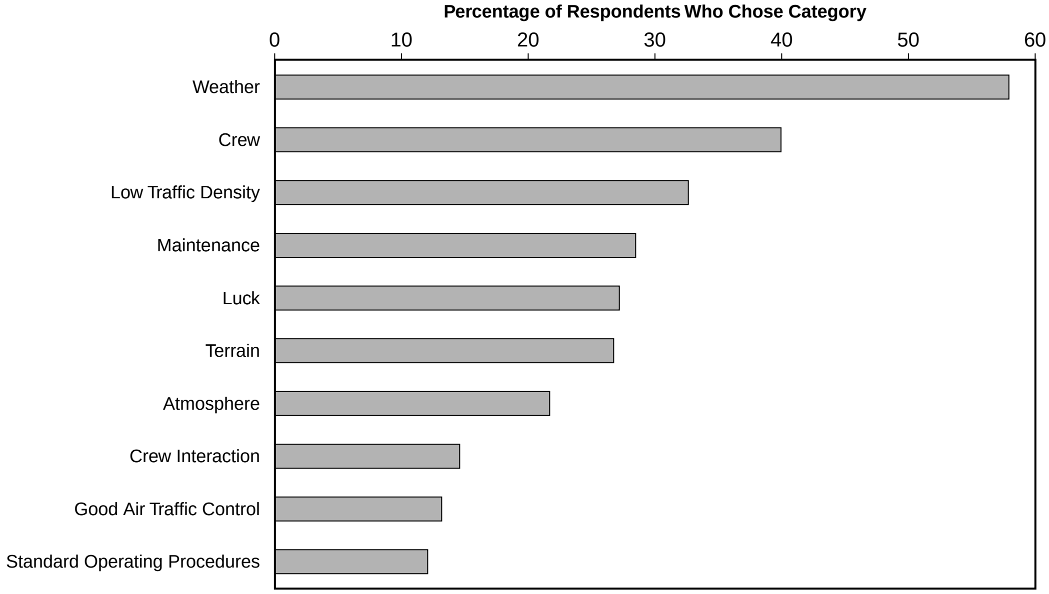


Source: Data reflect responses from 128 RAAF air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 7

How Has Australia "Managed to Achieve the Record of Zero Hull Losses For Jet Regular Passenger Transport Operations?"

Responses from Flight Crewmembers in Australia

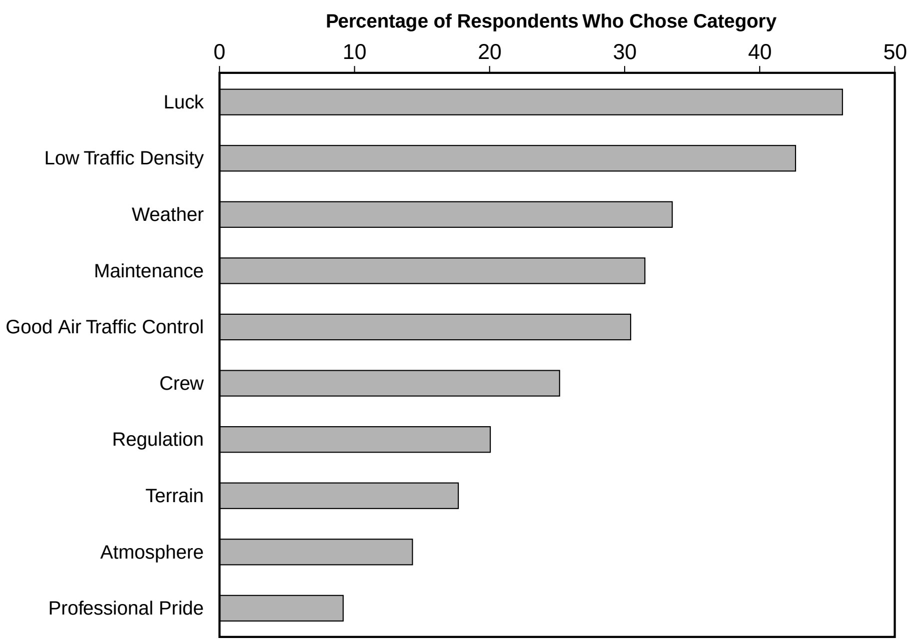


Source: Data reflect responses from 699 Ansett, Qantas and Royal Australian Air Force flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 8

How Has Australia "Managed to Achieve the Record of Zero Hull Losses For Jet Regular Passenger Transport Operations?"

Responses from Air Traffic Controllers in Australia



Source: Data reflect responses from 249 civil and Royal Australian Air Force air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 9

jets," the most frequent response from Ansett pilots was the low incidence of snow and ice; the most frequent response from Qantas pilots was crew training; and the most frequent response from RAAF pilots was low traffic density (Figure 10). The most frequent response for both civilian and military controllers was the good quality of air traffic control (Figure 11).

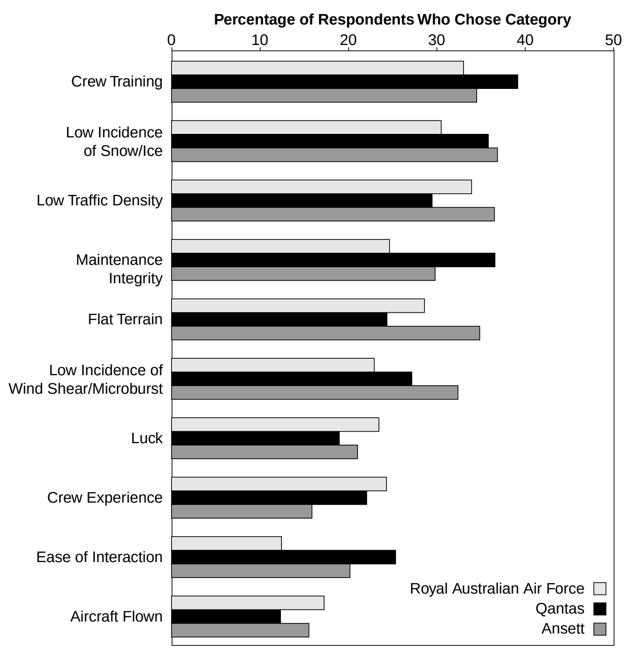
Pilots Agree on Response to Bad-weather Takeoff

The Australian pilots were nearly unanimous in their certainty that they would be cautious in a situation that required them to consider both deteriorating weather and commercial and organizational pressures to begin a flight. The survey question asked:

> "You are ready for departure, but the weather is getting steadily worse. Which of the following statements best describes your thoughts?
>
> 1. I would take off because my aircraft is equipped for all conditions;
> 2. I would feel obliged to take off for the sake of the passengers;
> 3. I would feel obliged to take off to keep on schedule;

"Which of the Following Factors Do You Consider Have Been Highly Significant in Australia's Safety Record?"

Responses from Flight Crewmembers

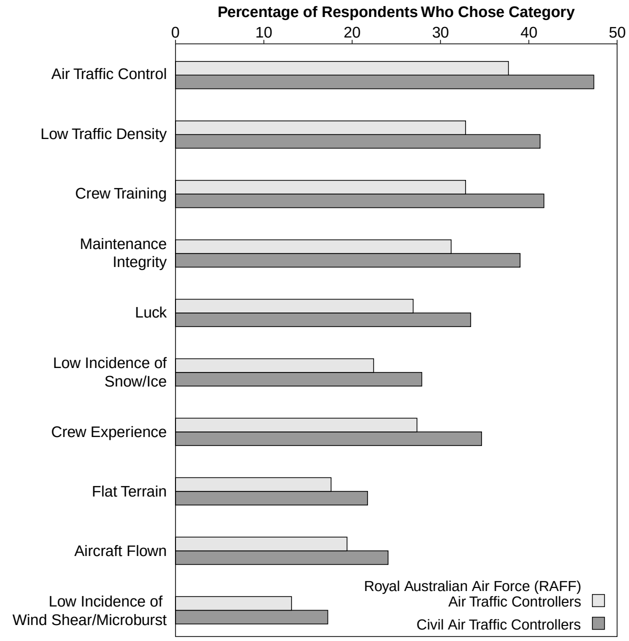


Source: Data reflect responses from 699 Ansett, Qantas and Royal Australian Air Force flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 10

"Which of the Following Factors Do You Consider Have Been Highly Significant In Australia's Safety Record?"

Responses from Air Traffic Controllers in Australia



Source: Data reflect responses from 249 civil and RAAF air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 11

> 4. I would take off if the rest of the crew were encouraging me to do so; [or,]
> 5. I would take off only if both my colleagues and I were completely confident."

The majority of crews gave answer no. 5. The values were: Qantas, 98.7 percent; Ansett, 97.3 percent; and RAAF, 96.8 percent.

Decline Perceived in Safety Conditions

The survey also questioned Australian flight crews and air traffic controllers about their beliefs about aviation safety:

> "Over the last five years, do you think Australian civil aviation in general has become ...?
>
> 1. More safe;
> 2. Remained about the same;
> 3. Less safe; [or,]
> 4. Don't know."

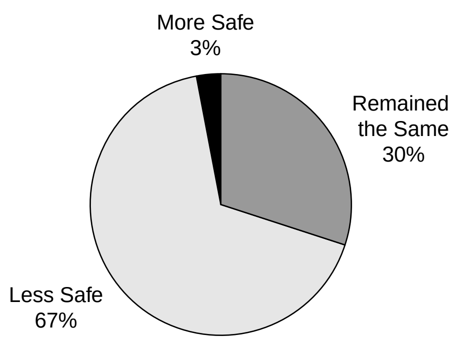
The question was circulated after several accidents and incidents in the early 1990s, including a nosewheel-up landing involving an Ansett B-747 at Sydney Airport and two fatal commuter accidents, which raised public awareness of aviation safety and prompted a House of Representatives inquiry on safety in commuter airlines and general aviation.[1]

About two-thirds of Ansett crewmembers (Figure 12) and Qantas crewmembers (Figure 13) said that civil aviation safety in general had deteriorated during the previous five years. Three percent of Ansett crewmembers and 5 percent of Qantas crewmembers said that civil aviation had become safer, and the rest said that safety had remained about the same.

Among RAAF crews, the percentage of "less safe" responses (45 percent) was more than six times higher than the 7 percent who said that aviation safety had improved (Figure 14).

