FLIGHT SAFETY FOUNDATION

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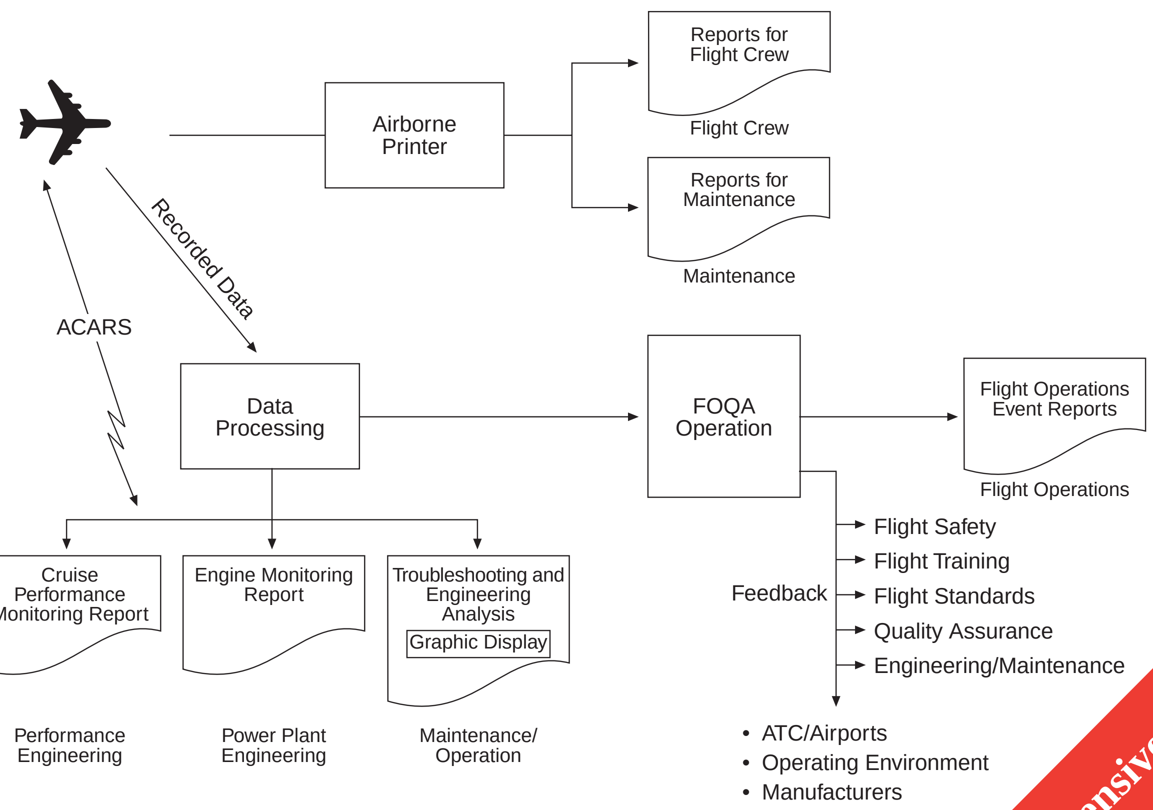
FLIGHT SAFETY DIGEST

Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs



FSF's Comprehensive FOQA Overview

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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.

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Foreword

This *Flight Safety Digest* presents the status of flight operational quality assurance (FOQA) programs in the United States as of early September 1998. FOQA has been broadly defined as a program for obtaining and analyzing data recorded in flight operations to improve flight-crew performance, air carrier training programs, operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design. A December 1997 report by the U.S. General Accounting Office has been updated in this issue by the FSF editorial staff, who also have included their in-depth reports on the details that surround this extraordinary safety tool.

For nearly a decade, the Foundation has supported vigorously the wider use of FOQA. In 1989, the Foundation presented a workshop in Taiwan that discussed the benefits of FOQA programs, and prompted it to encourage the adoption of FOQA throughout the aviation community. In April 1990, another FSF workshop focused on the development of FOQA programs in the United States; more than a hundred participants from 17 nations attended the meeting in Washington, D.C., where FOQA users among the Foundation's international membership discussed the enormous benefits of their programs. The Washington meeting was a catalyst for U.S. FOQA implementation.