"Over the Past Five Years, Do You Think Australian Civil Aviation In General Has Become …"

Responses from Ansett Australia Flight Crewmembers

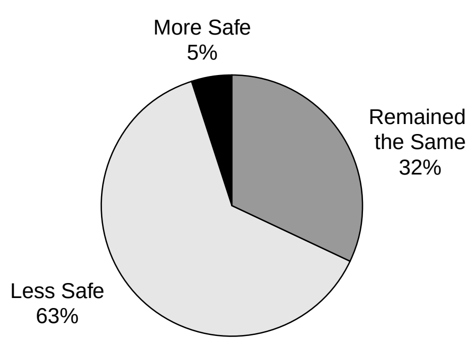


Source: Data reflect responses from 223 Ansett Australia flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 12

"Over the Past Five Years, Do You Think Australian Civil Aviation In General Has Become …"

Responses from Qantas Flight Crewmembers

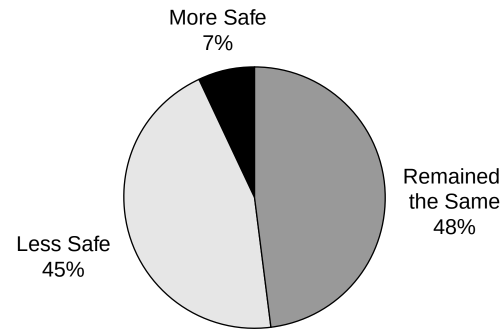


Source: Data reflect responses from 343 Qantas flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 13

"Over the Past Five Years, Do You Think Australian Civil Aviation In General Has Become …"

Responses from Royal Australian Air Force (RAAF) Flight Crewmembers



Source: Data reflect responses from 133 RAAF flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 14

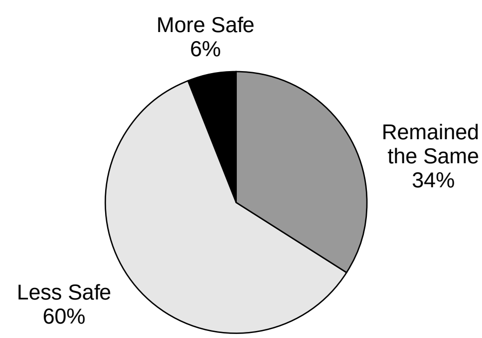
Sixty percent of civilian air traffic controllers (Figure 15) and 63 percent of military controllers (Figure 16, page 9) said that civil aviation had become less safe in Australia during the five-year period. Six percent of those in both groups said that civil aviation had become safer.

Survey Assesses Directness of Communications

One question was designed to assess the directness of communications among flight crewmembers and air traffic controllers:

"Over the Past Five Years, Do You Think Australian Civil Aviation In General Has Become …"

Responses from Civil Air Traffic Controllers in Australia

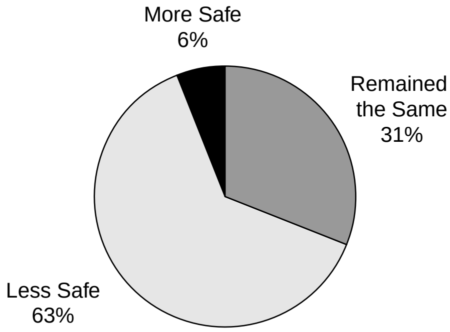


Source: Data reflect responses from 121 Australian civil air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 15

"Over the Past Five Years, Do You Think Australian Civil Aviation In General Has Become …"

Responses from Royal Australian Air Force (RAAF) Air Traffic Controllers

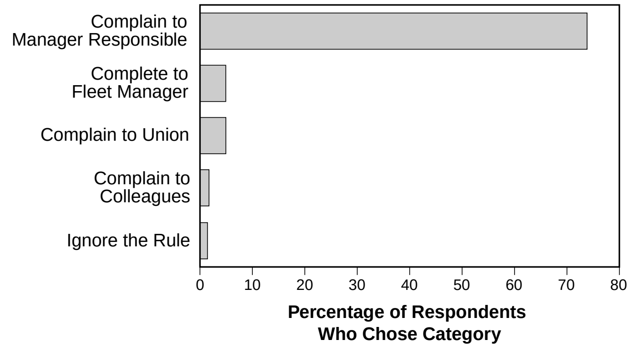


Source: Data reflect responses from 128 RAAF air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 16

"Which of the Following Statements Best Describes Your Actions?"

Responses from Ansett Australia Flight Crewmembers



Source: Data reflect responses from 223 Ansett Australia flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 17

"A senior manager introduces a new company rule you consider to be unsafe. Which of the following statements best describes your actions?

1. I would simply ignore the new rule; it's my life;
2. I would complain about the rule to my colleagues;
3. I would complain about the rule to my union representative;
4. I would complain about the rule to my fleet manager; [or,]
5. I would complain directly to the manager responsible for the rule."

Seventy-four percent of Ansett crewmembers (Figure 17) and 65 percent of Qantas crewmembers (Figure 18) said that they would complain to the manager responsible for the rule.

The difference between the responses of the two groups might be a result of the geographical distribution of the crewmembers; Qantas crewmembers sometimes are away from home base for up to two weeks at a time and therefore are less able to go directly to senior managers.

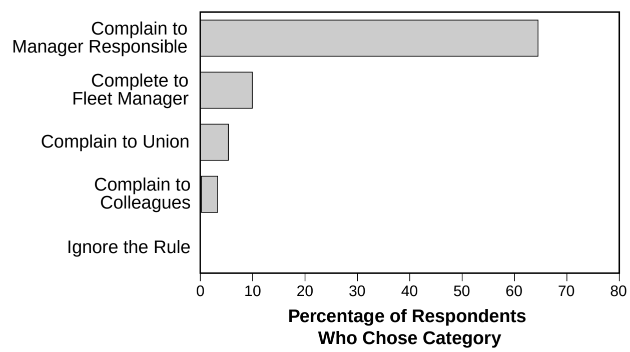
RAAF transport crews were expected to return a different set of answers, and their question was phrased to take this expectation into consideration:

"A senior officer introduces a new operating rule you consider to be unsafe. Which of the following statements best describes your actions?

1. I would simply ignore the new rule; it's my life;
2. I would complain about the rule to my colleagues;
3. I would complain about the rule to my wing commander;

"Which of the Following Statements Best Describes Your Actions?"

Responses from Qantas Flight Crewmembers



Source: Data reflect responses from 343 Qantas flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 18

4. I would complain directly to the officer responsible for the rule; [or,]
5. I would obey the rule, as it is my job to obey the rules."

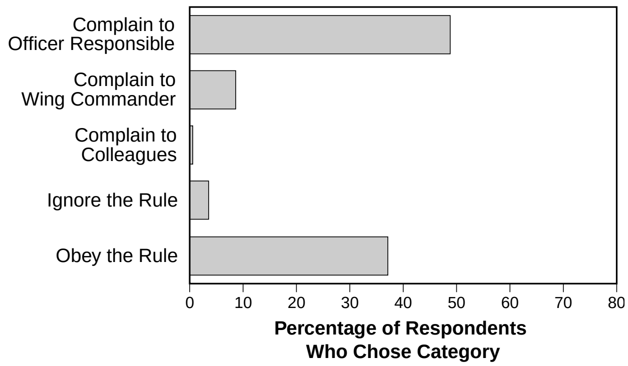
Most of the pilots said that they would go directly to the officer responsible for the new operational rule (Figure 19, page 10). Such direct communication is supported for flight safety matters and is not considered insubordinate. Thirty-seven percent of the crewmembers said that they would obey the rule.

Commercial Pressure Seen as Threat to Safety

The survey asked pilots and air traffic controllers about their perception of the greatest threat to aviation safety in the future:

“Which of the Following Statements Best Describes Your Actions?”

Responses from Royal Australian Air Force (RAAF) Flight Crewmembers



Source: Data reflect responses from 133 RAAF flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 19

“In your own words, what do you consider will pose the greatest threat to the safety of RPT carriers in Australia in the future?”

Crewmembers from Ansett (Figure 20, page 11) and Qantas (Figure 21, page 12) both responded most often with answers involving the related categories of commercial pressure (pressure to do more work with the same amount of resources) and economic rationalization (pressure to do the same work with fewer resources). Commercial pressure was cited by about 30 percent of the respondents at each airline; economic rationalization was cited by about 26 percent at Ansett and 24 percent at Qantas. Ranked third by Ansett crewmembers was ATC inadequacy; ranked third by Qantas crewmembers was fatigue.

Commercial pressure and economic rationalization each were cited by about 18 percent of RAAF crewmembers. Cited most often, by about 24 percent of the RAAF crewmembers responding, was increased traffic (Figure 22, page 13).

Commercial pressure and economic rationalization were among the top three factors cited by civil air traffic controllers, along with poor training — but not specifically training within their organization. In their comments about training, the controllers included observations not only about a shortage of new controllers but also about flight crewmembers’ failures to comply with ATC instructions (Figure 23, page 14). RAAF controllers cited a different set of concerns: low experience, increased traffic and airspace management (Figure 24, page 15).

Plan Implemented to Manage Increased Air Traffic

In the years since the survey was conducted, some of the concerns raised by the Australian pilots and controllers have been addressed.

For example, a new strategy for managing increased air traffic and assuring the effectiveness of Air Traffic Services (ATS) was implemented. The Australian Advanced Air Traffic System, a technologically advanced ATS, operates from control centers in Melbourne and Brisbane using computerized displays of aircraft under radar control and procedural control (beyond radar coverage). The last phase of the system was implemented in January 2000.

Another change was the requirement, effective January 2000, that all turbine-powered commercial transport aircraft with more than 30 passenger seats (or with maximum takeoff weights of more than 15,000 kilograms [33,069 pounds]) operating in Australian airspace have TCAS II, a version of the system that provides traffic advisories to inform pilots of the proximity of other aircraft, as well as resolution advisories to help pilots prevent collisions with other aircraft.

Extreme Weather Conditions Exist Along With ‘Blue Sky’

Flight crews said that Australia’s predominant “blue sky” weather has been an important factor in the safety record. Nevertheless, the question remains whether this view represents reality or is a misperception. The answer depends in part on the answer to another question: Does weather have a significant effect on the safe operation of commercial aircraft?

Data compiled from 1988 through 1997 by The Boeing Co. on 149 hull-loss accidents with known causes in the worldwide commercial jet fleet (including only Western-built jet airplanes weighing more than 60,000 pounds [27,216 kilograms] maximum gross weight) showed that weather was the primary factor in seven accidents, or 5 percent of the total.[2]

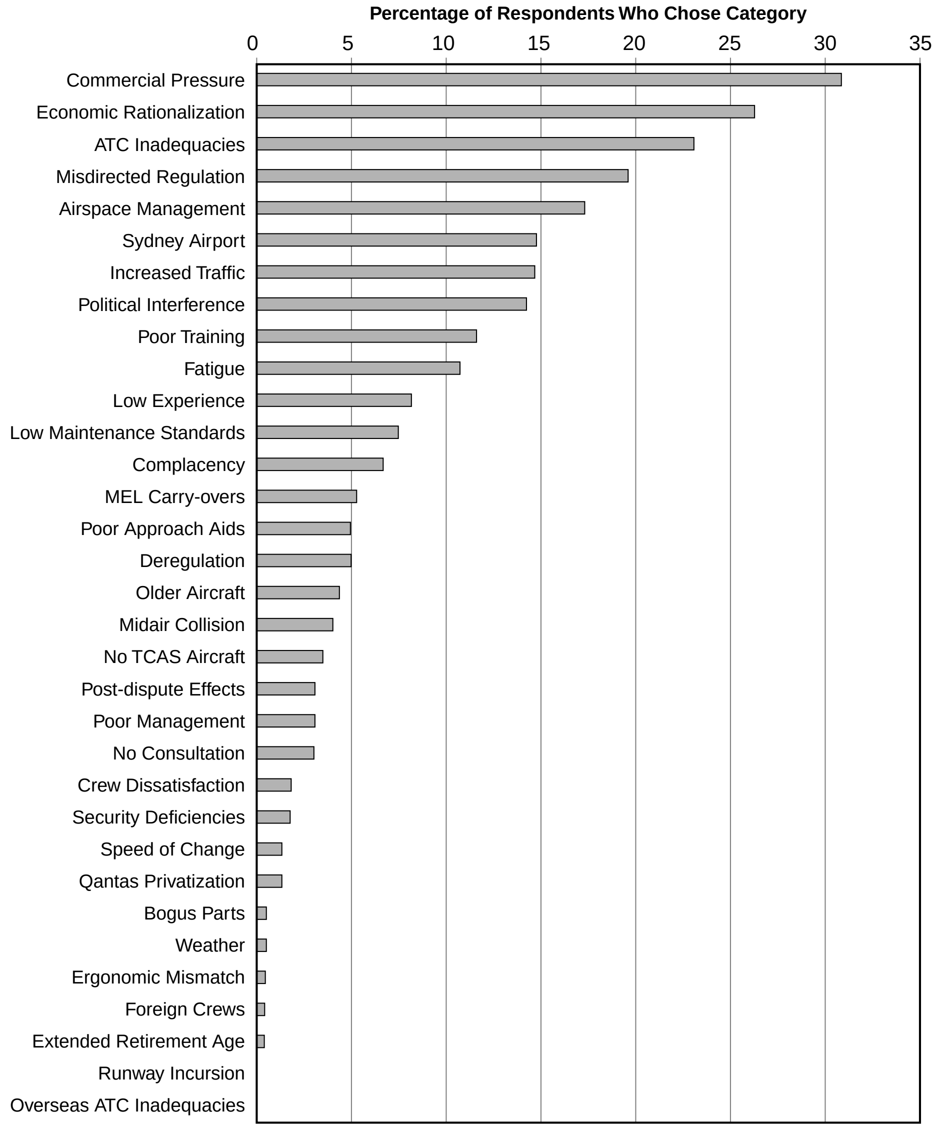
Boeing’s analysis of the 126 fatal accidents in the worldwide commercial jet fleet during the same 10-year period attributed four accidents to ice or snow and two accidents to wind shear. (Those six accidents resulted in 225 fatalities.)[2]

Weather is uncontrollable, but there are few weather phenomena for which operators cannot compensate. The geographic distribution of most weather phenomena is well known; therefore, appropriate equipment and training can prepare crews for expected hazards. Nevertheless, phenomena that are difficult to detect or to prepare for — severe low-level wind shear and microbursts — are significant hazards.

Australia experiences a variety of weather conditions because the large continent includes several climatic zones. Nevertheless, pilots’ general perceptions are that the country has favorable aviation weather, that aircraft are exposed less to variable weather conditions than aircraft in other countries and that Australian flight crews spend less time flying in marginal conditions. If these perceptions are valid, aircrews may have less experience flying in unfavorable weather, and consequently, they may have an increased risk of pilot errors when operating in such conditions. But that risk may be offset by the heightened

“What … Will Pose the Greatest Threat?”

Responses from Ansett Australia Flight Crewmembers



Post-dispute effects = Aftermath of 1989 domestic pilots’ strike
No consultation = Changes in airline policy and regulatory policy that respondents believed were made without proper consultation
ATC = Air traffic control MEL = Minimum equipment list TCAS = Traffic-alert and collision avoidance system

Source: Data reflect responses from 233 Ansett Australia flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 20

awareness and added caution that can accompany operations in unfavorable weather.

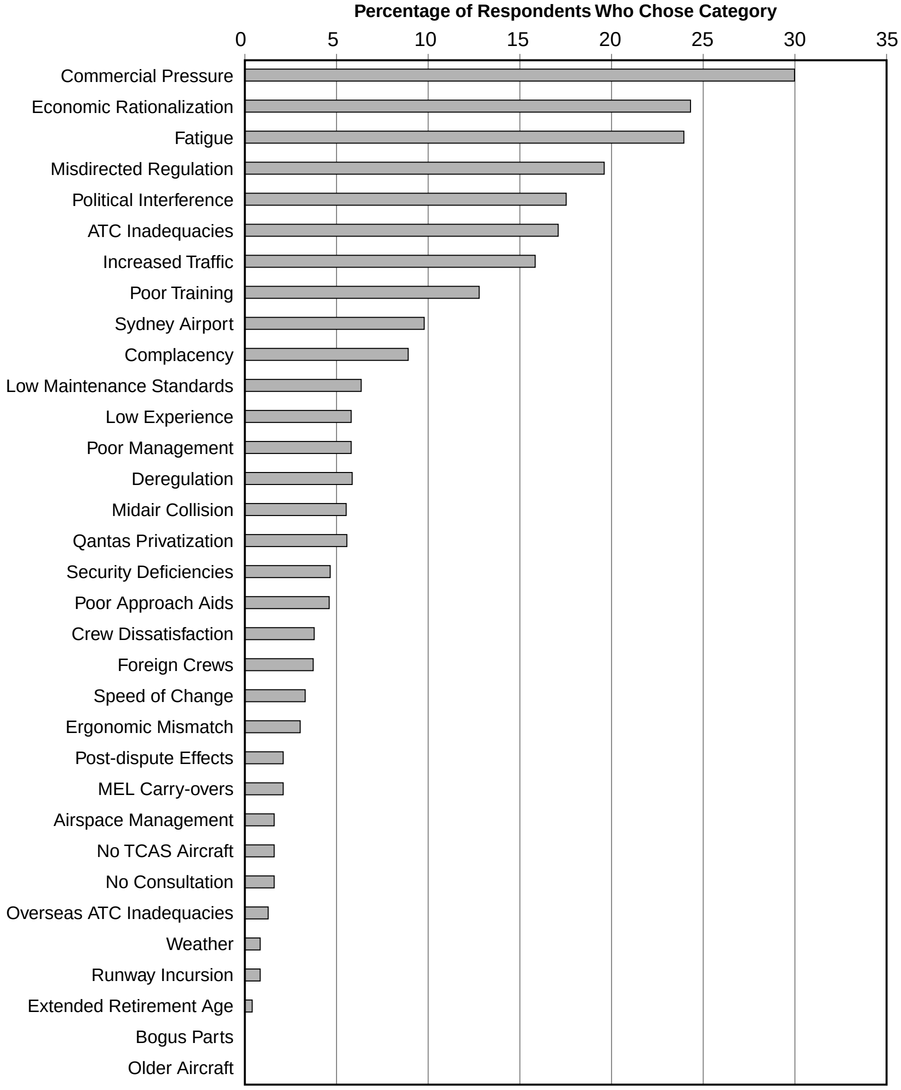
Severe wind shear, especially at low altitudes, is reported more frequently in the United States than anywhere else in the world. The frequency is partly a result of the greater volume of aviation traffic in the United States. As traffic volume increases at airports in Australia, the likelihood of encounters with wind shear also will increase.

The Australian Bureau of Meteorology has used records of severe thunderstorm activity to develop a graph to predict where microbursts and wind shear are most likely (Figure 25, page 16).[3]

Nevertheless, the Bureau of Meteorology said, “The geographical spread of severe thunderstorms in Australia is difficult to determine because of our low population density and lack of observations over most of the continent. While records of storm impacts show that the most damaging storms have occurred in the populous southeast quarter of the continent, analysis of wind, hail and tornado data suggests that severe thunderstorms are a significant threat throughout the country.”[3]

“What … Will Pose the Greatest Threat?”

Responses from Qantas Flight Crewmembers



Post-dispute effects = Aftermath of 1989 domestic pilots’ strike
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ATC = Air traffic control   MEL = Minimum equipment list TCAS = Traffic-alert and collision avoidance system

Source: Data reflect responses from 343 Qantas flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 21

Sydney, Perth and Gold Coast all are within the map’s severe-storm zone.

Few Parts of Australia Are Mountainous

The greatest cause of fatalities in civil aviation worldwide has been controlled-flight-into-terrain (CFIT) accidents. A CFIT accident occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew.