In 1993, under contract to the U.S. Federal Aviation Administration (FAA), the Foundation completed a comprehensive study of FOQA and published its findings in *Air Carrier Voluntary Flight Operational Quality Assurance Program.* The bottom line: U.S. air carriers were urged to adopt FOQA, and a plan was presented for FOQA implementation in the United States. Moreover, we advocate that this powerful accident-prevention tool should be part of an integrated aviation system that includes internal evaluations, safety-action programs, voluntary-disclosure reporting programs and other safety enhancements.

The Foundation's report has been the blueprint for FOQA progress in the United States. The lack of codified protection of FOQA data from use for purposes other than safety and operational enhancement, however, continues to generate tension and slow progress of FOQA implementation. Nevertheless, FAA, pilots, unions and air carriers agree that data protection is essential to achieve the ultimate benefit of FOQA in the United States, and there is a general belief that the issue will be resolved satisfactorily, as it has been in other countries.

The Foundation continues to call for implementation of FOQA, not only in the United States but also throughout the world.

— Stuart Matthews
Chairman, President and CEO
Flight Safety Foundation

Aviation Safety: U.S. Efforts to Implement Flight Operational Quality Assurance Programs

A recent report to the U.S. Congress by the General Accounting Office describes how the U.S. Federal Aviation Administration and four U.S. airlines have implemented flight operational quality assurance programs. The report examines how FOQA enhances aviation safety, the costs and benefits, factors that impede implementation, and actions to overcome impediments.

U.S. General Accounting Office

In a summary of the December 1997 report, *Aviation Safety: Efforts to Implement Flight Operational Quality Assurance Programs*, the U.S. General Accounting Office (GAO) noted:

- The early experience of domestic airlines with established FOQA programs [flight *operational* quality assurance and flight *operations* quality assurance are used interchangeably to describe the same programs], as well as the testimony of [non-U.S.] airlines with extensive experience in this area, attests to the potential of such programs to enhance aviation safety by identifying possible safety problems that could lead to [incidents or] accidents;

- Airlines have used FOQA programs to identify problems that were previously unknown or only suspected;

- Where problems were already known, airlines have used these programs to confirm and quantify the extent of the problems;

- On the basis of analyses of flight data, airlines have taken actions to correct problems and enhance aviation safety;

- Costs associated with implementing a FOQA program depend on a large number of factors, including the technology used to capture flight data, the number and types of aircraft to be equipped with this technology, and personnel costs;

- Although the program is primarily viewed as a safety program, U.S. and [non-U.S.] airlines have reported financial benefits as well;

- With additional data on aircraft systems and engine conditions, airlines are better able to achieve optimum fuel consumption and avoid unneeded engine maintenance;

- Enhanced safety should result in lower costs over time as a result of [incidents or] accidents avoided and lower insurance premiums;

- FAA's [the U.S. Federal Aviation Administration's] estimates suggest net savings from 50 aircraft of US$892,000 per year;

- The primary factor impeding the implementation of FOQA programs among the major domestic carriers is the [non]resolution of data-protection issues;

- Airline managers and pilots raise three significant data-protection concerns (use of data for enforcement and disciplinary purposes, disclosure to the media and the public under the provisions of the [federal] Freedom of Information Act [FOIA], and disclosure through the civil litigation discovery process);

- FAA has taken a number of actions that may resolve these issues, although it is not clear whether the aviation community will be satisfied with FAA's actions;

- FAA has begun work on a rule-making procedure to establish what protections from enforcement actions, if any, will apply to information submitted to FAA under a FOQA program;

- Congress enacted legislation, and FAA has begun work on a rule-making procedure, that would prohibit the [FAA] Administrator from disclosing voluntarily submitted safety information under certain circumstances; and,

- Airlines seek to protect voluntarily collected safety information from disclosure in civil litigation on a case-by-case basis.

[FSF editorial note: The GAO report continues with the following letter of Dec. 2, 1997, from John H. Anderson Jr., GAO director, transportation issues, addressed to U.S. Sen. Wendell H. Ford and U.S. Sen. Ron Wyden.]

The analysis of aircraft data recorded during flight has played a crucial role in determining the causes of [aircraft accidents]. Recently, however, some U.S. airlines have begun to analyze flight data from uneventful flights to identify problems and correct them before they lead to incidents or accidents. In your letter of Dec. 2, 1996, you asked [GAO] to examine efforts by [FAA] and U.S. airlines to implement [FOQA] programs.