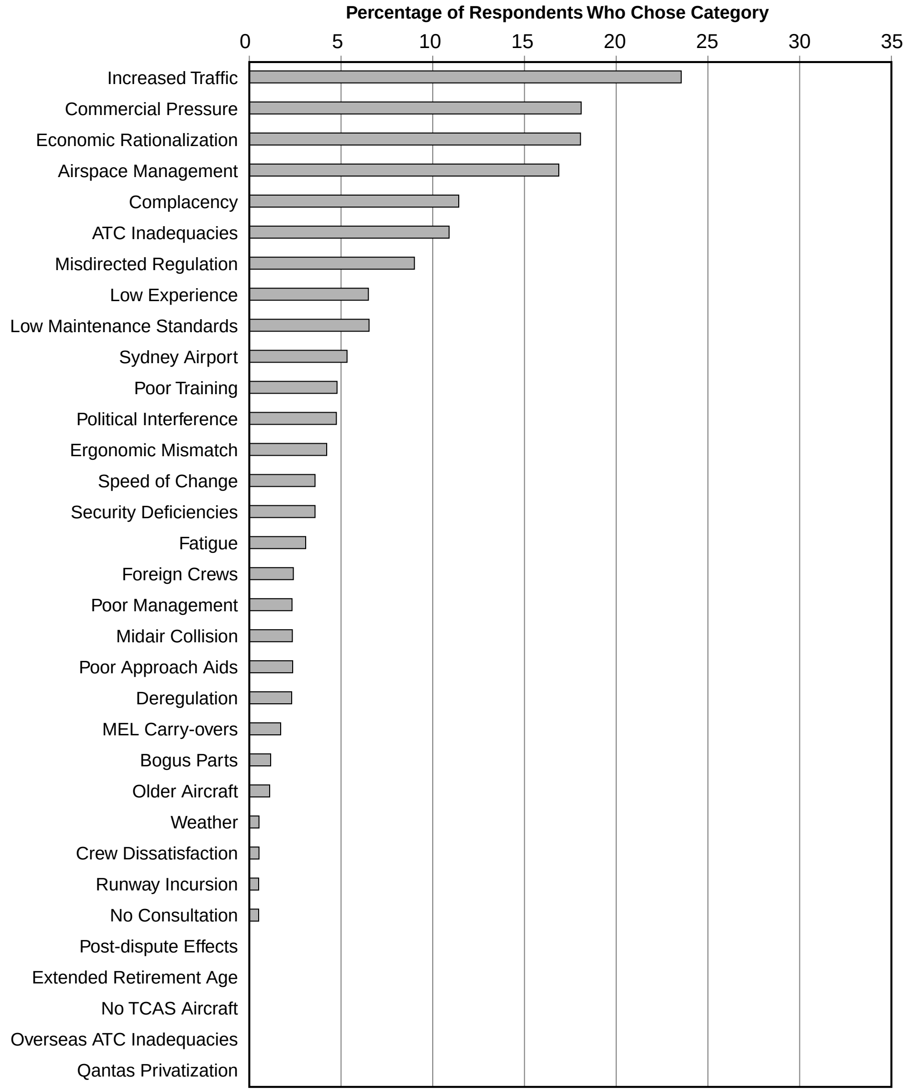
The 1988–1997 Boeing survey found that 2,806 people were killed in CFIT accidents, about 41 percent of the 6,792 people who were killed in all types of aircraft accidents during that period. Of the 126 fatal accidents during that period, 36 accidents, or 29 percent, were CFIT accidents.[2]

The risk of a CFIT accident increases when aircraft are flown to airports that are in mountainous terrain and have only nonprecision approaches and no radar coverage.[4]

The risk of CFIT also is increased when ATC radar facilities do not have minimum safe altitude warning systems.[5]

“What … Will Pose the Greatest Threat?”

Responses from Royal Australian Air Force (RAAF) Flight Crewmembers



No consultation = Changes in airline policy and regulatory policy that respondents believed were made without proper consultation
Post-dispute effects = Aftermath of 1989 domestic pilots’ strike
ATC = Air traffic control MEL = Minimum equipment list TCAS = Traffic-alert and collision avoidance system

Source: Data reflect responses from 133 RAAF flight crewmembers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

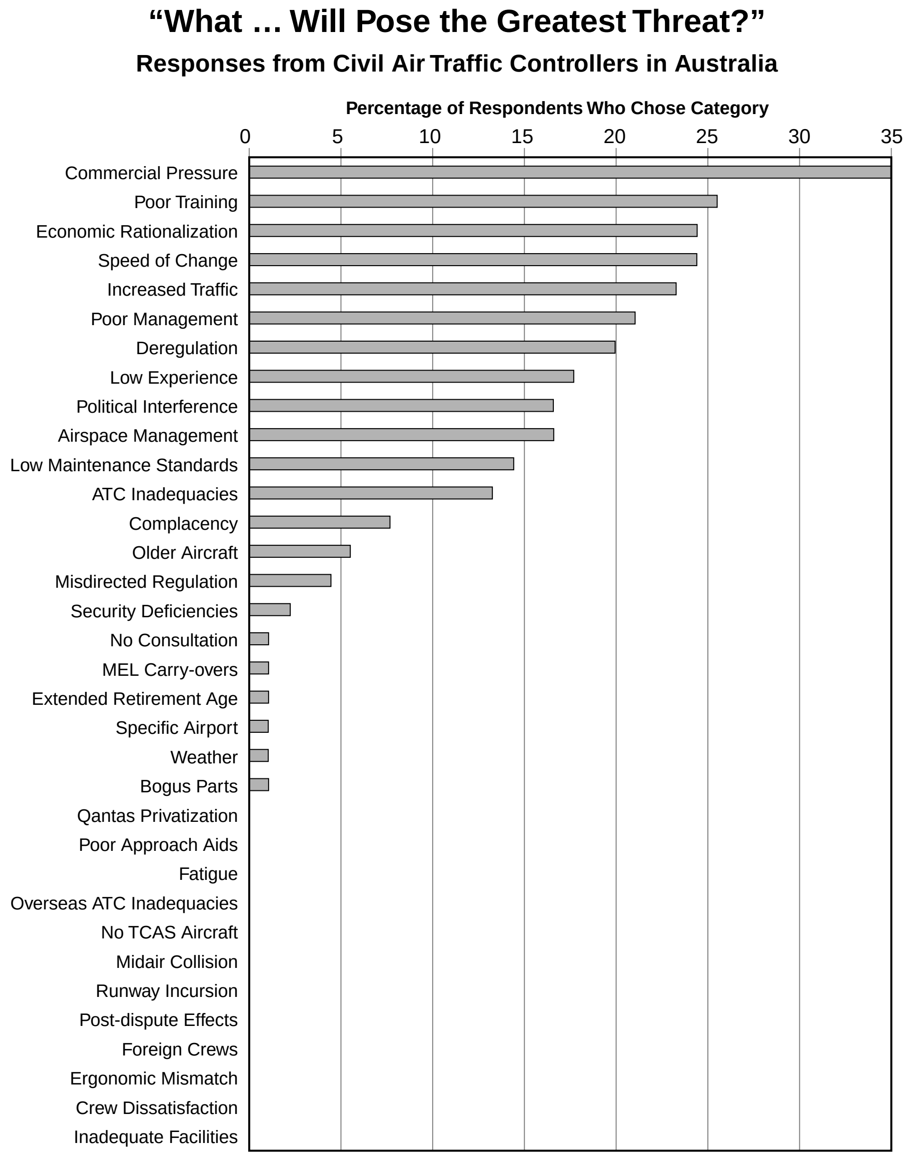
Figure 22

A Flight Safety Foundation (FSF) study of CFIT approach-and-landing accidents (ALAs) said that 67 percent of CFIT occurrences were in hilly or mountainous terrain, and 29 percent were in areas of flat terrain.

“Although significant terrain features are an important operational consideration, they are not necessarily a prerequisite for CFIT,” the study said.[6]

A non-RPT accident involving a commuter airline’s Piper Chieftain in Young, about 75 miles (121 kilometers) northwest of Canberra, in 1993 was an example of how an unstabilized approach may occur at an airport with a nonprecision approach in an area of relatively flat terrain. The aircraft was flown below minimum safe circling altitude after crossing the airport nondirectional beacon (NDB) and collided with terrain 275 feet (84 meters) above the airfield elevation. All seven people on the airplane were killed. The accident-investigation report by the Bureau of Air Safety Investigation (BASI) said that the height of surrounding terrain and the meteorological conditions on the day of the accident were coincidental to latent problems within the carrier’s operation.[7]

Few parts of Australia are mountainous. About 2 percent of terrain in Australia is higher than 3,281 feet (1,000 meters) above sea level. The only major RPT airports that are near



No consultation = Changes in airline policy and regulatory policy that respondents believed were made without proper consultation
Post-dispute effects = Aftermath of 1989 domestic pilots’ strike
Inadequate facilities = Aviation Rescue and Fire Fighting and flight-service assistance
ATC = Air traffic control   MEL = Minimum equipment list   TCAS = Traffic-alert and collision avoidance system

Source: Data reflect responses from 121 Australian civil air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 23

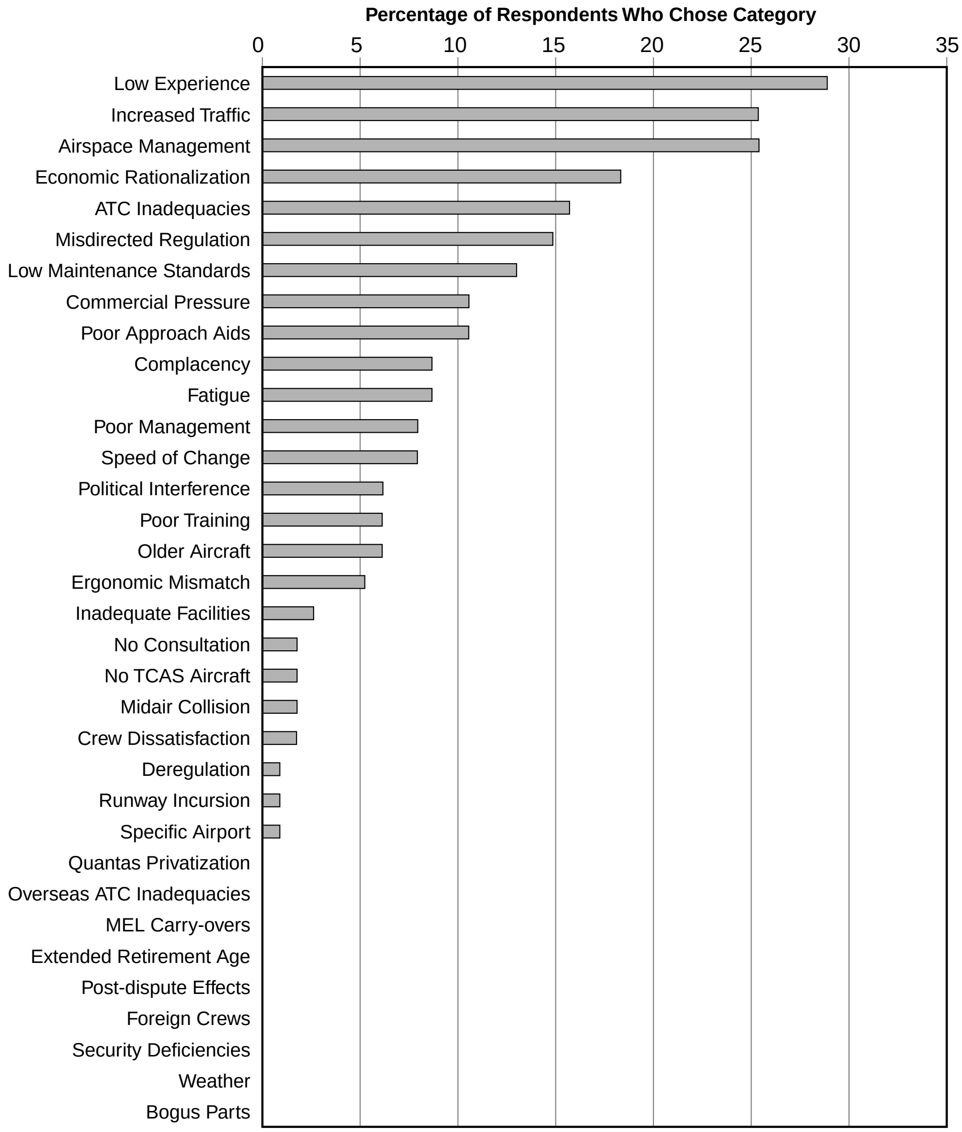
high terrain are Canberra, which is surrounded by higher terrain, and Cairns, which has steep terrain to the west.

Flight crew reports of nuisance alerts from ground-proximity warning systems (GPWS) on approaches to Canberra are numerous. (A nuisance alert is one in which the GPWS issues an alert for rising terrain when an aircraft is on the correct vertical approach path, especially on an approach where the terrain becomes lower before the aircraft would strike the ground. The alert is valid but is classified as a nuisance alert.) Repeated nuisance alerts can result in pilot complacency.

Because jet aircraft on approaches to Canberra — especially those arriving from the north with their landing gear up and flying about 290 knots — routinely received GPWS warnings, Qantas restricted the speed to 200 knots and required the landing gear to be lowered earlier.[8] Lowering the landing gear prevents the GPWS nuisance alerts, and the speed limit reduces the number of such alerts caused by the system’s prediction of an unsafe closure rate with nearby terrain. Although these steps may reduce the recurrent nuisance alerts, they might diminish the effectiveness of the system. A similar situation occurred at Cairns, where aircraft approaching from the west are flown over long and steep terrain that rises to a

“What … Will Pose the Greatest Threat?”

Responses from Royal Australian Air Force (RAAF) Air Traffic Controllers



Inadequate facilities = Aviation Rescue and Fire Fighting and flight-service assistance
No consultation = Changes in airline policy and regulatory policy that respondents believed were made without proper consultation
Post-dispute effects = Aftermath of 1989 domestic pilots’ strike
ATC = Air traffic control   TCAS = Traffic-alert and collision avoidance system   MEL = Minimum equipment list

Source: Data reflect responses from 128 RAAF air traffic controllers in a survey of Australian aviation safety conducted by Graham R. Braithwaite.

Figure 24

slope of about 30 degrees. Recurrent nuisance alerts were reduced by the same method used in Canberra.

Midair Collisions Not Always Linked To High Traffic Density

Flight crewmembers said that a midair collision is one of the greatest threats to their flying safety; Boeing’s 1988–1997 survey showed that two of the 126 fatal accidents during that period were midair collisions.[2]

Several near midair collisions have involved low traffic density that resulted in reduced vigilance by pilots and controllers. In May 1995, for example, a Qantas B-737 and a British Airways B-747 were involved in a near midair collision about 180 miles (290 kilometers) north of Broken Hill, which is in western New South Wales, about 650 miles (1,046 kilometers) from

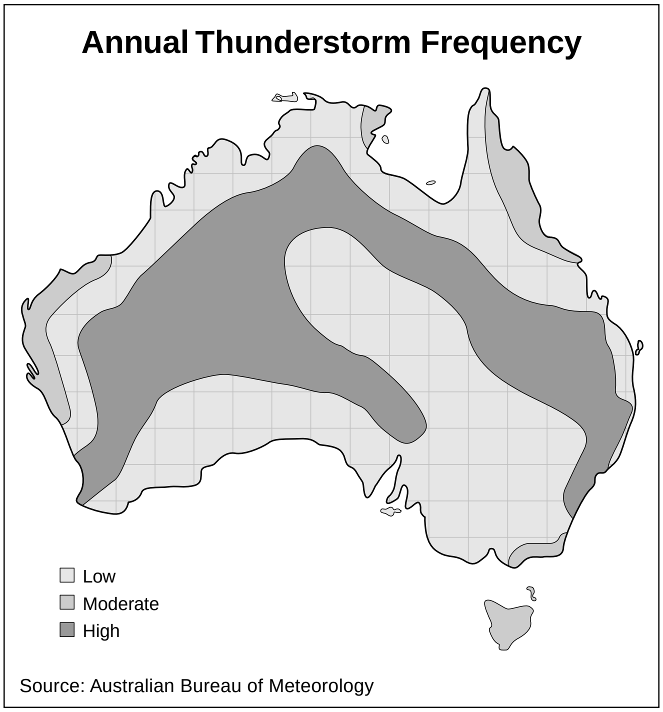


Figure 25

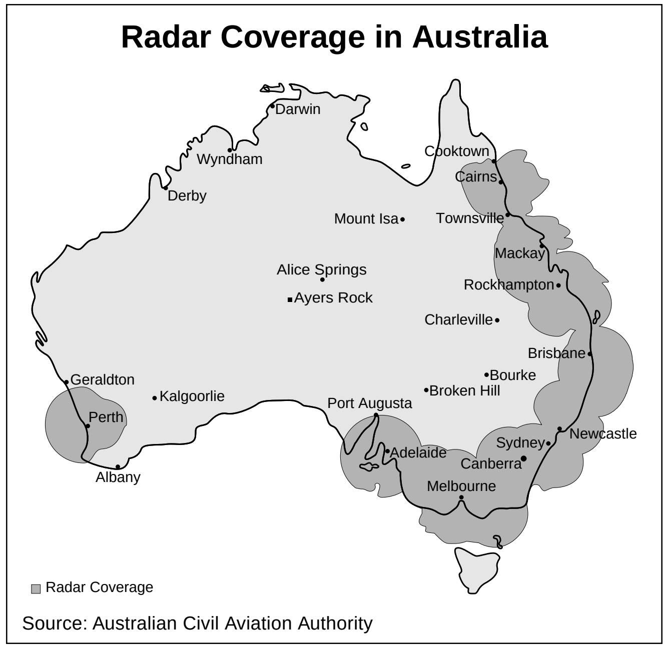


Figure 26

Sydney. A collision was avoided because of a TCAS resolution advisory on the B-747, which enabled the crew to conduct an evasive maneuver.

The BASI report on the 1995 incident said that the controller was handling three aircraft when the near midair collision occurred and that the controller was interrupted by "nine separate items involving 25 interchanges" while attempting to perform a time-of-passing calculation.[9] The high mental workload caused by the interruptions was cited as a possible reason for the erroneous calculation that directed the pilots onto the collision course.

Radar Coverage Limited

Radar coverage within Australia is limited (Figure 26). Approaches to large airports, such as Melbourne and Sydney, are controlled by a mix of primary radar and secondary radar; small airports (if they operate under ATC) and cross-country air routes (beyond radar coverage) use procedural control, under which pilots report to ATC the positions of their aircraft over specified reporting points.

In instances in which aircraft operating under procedural control are involved in a loss of separation (perhaps as a result of misinterpretation of ATC instructions or because of incorrect instructions), the controller is unable to see a possible collision developing on a radar display or to receive an automated warning of traffic conflicts.

Traffic density in Australia generally is relatively low. Former Civil Aviation Authority (CAA) Chairman Dick Smith said that at any one time, the air traffic over Australia is equivalent to about 3 percent of the traffic over the continental United States. (More than 200,000 aircraft are registered in the United States, compared with fewer than 10,000 aircraft registered in Australia.)[10] But Australia's 1,100 air traffic controllers are responsible for one-ninth of the world's airspace.[11]

Traffic is not equally spread across the Australian system but is centered around a relatively small number of cities on the eastern seaboard and in Perth, where traffic is often a mixture of low-level private operations and general aviation operations, military traffic and commercial RPT traffic.

Poor Communications Blamed For Most ATC Failures

Air traffic management is similar to aircraft operation in that communication may be both the strongest defense and the weakest link in safety. A report on a CAA forum in 1994 said that "inadequate communication is a major human factor in most failures of the system."[12]

A Boeing analysis of 93 accidents said that deficient communications between ATC and flight crewmembers occurred in 9 percent of accidents, but this is not necessarily an indication of the prevalence of deviation from standard operating procedures (SOPs) in ATC-crew communication.[13]

Problems of compliance occur as a result of misinterpreted instructions or procedures that may be a result of changes. For example, the pilots and controllers surveyed said that they had concerns about revisions of approach paths and departure paths, especially around Sydney Airport. A practice evolved in the mid-1990s in which clearances for standard terminal arrival routes (STARs) were amended early (where traffic permitted) to facilitate faster arrivals and then were reissued because of slower-than-expected preceding traffic. This practice violated the concept of standardization that STARs were designed to achieve, and the practice was ended in 1997.

Communications between Australian controllers and pilots are in English, but when Australian international flights enter ATC control zones where the national language is not English, the crews may not understand other pilots speaking to controllers in the national language and may not receive useful and important information.

Carriers and flight crews operate to a limited number of airports in Australia. This enhances their familiarity with ATC procedures. But long-haul operations mean that a large number of non-Australian ATC authorities are involved and that individual crewmembers fly to some destinations relatively infrequently. The safety risk is a lack of familiarity, which is addressed through chart updates and communications systems within flight operations.

Approach Aids Enhance Airport Quality

Accidents that occur on final approach and landing account for the greatest proportion of accidents, the 1988–1997 Boeing survey showed.[2] The data showed that 11 percent of accidents occurred during the final approach phase and 36 percent occurred during landing, even though together those phases account for 4 percent of flight time, based on a flight with a duration of 1.5 hours.

Data compiled by the FSF Approach-and-landing Accident Reduction Task Force showed that there were 287 ALAs between 1980 and 1996 involving jet and turboprop aircraft (maximum takeoff weight of more than 12,500 pounds/5,700 kilograms), resulting in 7,185 fatalities.[6] Among the occurrences for which data were available, three-fourths of the accidents occurred where a precision-approach aid was not available or was not used.

Larger airports, including Sydney, Melbourne and about a dozen others in Australia, are equipped with instrument landing system approaches. Other airports use nonprecision very-high-frequency omnidirectional range (VOR) approaches, VOR/distance-measuring equipment approaches or NDB approaches.