The objective of a FOQA program is to use flight data to detect technical flaws, unsafe practices, or conditions outside of desired operating procedures early enough to allow timely intervention to avert accidents or incidents. These programs are voluntary efforts by airlines that involve equipping aircraft with specialized devices to continuously record up to hundreds of different flight-data parameters from aircraft systems and sensors, analyzing the data, identifying trends, and taking action to correct problems. The analysis of flight data allows airlines to reconstruct entire flights on the basis of the values over time of flight-data parameters such as heading, altitude, throttle settings, groundspeed and many others. Currently, about 33 [non-U.S.] airlines and four U.S. airlines — Alaska Airlines, Continental Airlines, United Airlines and US Airways — have implemented FOQA or FOQA-type programs.

You requested that [GAO] determine how FOQA programs will enhance aviation safety, the costs and benefits of such programs and the factors that could impede their full implementation, and actions that could be taken to overcome any impediments.

Results in Brief

The early experience of domestic airlines with established FOQA programs, as well as the testimony of non-U.S. airlines with extensive experience in this area, attests to the potential of such programs to enhance aviation safety by identifying possible safety problems that could lead to incidents or accidents. Airlines have used FOQA programs to identify problems that were previously unknown or only suspected. Where problems were already known, airlines have used these programs to confirm and quantify the extent of the problems. And most important, on the basis of analyses of flight data, airlines have taken actions to correct problems and enhance aviation safety.

> ***Airlines have used FOQA programs to identify problems that were previously unknown or only suspected. Where problems were already known, airlines have used these programs to confirm and quantify the extent of the problems.***

The costs associated with implementing a FOQA program depend upon a large number of factors, including the technology used to capture flight data, the number and types of aircraft to be equipped with this technology, and personnel costs. Although the program is primarily viewed as a safety program, U.S. and non-U.S. airlines have reported financial benefits. With additional data on aircraft systems and engine conditions, airlines are better able to achieve optimum fuel consumption and avoid unneeded engine maintenance.

Although more difficult to quantify, enhanced safety should result in lower costs over time as a result of [incidents or] accidents avoided and lower insurance premiums. FAA's preliminary estimates place the annual cost of a U.S. program with 50 aircraft at approximately $760,000. Savings from reduced expenditures for fuel, engine maintenance, and accident costs for a 50-aircraft program are estimated at $1.65 million per year. FAA's estimates suggest a net saving from 50 aircraft of $892,000 per year.

[FSF editorial note: In August 1998, Thomas M. Longridge, manager of FAA's Advanced Qualification Program (AQP) and the FOQA demonstration project (DEMOPROJ), said that an ongoing study of operational costs generally supports these estimates. The AQP is an alternate method of qualifying, training, certifying and ensuring the competence of flight crewmembers and other operations personnel under U.S. Federal Aviation Regulations (FARs) Part 121 and Part 135.]

> The primary factor impeding the implementation of FOQA programs among the major domestic carriers is the [non]resolution of data-protection issues. Airline managers and pilots raise three significant data-protection concerns: use of the data for enforcement/disciplinary purposes; disclosure to the media and the public under the provisions of FOIA; and disclosure through the civil-litigation discovery process.
>
> FAA has taken a number of actions that may resolve these issues, although it is not clear whether the aviation community will be satisfied with FAA's actions. First, FAA has begun work on a rule-making procedure to establish what protections from enforcement actions, if any, will apply to information submitted to FAA under a FOQA program. Second, on Oct. 9, 1996, the Congress enacted legislation, and FAA has begun work on a rule-making procedure that would prohibit the [FAA] Administrator from disclosing voluntarily submitted safety information under certain circumstances. These actions may ameliorate concerns about FOIA. And third, airlines currently seek to protect voluntarily collected safety information from disclosure in civil litigation on a case-by-case basis.

"The primary factor impeding the implementation of FOQA programs among the major domestic carriers is the [non]resolution of data-protection issues."

[FSF editorial note: FAA's Longridge said in August 1998 that FAA's continuing efforts to address regulatory issues for FOQA and FOIA are separate but interrelated. "FOQA and FOIA will be addressed by separate notices of proposed rule making (NPRMs)," he said.]

Background

Modern commercial aircraft contain sophisticated electronic systems that gather, process and manage digital data on many aspects of flight. These data originate from various systems and sensors throughout the aircraft. The data range from pilot operations to the outputs of sensors and systems. Some of these data are continuously recorded by the aircraft's digital flight-data recorder [DFDR, commonly referred to as the "black box"] to help investigators understand what happened if the aircraft is involved in an accident or a serious incident. (The U.S. National Transportation Safety Board, the official source of information on airline accidents, defines accidents as events in which individuals are killed or suffer serious injury, or the aircraft is substantially damaged; incidents are defined as occurrences other than accidents associated with the operation of an aircraft that affect or could affect the safety of operations.) Designed to survive aircraft accidents, DFDRs typically retain the data recorded during the last 25 hours of flight.

Rather than analyzing flight data only after an accident or incident, some airlines routinely analyze the flight data from [routine] flights. Their aim is to identify problems that occur in normal operations and to correct these problems before they contribute to accidents or incidents. In its [study completed in 1993] for FAA, Flight Safety Foundation coined the term "flight operational quality assurance" to describe this function. The Foundation defined FOQA as "a program for obtaining and analyzing data recorded in flight to improve flight-crew performance, air carrier training programs and operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design."

FOQA has its origin in the use of FDRs as mandated by the U.S. Civil Aeronautics Administration in 1958. Although the first FDRs captured only six parameters (time, airspeed, heading, altitude, vertical acceleration and time of radio transmission), they were a valuable tool for reconstructing what had occurred preceding [an accident]. In addition to recording data to assist in [accident] investigations, some airlines began to monitor data recorded on routine flights. Initially, the monitoring systems captured airworthiness data, but over time they have expanded to include operational data.

FOQA programs were established first in Europe and Asia, and only within the past few years have some U.S. airlines begun adopting such a system on a trial basis. At present, about 33 [non-U.S.] airlines and four U.S. airlines — Alaska Airlines, Continental, United and US Airways — have implemented FOQA or FOQA-type programs. (See Appendix I [page 22] for more detailed background information on FOQA and U.S. airlines' experience with the programs.) [See Table 1, page 4 for a list of the airlines using FOQA.]

As part of FAA's strategy to achieve significant reductions in aviation accident rates despite the rapid increase in air travel anticipated during the next decade, in 1995 the agency initiated a FOQA demonstration project to promote the voluntary implementation of FOQA programs by U.S. airlines. The objective of such a program is to use flight data to detect early enough technical flaws, unsafe practices or conditions outside of desired operating procedures to allow intervention to avert accidents or incidents. For example, identifying repeated instances of unstabilized approaches to

Table 1
U.S. and Non-U.S. Airlines with FOQA or FOQA-type Programs

Adria Airways	Emirates The International Airline of the United Arab Emirates
Aeroflot Russian International Airlines	Ethiopian Airlines
Air Afrique	EVA Airways
Air France	Garuda Indonesia
Air Inter [now part of Air France Europe]	GB Airways
Air Liberte	Gulf Air
Alaska Airlines	Japan Airlines
All Nippon Airways	KLM-Royal Dutch Airlines
Asiana Airlines	Kuwait Airways
Balkan Bulgarian Airlines	Lufthansa German Airlines
Britannia Airways	Qantas Airways
British Airways	Saudi Arabian Airlines
British Midland Airways	Scandanavian Airlines System (SAS)
Cathay Pacific Airways	Singapore Airlines
China Airlines	TAP Air Portugal
China Southern Airlines	Thai Airways International
China Southwest Airlines	United Airlines
Continental Airlines	US Airways
	Wideroe's Flyveselskap

[FSF editorial note: This table appeared as Appendix II in the original report. The list may not be complete.]

Source: GAO and The Flight Data Co.

a particular airport could help to define a new approach procedure less likely to lead to an accident under adverse conditions, or to improved pilot training. Such a system has potentially broad application to flight crews' performance and training, aircraft operating procedures, air traffic control procedures, aircraft maintenance, and airport design and maintenance. Major airlines in Europe and Asia, as well as the U.S. airlines that have FOQA programs, are uniform in their support of the program.

How FOQA Works

FOQA involves capturing and analyzing flight data to determine if the pilot, the aircraft's systems, or the aircraft itself deviated from typical operating norms; identifying trends; and taking action to correct problems. Airlines with FOQA programs typically use a device called a quick-access recorder (QAR) to capture flight data onto a removable optical disk that facilitates the data's frequent removal from the aircraft. (These data typically include the parameters required to be collected on the aircraft's DFDR plus many more parameters; see Appendix I [page 22], for more information on QARs and DFDRs.)