In terms of visual guidance systems — such as the visual approach slope indicator (VASI) system, T-visual approach slope indicator (T-VASI) or precision approach path indicator — the main airports in Australia generally are equipped with T-VASI. A more accurate and flexible version of the original VASI, T-VASI was pioneered in Australia.[14]

The presence of obstacles during the climb-out and approach phases of flight can be a latent risk in the aviation system that later may combine with active failures, such as engine failures, improperly configured aircraft or unstabilized approaches. The International Civil Aviation Organization (ICAO) recommends minimum requirements for clearance surfaces around airports, and these have been accepted by member states, including Australia.[15] In examining differences in safety margins, consideration may be given to the extent to which airports exceed the ICAO-recommended minimums. In accidents in which aircraft have undershot runways, overshot runways or veered off runways, the severity of the outcome often has been related to exceedances of minimums for obstruction clearance.

‘Apprenticeship’ Programs Help Train Some Pilots

Competition for employment with Australia’s major RPT carriers is intense, and the carriers are able to choose applicants with the most compatible experience. This does not necessarily mean hiring applicants with the highest number of flight hours; *ab initio* trainees may have a comparatively low number of hours. Secondary-level carriers generally demand a higher number of flying hours because their new recruits will fly aircraft as first officers. Qantas, for example, trains new pilots through the “apprenticeship” second officer position, a rank that a crewmember may hold for two years to three years. Second officers on the flight decks of Qantas international jet aircraft fill several roles; in addition to training and accumulating flying hours, they serve as relief pilots during the cruise phase on long-distance routes. The second officer is a licensed air transport pilot, but flies the airplane only during cruise flight until reaching the rank of first officer.[16,17] Cross-checking of senior crewmembers by the second officer was specified in SOPs as part of the second officer’s duties.

A worldwide study showed that, in 54 percent of 118 large-jet accidents, there was inadequate cross-checking by other crewmembers.[18]

The main source of pilots for airlines has been from general aviation or the military. Traditionally, about 60 percent of Australian airline pilots have been from general aviation, 35 percent from the military and 5 percent from other airlines.[19] Although the major carriers have operated cadet programs, those programs have not been the main source of pilots.[20]

A low turnover of staff within the major carriers means that pilots in all positions have a high average level of experience. “Career first officers” are typical, as are first officers who have 10 years or more of experience in their positions.

Geography Demands Long-range Aircraft

International flights to and from Australia are among the longest average sector lengths in the world.[21] The advent of long-range aircraft has been partly a result of demand from Australian carriers.[22]

Long sectors such as Sydney to Los Angeles, California, U.S. (12,054 kilometers [7,486 miles]), Singapore to London (10,873 kilometers [6,752 miles]) and Melbourne to Johannesburg, South Africa (10,312 kilometers [6,404 miles]) mean that each flight crewmember is the pilot flying during takeoffs and landings only one time or two times a month.

This presents a risk of diminished recent experience for these pilots, especially experience with local airport conditions, such as weather or unusual approach procedures. The lack of recent experience is mitigated by three simulator checks per year and by a heightened awareness of the safety risk inherent in such operations.

Australia's carriers conduct long-distance domestic flights. For example, domestic B-767-200s operate on routes to Perth, Adelaide, Melbourne, Sydney, Brisbane and Cairns.

Monitoring Prompts Change In Takeoff Technique

Ansett and Qantas use flight operational quality assurance (FOQA) programs, which collect and analyze data recorded during flight to improve the safety of flight operations. FOQA is a program for obtaining and analyzing data recorded in flight operations to improve flight crewmembers' performance, air carrier training programs, operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design.[23]

At Qantas, for example, one of the early successes of FOQA was the discovery of fleetwide over-rotation at takeoff on the B-747-400 fleet, which was causing the speed to dissipate at the most critical phase of takeoff. The problem highlighted deficiencies in the conversion training from the earlier B-747-100/200/300 series aircraft, and the training subsequently was amended before a tail strike — or a more serious problem — occurred.[24]

Airlines Oppose Reliance On Deferred Maintenance

The 1988–1997 Boeing data for hull-loss accidents showed that maintenance was cited as the primary cause of nine of the 149 accidents with known causes, or 6 percent. By comparison, "flight crew" was listed as the primary cause of 105 of the 149 accidents, or 70 percent.[2]

Provisions of minimum equipment lists (MELs) allow some maintenance to be deferred (or carried over) and allow continued flight operations. Nevertheless, Ansett and Qantas have policies that aircraft should not carry over MEL deficiencies between maintenance checks. These policies are an outgrowth of the emphasis on engineering reliability that has existed since the early days of the Australian aviation industry, when Australia's distance from aircraft factories meant that aircraft were assembled in Australia using imported parts.

Fire Fighting Coverage Sometimes Falls Below Recommended Level

Within Australia, changes in the level of aircraft rescue and fire fighting (ARFF) coverage at small regional airports have led to a situation in which some aircraft, such as B-737s, Fokker F28s and British Aerospace BAe 146s, operate into airports that do not conform to ICAO's recommended ARFF minimums. Those minimums include the length of time that fire fighters should take to arrive at an accident scene and to apply a specified amount of fire-extinguishing materials. For example, B-737s land and take off from the airport in Yulara, which has no specialized ARFF services and no local fire department; the nearest fire truck is in Alice Springs, about 200 miles (322 kilometers) northeast of the airport.[25]

Economic Pressure, Increased Traffic, Complacency Called Hazards

Despite Australia's record, flight crews and air traffic controllers said that they perceived specific threats to aviation safety, including economic pressure on the aviation industry, an increase in aviation traffic and complacency within the system.

In Australia, economic pressure has been heightened by significant structural changes in the aviation industry during the past decade, including the 1992 merger of Australian Airlines and Qantas, and Ansett's expansion into international operations. Cost-cutting within both airlines has been significant and has placed pressure on all aspects of the operations.

An expected increase of about 7 percent a year in aviation traffic in Australia will impose additional pressure on the industry, partly because of competition within the Asia-Pacific region, where the traffic increase is predicted to be as high as 11 percent a year. One challenge will be the increasing pressure on infrastructure, especially ATC, airports, training and maintenance.

Complacency is associated with any socio-technical system that appears to be working well. A lack of accidents is an imprecise guide to system safety. In aviation, the absence of accidents in the past is not an accurate measure of current performance or an accurate way to predict the future. Ongoing evolution of the aviation environment will require the adoption of risk countermeasures to maintain safety.

Although complacency is the belief that "nothing needs to be done," a more serious threat comes from a belief that "nothing can be done" — a fatalism about things that seem to some people to be beyond human control. This belief has been expressed by people who have said that "Australia is due for a crash" or that the "good luck has to come to an end." But accidents do not occur because statistics say that they should. A good accident record is no guarantee of future success; neither is it a bad omen.♦

[Editorial note: This article was adapted from "Australian Aviation Safety: A Systemic Investigation and Case Study

Approach," April 1998. The original paper, which was written as the author's doctoral dissertation, consisted of 375 pages, plus appendices. This article has been edited by the FSF editorial staff in cooperation with the author.]

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Aviation Statistics

Number of Aircraft Accidents Decreases in Canada in 1999

Data show 340 accidents were reported, compared with 385 in 1998, and the 1999 accident rate was 8.3 accidents per 100,000 flight hours, compared with 9.6 accidents per 100,000 flight hours the previous year.

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Data compiled by the Transportation Safety Board of Canada (TSB) showed that Canadian-registered aircraft were involved in 340 reported accidents in 1999, compared with 385 accidents in 1998 (Table 1, page 21).

The 340 accidents represented an 8.4 percent decrease when compared with the five-year average of 371 accidents a year recorded from 1994 through 1998. The statistics do not include accidents involving ultralight aircraft.

Flying activity increased by 2.7 percent in 1999 to 4.1 million hours, resulting in an accident rate of 8.3 accidents per 100,000 flight hours, compared with a 1998 accident rate of 9.6 accidents per 100,000 flight hours. The five-year average for 1994–1998 also was 9.6 accidents per 100,000 flight hours.

Canadian-registered aircraft were involved in 35 fatal accidents that resulted in 67 fatalities in 1999, compared with the 1994–1998 average of 39 fatal accidents and 84 fatalities per year. About half of the fatal accidents involved privately operated aircraft; most of the rest involved commercial aircraft weighing less than 12,500 pounds/5,700 kilograms.

Data showed that 701 incidents were reported to TSB in 1999, a decrease of 10.4 percent from 1998 but an increase of 3.5 percent over the 1994–1998 average.♦

Table 1
Aviation Occurrences in Canada, 1994–1999

	1999	1998	1994–1998 Average
Canadian-registered Aircraft Accidents[1]	**340**	**385**	**371**
Aeroplanes Involved[2]	285	316	301
Airlines	7	14	8
Commuters	12	10	13
Air Taxis/Aero Work Aircraft	92	128	121
Other Commercial Air Services[3]	11	–	–
Private/Corporate/State	163	164	159
Helicopters Involved	45	56	59
Other Aircraft Involved[4]	15	17	14
Hours Flown (Thousands)[5]	4,100	4,000	3,877
Accident Rate (per 100,000 hours)	8.3	9.6	9.6
Fatal Accidents	35	31	39
Aeroplanes Involved	29	24	31
Airliners	1	0	0
Commuters	2	1	1
Air Taxis/Aero Work Aircraft	6	9	13
Other Commercial Air Services	0	–	–
Private/Corporate/State	20	14	17
Helicopters Involved	4	6	7
Other Aircraft Involved	4	2	1
Fatalities	67	83	84
Serious Injuries	43	48	49
Ultralight Aircraft Accidents	**35**	**39**	**41**
Fatal Accidents	12	5	6
Fatalities	18	9	9
Serious Injuries	8	7	8
Foreign Aircraft Accidents in Canada	**24**	**22**	**20**
Fatal Accidents	6	5	4
Fatalities	9	236	56
Serious Injuries	1	4	3
All Aircraft Incidents	**701**	**782**	**677**
Collision Risk of Collision, Loss of Separation	176	185	180
Canada, N.W, Atlantic –Airborne Air Proximity[6]	138	151	140
–Loss of Separation[7]	98	116	87
Declared Emergency	207	229	191
Engine Failure	157	173	167
Smoke/Fire	85	111	73
Other	76	84	66

[1] Ultralight aircraft excluded.

[2] As some accidents may involve multiple aircraft, the number of aircraft involved may not equal the number of accidents.