Periodically, the optical disks are removed from the aircraft and the flight data are analyzed by the ground analysis system at a centralized location. The data are analyzed by a computer system that evaluates about 40 to 80 predefined events for deviations from the airline's specified tolerance thresholds. For example, an event might be the descent rate during approach. Deviations of more than certain predetermined values — called exceedances — are flagged and evaluated by a monitoring team. After investigating these exceedances to determine their validity and analyzing them to understand possible causes, the monitoring team will propose and evaluate corrective actions. Periodically, airlines aggregate exceedances over time to determine and monitor trends. (For a more complete discussion of FOQA operations, see Appendix I [page 22].)

FOQA Demonstration Project

In July 1995, FAA initiated a three-year, $5.5 million demonstration project to facilitate the start-up of voluntary airline FOQA programs and to assess the costs, benefits and safety enhancement associated with such programs. FAA provided hardware and software to each of the three airlines — Continental, United and US Airways — that have implemented FOQA programs according to the demonstration project's requirements.

[FSF editorial note: Alaska Airlines met the demonstration project's requirements to receive hardware and software from FAA in April 1998.]

FAA purchased QARs to equip 15 Boeing 737 aircraft at each of the three airlines. FAA also purchased a ground analysis system — the computer hardware and software for analyzing and visualizing FOQA data — for US Airways and Continental. Because United already had purchased a ground analysis system that analyzes these data for other types of aircraft, FAA purchased for the airline the additional software required to analyze FOQA data from B-737s. For their part, these airlines funded the cost of obtaining supplemental type certification of the airborne equipment, the costs of installation and maintenance, and the cost of personnel to run and monitor the program (an FAA type certificate is issued when an aircraft, aircraft engine, propeller or appliance is properly designed and manufactured, performs properly, and meets the regulations and minimum standards prescribed by the [FAA] Administrator; an FAA supplemental type certificate is required when there is a change to an aircraft, aircraft engine, propeller or appliance).

Alaska Airlines is the fourth U.S. airline to have begun a FOQA program, but it has only recently met the demonstration project's requirement for an agreement on FOQA by the [airline pilots'] union. Consequently, the project has not yet provided any equipment to the airline. Alaska Airlines, however, received QARs and a ground analysis system from the FAA Structural Loads Program and uses this equipment to operate its FOQA program. (See Appendix III [page 32] for more information on the Structural Loads Program.)

[FSF editorial note: The Structural Loads Program, part of the FAA's Aging Aircraft Research and Development Program, is a cooperative effort of FAA and the U.S. National Aeronautics and Space Administration (NASA) to collect information about the external loads to which aircraft components are subjected during flight.]

Other airlines that are participating in the demonstration project and are considering the implementation of a FOQA program are America West Airlines, Continental Express, Delta Air Lines, Northwest Airlines, Southwest Airlines, Trans World Airlines and United Parcel Service Co. (See Appendix I [page 22] for a detailed description of the FAA demonstration project. Although not a participant in the demonstration project, American Airlines is considering the implementation of an internal FOQA-type program.) As a research and development effort of the FOQA initiative, [under contract to the FAA, NASA] is developing the Aviation Performance Measuring System (APMS), an advanced system for conducting automated analysis and research on FOQA data. (See Appendix III [page 32] for a description of this system and FAA's other related technical programs.)

[FSF editorial note: FAA's Longridge said in August 1998, "There have been no new implementations of FOQA in 1998, although a number of airlines that have been in the planning stage are now poised to begin program implementation."]

Rather than requiring airlines to implement FOQA, FAA has chosen to promote the initiative through a cooperative demonstration project in partnership with the industry. According to [Longridge,] the demonstration project's program manager, it would be premature for FAA to mandate FOQA at this time because U.S. aviation is in the early stages of developing FOQA and is primarily in a learning mode. The program manager contends that a mandated program would stifle innovation, encounter substantial resistance from airlines and pilots, and most likely result in minimal compliance. Thus, at present FAA is working with the industry to raise interest in the concept, facilitate the design and implementation of voluntary FOQA programs, provide financial and technical assistance, and foster innovation.

[FSF editorial note: FAA's Longridge said in August 1998, "There has been no change, nor is any change contemplated, regarding FAA's position that FOQA should remain a voluntary program."]

FOQA Identifies Safety Problems

The primary characteristic that distinguishes FOQA from other safety reporting programs, such as the [NASA] Aviation Safety Reporting Program [ASRP] or [various FAA] Aviation Safety Action Programs (ASAPs) is that FOQA provides objective, quantitative data on what occurs during flights rather than what is subjectively reported by individuals. Instead of relying on perceived problems or risks, FOQA yields precise information on many aspects of flight operations, and this information can be used to help evaluate objectively a wide range of safety-related issues.

[FSF editorial note: ASRP was established by FAA in 1975 and is administered by NASA to promote the voluntary reporting of problems to the Aviation Safety Reporting System (ASRS) database. FAA ASAPs established incentives to encourage employees of air carriers to voluntarily disclose information about potential safety problems and to identify possible violations of the FARs without fear of punitive legal enforcement sanctions. FAA's Longridge said that the ASAP is a formally designated program for which FAA has published an advisory circular and which involves an FAA representative as a member of an event-review team. U.S. airlines also may elect to establish their own internal employee self-reporting programs, separate from the formal reporting requirements of an ASAP. See Appendix IV (page 33) for more details of these programs.]

U.S. and [non-U.S.] airlines have reported on previously unknown or suspected problems for which FOQA has provided objective information that resulted in corrective actions.

One airline found through its FOQA program that more exceedances occurred during visual flying than during instrument flying. This finding prompted the airline's flight-training managers to rethink the relative emphasis given visual and instrument flying in the airline's training programs.

Another airline's FOQA analysis confirmed that the incidence of descent-rate exceedances during approaches was significantly higher at a particular runway at a U.S. airport than at other runways. After investigating the problem, the airline concluded that the air traffic control approach [procedure required] pilots to descend more steeply than usual during their final approach. When the airline shared its findings with FAA management, the approach was modified to correct this problem.

For landings, some airports' air traffic control procedures require pilots to approach high and fast and then descend steeply. These approaches can result from a number of factors, including noise-abatement rules, traffic volume, terrain or weather conditions. Although airline managers know about the situations from pilots' reports, FOQA provides the quantitative information to demonstrate the extent of this problem at the various airports. With these data in hand, managers can be more effective in addressing the problem and taking action to reduce or eliminate risks.

FOQA can also help airlines determine the frequency of certain occurrences rather than relying on human judgment, particularly for the level of maintenance required. Two examples of these types of occurrences are hard landings and exceedances in engine temperatures. Prior to FOQA, airlines generally relied on pilots' judgment of the necessity for corrective action if a hard landing occurred or an engine overheated. FOQA, however, can provide better information on the amount of force the aircraft experienced during a hard landing. Similarly, FOQA gives more data on the engines' temperatures and the duration of overheating in some aircraft than were previously available without FOQA. With these data, managers can make more informed decisions about whether an aircraft needs to be inspected to check for structural damage or whether an engine needs to be overhauled.

U.S. and [non-U.S.] airlines have reported that they have used FOQA analysis to identify a variety of safety problems and take action to resolve or mitigate them. These have included [excessive rotation on takeoff], which can damage the aircraft's tail; approaches that are outside the prescribed procedures for a stabilized approach; descent rates or bank angles that are considered excessive; high taxi speeds; hard landings; wind-shear occurrences; ground-proximity warnings; and engine malfunctions. Corrective action can include notifying pilots of a change in standard operating procedures or restating and emphasizing them, correcting an equipment problem, or providing additional training. The continued monitoring of trends will show the airline if the corrective action has been effective or if additional measures are needed.

A number of airlines plan to complement the use of FOQA data with information from safety-reporting systems, such as ASAPs or internal pilot reporting systems. FOQA data, originating from aircraft sensors and systems, tell "what" happened to the aircraft. Internal safety-reporting systems, based on reports of pilots, flight crews and other persons, are more likely to tell "why" something happened. Together, information from FOQA and internal reporting systems can provide valuable insight into current and emerging problems.

FOQA's Potential Costs and Benefits

Based on preliminary estimates from an ongoing cost-benefit study by Universal Technical Resource Services Inc. (UTRS), an FAA contractor, Table 2 summarizes the estimated annual costs for airlines to equip 15, 50 and 100 aircraft with QARs, purchase a ground analysis system, and pay FOQA-related salaries. (Because FAA's cost-benefit study is in progress, the GAO was not able to verify FAA's estimates of FOQA costs and savings; the cost and savings figures are preliminary and may change as more data are gathered.)