[3] Category broken out from Air Taxis/Aerial Work Aircraft.

[4] Includes gliders, balloons and gyrocopters.

[5] Source: Statistics Canada (1996, 1997, 1998 and 1999 hours flown are estimated).

[6] This category includes incidents in Canada or Canadian-controlled North Atlantic airspace in which an aircraft was unintentionally operated in close proximity to another.

[7] This category includes those in which established separation criteria were violated in controlled airspace. (1999 figures are preliminary as of Jan. 19, 2000, and are subject to change)

Source: Transportation Safety Board of Canada

FAA Publishes Index of Aviation Medical Reports

The publication lists documents published during nearly four decades and describes the research activities of the FAA Office of Aviation Medicine.

FSF Library Staff

Reports

Index to FAA Office of Aviation Medicine Reports: 1961 Through 1999. Collins, William E.; Wayda, Michael E. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-00/1. January 2000. 84 pp. Available through NTIS.*

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

This index includes reports published from 1961 to 1963 by the FAA Civil Aeromedical Institute and reports published from 1964 to 1999 by the FAA Office of Aviation Medicine. Reports are indexed chronologically, alphabetically by author and alphabetically by subject. The foreword describes the activities of the FAA Office of Aviation Medicine's research program during the past 38 years, explains the sections of the index and outlines how to obtain technical reports published by the Office of Aviation Medicine. [Adapted from Introduction and Foreword.]

Measuring Air Traffic Controller Performance in a High-Fidelity Simulation. Manning, Carol A., editor. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-00/2. January 2000. 37 pp. Available through NTIS.*

Keywords:
1. Air Traffic Control
2. Performance Measurement
3. Simulation

This document contains two reports that resulted from the Air Traffic Selection and Training (AT-SAT) High-fidelity Simulation Study, conducted at the FAA Academy in Oklahoma City, Oklahoma, U.S., in 1997. The study was designed to test the performance of 107 operational en route controllers during 2.5 days of simulations.

The first report outlines the development of a work sample method designed to measure an individual's skill level by examining samples of behavior under realistic job conditions. This method established that high-fidelity performance measures can reflect controller performance.

The second report used measures collected in the first study to predict the over-the-shoulder (OTS) performance rating. OTS ratings are used to evaluate controller performance by evaluating the frequency of specific events, control judgment, situational awareness and the effectiveness of activities performed. These tests are conducted by full-performance-level, subject-matter-expert controllers. Results showed that the method that included both counts of mistakes and computer-derived performance measures was a better predictor of OTS ratings than the computer-derived measures alone. [Adapted from Introduction and Discussion.]

Enhancing GPS Receiver Certification by Examining Relevant Pilot-Performance Databases. Joseph, Kurt M.; Jahns, Dieter W. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-00/4. February 2000. 11 pp. Available through NTIS.*

Keywords:
1. GPS Receivers
2. Certification
3. Human Factors
4. General Aviation

The rapid introduction and development of global positioning system (GPS) receivers for use in airborne navigation has outpaced the capacity of international aviation authorities to resolve human factors issues involving the safe and efficient use of these devices. Existing certification technical standards appear to have had little influence on the standardization of receiver architectures, interfaces and operating manuals. There also is no standard for the design of hand-held GPS receivers, despite their common use among general aviation pilots. This report examines the relationship between existing human factors data concerning GPS-interface design and incident/accident databases to highlight safety in GPS-receiver-interface issues. [Adapted from Introduction and Conclusions.]

Books

The World's Major Airlines and Their Aircraft. Wragg, David. Sparkford, Yeovil, Somerset, England: Haynes Publishing, 1998. 271 pp.

This reference work contains more than 500 entries in alphabetical order describing every airline worldwide that has more than five aircraft with more than 19 seats or with the equivalent cargo capacity. Each entry provides information on the name, history, bases, aircraft fleets, routes flown, and the number of passengers and volume of cargo transported annually. Statistical data are provided, where the data are available, on numbers of airline employees, traffic figures and revenue, in both U.S. dollars and U.K. pounds sterling. Contains an index of airlines. [Adapted from Introduction and Back Cover.]

Bombers: From the First World War to Kosovo. Wragg, David. Phoenix Mill, England: Sutton Publishing, 1999. 280 pp.

This book describes the role of bomber aircraft in twentieth-century warfare. Blending narrative and personal accounts, Wragg records the history of the principal bombing raids and describes the skill of the crewmembers who flew them. The author begins with the origins of the concept of aerial bombardment and traces its development through World War I, the Spanish Civil War and other conflicts. During World War II, large numbers of bomber aircraft were deployed as strategic weapons and tactical weapons. The book concludes with the modern era, with the development of stealth technologies and cruise missiles. Contains a bibliography and an index. [Adapted from Introduction and Back Cover.]♦

Sources

*National Technical Information Service (NTIS)
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Springfield, VA 22161 U.S.
+1 (703) 487-4600

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

Advisory Circulars

AC No.	Date	Title
150/5200-30A	Nov. 15, 1999	*Change 4 to Airport Winter Safety and Operations.*
70/7460-1K	Mar. 1, 2000	*Obstruction Marking and Lighting.* (Cancels AC 70/7460-1J, *Obstruction Marking and Lighting*, dated Jan. 1, 1996.)

International Reference Updates

Airclaims

Supplement No.	Date	
117	Nov. 29, 1999	Updates "Major Loss Record."
118	Jan. 19, 2000	Updates "Major Loss Record."
118	February 2000	Updates "World Aircraft Accident Summary."

Emergency Escape Slide Falls From Airplane

Pilots said that they felt a bump at 12,000 feet as the left off-wing emergency escape slide and the slide door separated.

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

Air Carrier

Indication of Problem With Escape Slide Prompts Return to Airport

Boeing 767. Minor damage. No injuries.

Visual meteorological conditions prevailed for the late-afternoon flight. Crewmembers said that they felt a bump as the airplane climbed through 12,000 feet about eight minutes after takeoff from an airport in the United States. Crewmembers also observed an indication on the engine-indication and crew-alerting system that referred to the left off-wing emergency escape slide.

The captain asked the lead flight attendant to confirm that the overwing hatch was secured, then flew the airplane to the departure airport. The landing was uneventful, the airplane was taxied to the gate, and the passengers were deplaned.

Inspection of the airplane revealed that the left off-wing emergency escape slide and door had separated. The door latch torque tube also had failed, and the forward latch pin and aft latch pin were in the "latched" position. The slide door was recovered, but the slide was not located.

Runway Sealant Found In Airplane's Engine

McDonnell Douglas MD-80. Minor damage. No injuries.

The pilots were beginning the takeoff at an airport in Russia when a compressor stall occurred in the right engine. The pilots rejected the takeoff. The airplane was taxied to the terminal, and the 38 passengers were deplaned.

Examination of the engine showed that the engine had ingested bituminous-polymer sealant, which had been applied recently to the runway.

Airplane Destroyed by Fire After Landing with Nose Landing Gear Retracted

Boeing 747. Airplane destroyed. No injuries.

The flight crew was unable to extend the airplane's nose landing gear, either by normal procedures or by emergency procedures. The airplane was landed at an airport in India with the nose landing gear retracted. The accident resulted in a fire that destroyed the airplane. The two crewmembers, who were the only people on the airplane, were not injured.

Air Taxi Commuter

Maintenance Technicians Extinguish Engine Fire

Beech 1900D. Minor damage. No injuries.

The crew had just landed the airplane at an airport in Australia, and the airplane was being taxied from the runway. The first officer switched off the landing lights and made a radio transmission to air traffic control (ATC). The crew observed that the master warning light, the right alternating-current (AC)-electrical-bus warning light and the right fuel-pressure-low warning light had illuminated.

The crew conducted checklist actions for the right AC bus failure, but, because the airplane was near the terminal, they did not conduct checklist actions for the fuel-low-pressure warning. The fuel-low-pressure checklist required activation of the standby boost pump.

The first officer then smelled acrid smoke and observed flames emanating from the bottom of the right engine nacelle. The crew stopped the airplane and shut down both engines. (No fire-warning indication was apparent during the incident.) Both engine-fire "T" handles were operated, and unsuccessful attempts were made to discharge the right-engine fire bottle.

The first officer directed the passengers to exit through the forward cabin door while the captain transmitted a radio message to request aircraft rescue and fire fighting assistance and then turned off electrical power to the airplane. Two maintenance technicians observed the flames and used dry-chemical-powder fire extinguishers to extinguish the fire before the firefighters arrived.

An inspection revealed that the fire was fed by fuel leaks from fuel lines outboard of the right engine nacelle. The leaks apparently were a result of electrical arcing from the right-landing-light direct-current power wires to the fuel lines.

Airplane Overruns Runway After Rejected Takeoff

Fokker F27. Substantial damage. No injuries.

Visual meteorological conditions prevailed, and an instrument flight rules flight plan had been filed for the late-morning flight from an airport in Ecuador.

The airplane overran the runway after the flight crew rejected the takeoff. The crewmembers told investigators that they felt a vibration in the airplane during the takeoff run, before the airplane reached V_1, the maximum speed in the takeoff at which the pilot must take the first action (e.g., apply brakes, reduce thrust, deploy speed brakes) to stop the airplane within the accelerate-stop distance. They were unable to stop the airplane before overrunning the runway.

Hydraulic System Failure Prompts Diversion of Flight

Fokker F28 Mk 4000. No damage. No injuries.

Visual meteorological conditions prevailed during the night flight to an airport in the United States when the primary hydraulic system failed and the airplane was diverted to another airport. The airplane was landed without further incident.

The pilots said that, during cruise flight, the indication for the no. one hydraulic (utility) fluid quantity dropped below the red mark on the gauge. The pilots notified their carrier's maintenance technicians and decided to land the airplane at a closer airport. The secondary hydraulic system was used for the rest of the flight.

The pilots said that the no. one hydraulic system's fluid level had dropped earlier in the day and that maintenance technicians had serviced the system with hydraulic fluid. The pilots then operated the engines and cycled the flight controls while maintenance personnel checked for leaks and found none.

Inspection of the airplane revealed that a hydraulic line for the flap-drive motor was chafed and was leaking in the left wheel well. Maintenance technicians replaced the chafed line.

‘Unusual’ Descent Rate Precedes Landing 12 Feet From Runway

Gates Learjet 35A. Substantial damage. Two minor injuries.

Visual meteorological conditions prevailed for the late-morning instrument flight rules flight to an airport in the United States. As the airplane approached the airport, the first officer twice received automated weather observation service information reports of wind gusts at no more than eight knots.

The pilots used the instrument landing system localizer and glideslope as references for their visual approach to the runway. The captain told investigators that the approach initially was stabilized but that “an unusual descent rate developed on short-final approach.”

He tried to slow the rate of descent, but the airplane landed “a few feet short of the runway,” he said.

A transcript of the airplane’s cockpit voice recorder (CVR) showed that, about 33 seconds before the airplane struck the ground, the first officer said “ref [reference speed] 10, sinking a thousand.” About four seconds before impact, the first officer called out the winds as “one twenty at twelve.” About a second before impact, the first officer said “watch it, watch it, watch it!”

The CVR also showed that the crew did not conduct a briefing before beginning the visual approach.

The airplane touched down 12 feet (3.7 meters) from the landing threshold for Runway 19, and the main landing gear struck the concrete foundation supporting the green lights for the runway’s medium-intensity approach lighting system. The airplane traveled about 1,700 feet (213 meters), then stopped on the east side of the 6,011-foot (1,833-meter) runway.

An inspection revealed structural damage to the fuselage and the left wing. The left main landing gear separated from the airframe and struck the left trailing edge flap, the left engine and the leading edge of the left horizontal stabilizer. The left fuel cell also was damaged; fuel spilled from the fuel cell, but there was no fire.

The 31-year-old captain had 3,100 flight hours, including 50 flight hours in Learjets, all within the preceding 90 days. The 57-year-old first officer had 14,000 flight hours, with approximately 2,100 flight hours in Learjets.

Airplane Loses Landing Gear Wheel Assembly During Takeoff

Israel Aircraft Industries 1124. Minor damage. No injuries.

Visual meteorological conditions prevailed for the morning takeoff from an airport in the United States. During the takeoff, the right main landing gear wheel assembly separated from the airplane.

Inspection of the airplane revealed that the right wheel bearing had failed and that the wheel assembly separated from the spindle assembly. The inspection also revealed that the proper wheel-bearing lubricant was present in the wheel hub and bearing assembly.

Section of Landing Gear Lock Strut Breaks During Approach

Fairchild Hiller FH-227B. Substantial damage. No injuries.

The flight crew was preparing to land the airplane, which was being ferried across the Atlantic Ocean, at an airport in Iceland just before midnight. When they extended the landing gear, the pilots heard a loud cracking noise from the rear of the airplane, and they rejected the landing. They flew the airplane past the control tower for observation of the landing gear, and one of the pilots walked into the cabin to determine whether the landing gear had extended.

The pilot “observed that the right landing-gear lock-strut rear member had broken loose from the side-member assembly and was hanging down. Thus, the gear was unstable and on landing, when the gear took weight, it folded up, and the aircraft right propeller, wing tip and bottom of the fuselage touched ground.”

The airplane “went off the runway in a gentle right turn.”

Examination of the airplane revealed that the skin and the frame structure on the bottom of the fuselage were extensively damaged and that the right wing tip, propeller blades, lock strut assembly and drag strut were destroyed. Investigators determined that no lubricant was in the lock-strut hinge pin, which normally is packed with grease.

Other General Aviation

Airplane Damaged During Attempted Takeoff From Wet Grass Airstrip

Auster D4-108. Minor damage. No injuries.

The pilot conducted a preflight inspection and calculated the takeoff distance for the downward-sloping 2,700-foot (824-meter) grass airstrip in England using an estimated aircraft weight of 1,622 pounds (736 kilograms). (The maximum takeoff weight is 1,900 pounds [862 kilograms].) He determined that the takeoff for his mid-morning flight in visual meteorological conditions, with a two-knot tail wind, would require a runway length of 1,233 feet (376 meters).

The pilot also determined that the final 600 feet to 750 feet (183 meters to 229 meters) would not be usable because of standing water and that there were wet patches about midway along the runway but that at least the first 1,500 feet (458 meters) of the runway would be usable. Local pilots said that "it is prudent to abandon the takeoff" if the airplane is not airborne soon after passing the windsock, which is about 900 feet (275 meters) from the point where the takeoff roll begins. The pilot rotated the airplane for takeoff shortly before reaching the windsock, and the airplane became airborne, flew about 60 feet (18 meters) and settled back onto the runway, then lifted off again for 120 feet to 150 feet (37 meters to 46 meters) and settled onto the runway a second time.

The pilot observed an "almost immediate drag" on the tailwheel. The pilot closed the throttle and began to brake. Then, as the airplane slowed, he released the brakes to prevent skidding and pulled the mixture to idle. When the tailwheel was on the ground, the pilot lost forward vision, and the aircraft crossed the centerline onto softer ground in a wet area of the airstrip. The nose pitched down, and the propeller struck the ground.

Unexpected Wind Shift Cited in Runway Accident

Boeing Stearman. Substantial damage. No injuries.

The airplane was being flown to an airport in the United States after the pilot's third short flight of the day in the local area in visual meteorological conditions and gusty winds.

The pilot told investigators that the winds "were acting up" shortly before his early-afternoon landing. While flying the airplane on final approach to Runway 22L, the pilot was told first that the wind was from 140 degrees at 10 knots with gusts; later, he was told that the wind was from 160 degrees at 15 knots.

The pilot said that he conducted a wheel landing and that the airplane rolled a short distance before suddenly turning 90 degrees to the left. The right landing gear collapsed, and the right lower wing was bent. The pilot said that he encountered a wind phenomenon that was so abrupt that he was unable to make any corrections.

VFR Flight Into IMC Conditions Cited in Mountain Accident

Piper PA-32-300. Airplane destroyed. Three fatalities.

Instrument meteorological conditions (IMC) prevailed, and the non-instrument-rated pilot received two weather briefings before the accident flight advising that visual flight rules (VFR) flight was not recommended.

The forecasts were for continued IMC, mountain obscurement, turbulence and icing conditions along the route of flight. No witnesses observed the takeoff, but a search began after the airplane failed to arrive at the pilot's planned destination on time. The airplane was found about 10 days later on the side of a mountain peak in the United States. Examination of the wreckage revealed no evidence of mechanical malfunction, and investigators said that the probable cause of the accident was the pilot's continued VFR flight into IMC. Related factors were flight into known adverse weather, the adverse weather, mountain obscuration, snow, icing and high density altitude. (Density altitude had been calculated to be 13,248 feet.)

Rotorcraft

Fueling Procedures Cited in Helicopter's Engine Failure

Hughes 369HS. Substantial damage. No injuries.

The helicopter was landed at an airport in Australia for refueling. The fuel agent told the pilot that Jet A-1 fuel was not available. The pilot said that the operator's maintenance organization had told him that aviation-grade gasoline (avgas) was an acceptable alternative.

After refueling with avgas, the pilot performed a preflight inspection before his early-afternoon takeoff and then conducted a circuit of the airport to ensure that the engine was operating properly. The pilot then prepared to resume his cross-continent ferry flight. As the helicopter reached about 500 feet, the pilot turned off the fuel start pump switch, and the engine failed.

The pilot said that he conducted an autorotation, turned on the start pump and declared mayday. The helicopter received substantial damage during the landing, but the pilot was not injured.

The helicopter flight manual included a warning that "when using alternate fuel mixtures or emergency fuels, the start pump should remain on until the engine is shut down."

Because avgas has a higher vapor pressure than jet fuel, it is susceptible to vapor lock in the helicopter's vacuum-type fuel system. The pilot said that the maintenance organization had not advised him of the fuel-pump requirement and that the warning was not included in the flight manual available in the aircraft. The helicopter manufacturer said that the instruction was issued in 1998; the operator "was unable to provide a reason for the failure to incorporate the amendment relating to the use of alternative fuels in the helicopter's flight manual."

The investigation also determined that the fuel-filter element's outer fine-mesh screen was "substantially blocked" with corrosion byproducts from the mesh-filter element and that some of the screen pleats at the bottom of the filter element had cracked. An analysis determined that the corrosion may have been caused by sulfur-bearing compounds in Jet A-1 fuel. Normally, the blockage would have triggered the fuel-filter caution light, but the crack in the filter-element pleat may have been large enough to permit fuel to pass through and not create enough pressure differential to trigger the caution light.

Uncommanded Right Yaw Prompts Emergency Landing

Bell 206L-3. Substantial damage. No injuries.

A test flight was conducted after an engine was replaced. The helicopter then was flown in a search for a missing police officer. Winds were reported at 15 knots, with gusts to 24 knots during the afternoon flight in visual meteorological conditions. The crew reported that the flight to the search area from an airport in the United States was uneventful. After several orbits of the area and some hover work by the helicopter, the missing police officer was located in a swamp.

The pilot hovered the helicopter, then prepared for a high orbit, but as the pilot initiated a right turn, an uncommanded right yaw occurred, accompanied by a "high engine-whine sound." When application of the left rudder pedal failed to stop the rotation, the pilot lowered the collective and turned right in an effort to fly out of the rotation. After the helicopter made three 360-degree turns to the right, the pilot closed the throttle to idle and conducted an autorotation.

The helicopter came to rest next to a tree, with branches cut about 15 feet (4.6 meters) from the base. The helicopter's tail boom was bent downward about 10 degrees about 15 inches (38 centimeters) from the fuselage, there was no evidence of either a main-rotor impact or a tail-rotor impact with the tail boom, and the 90-degree gearbox was intact. The horizontal stabilizers were not damaged. The high skid landing gear was attached to the airframe but had been crushed. Both main-rotor blades were scored along their entire lengths and had deep dents.

Inspection of the helicopter revealed no evidence of pre-impact malfunction.

Engine-off Landing Demonstration Ends in Hard Landing

Schweizer 330. Substantial damage. One minor injury.

The captain was demonstrating an engine-off landing during an afternoon flight from an airport in England. He began to conduct an autorotation, but as the helicopter descended to about 300 feet above ground level, the indicated airspeed suddenly decreased. The captain eased the cyclic control forward to increase airspeed, but the rate of descent increased, and the helicopter struck the ground and rolled onto its right side.

The right-seat passenger kicked out the front canopy and all three occupants climbed out of the helicopter.

The captain, who normally flew turbine helicopters, was accustomed to a low rotor-revolutions-per-minute (rrpm) warning horn that indicated when to lower the collective. But in this type of helicopter, the low rrpm warning system does not sound an alarm when the throttle is in idle. Glare from the sun prevented the captain from reading the rrpm gauge.

"It would appear that on rollout from the turn with some collective applied (low rrpm) and low airspeed in conjunction with a larger wind shear factor — a heavy landing was inevitable."♦

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