[FSF editorial note: FAA's Longridge said in August 1998 that the cost-benefit study, part of a forthcoming technical report by UTRS, is expected to show FOQA operational costs similar to the preliminary estimates used in this GAO report.]

The cost-benefit study estimates that airlines will reduce their expenditures for fuel and maintenance as well as reduce the number of accidents and incidents over time, avoiding their associated costs. Because FOQA programs analyze additional data on aircraft systems and engine conditions, airlines are better able to achieve optimum fuel consumption and avoid unneeded engine maintenance. Although more difficult to quantify and directly relate to a FOQA program, enhanced safety should result in lower costs over time as a result of accidents avoided and lower insurance premiums. Table 3 summarizes the estimated annual savings for fleet sizes of 15, 50 and 100 aircraft. Fuel-savings [figures] and engine-savings figures are based on estimates of a one-half percent reduction in fuel consumption and a one percent reduction in engine maintenance costs. The safety-savings figure is based on a hypothetical one percent reduction in the annual costs incurred from accidents. [UTRS] based its safety-savings calculation on a current loss rate of two aircraft per million departures at a cost of $150 million for each loss.

Table 2
Estimated Total Annual Costs Of FOQA, By Fleet Size

	15 aircraft	50 aircraft	100 aircraft
Equipment costs	$98,500	$259,000	$492,000
Personnel costs	385,000	500,000	775,000
Total annual costs	**$483,500**	**$759,000**	**$1,267,000**

Note: Costs are shown in U.S. dollars. Equipment costs are based on the invoice price paid to vendors in the FOQA demonstration project. To annualize the figures, the equipment purchase costs have been spread over a five-year period. Personnel costs are based primarily on estimates of FOQA management, analysis, monitoring and engineering costs from an airline participating in the demonstration project.

FOQA = flight operational quality assurance

Source: Universal Technical Resource Services

Table 3
Estimated Total Annual Savings From FOQA, By Fleet Size

	15 aircraft	50 aircraft	100 aircraft
Fuel savings	$145,800	$486,000	$972,000
Engine savings	300,000	1,000,000	2,000,000
Safety savings	49,500	165,000	330,000
Total annual savings	**$495,300**	**$1,651,000**	**$3,302,000**

Note: Savings are shown in U.S. dollars. Fuel and engine savings were estimated on the basis of discussions with an airline participating in the FOQA demonstration project. Safety savings were estimated on the basis of information from a European airline with a long-term FOQA program. Savings estimates were also based on an assumption of 3,000 flight hours per aircraft per year.

FOQA = flight operational quality assurance

Source: Universal Technical Resource Services

According to these annual cost and savings estimates, FOQA would result in net annual savings of $11,800 for 15 aircraft, $892,000 for 50 aircraft and $2,035,000 for 100 aircraft. See Table 4.

[FSF editorial note: See "Pilot Union Encourages Use of FOQA Programs," page 8.]

Table 4
Estimated Net Annual Savings From FOQA, By Fleet Size

	15 aircraft	50 aircraft	100 aircraft
Total annual costs	$483,500	$759,000	$1,267,000
Total annual savings	495,300	1,651,000	3,302,000
Net annual savings	**$11,800**	**$892,000**	**$2,035,000**

Note: Costs and savings are shown in U.S. dollars.
FOQA = flight operational quality assurance

Source: Universal Technical Resource Services

Factors Impeding Implementation and Actions to Overcome Impediments

Although airline officials, pilot organizations and FAA officials recognize the potential for improving safety and operations through FOQA programs, airline officials and representatives of the pilot organizations were unanimous in their view that data-protection issues need to be resolved. Both airline officials and pilots' representatives stated that the lack of protections for FOQA data has been a major contributor to pilot unions' reluctance to sign FOQA agreements with airlines, and airlines' reluctance to implement FOQA programs.

According to the Foundation's [1993] report, the greatest impediment to the implementation of FOQA in the United States is associated with the "protection of data from use for other than safety and operational-improvement purposes." Basically, airline managers and pilots have three concerns: that the information may be used in enforcement/discipline actions; that such data in the possession of the federal government may be obtained by the public and the media through the provisions of FOIA; and that the information may be obtained in civil litigation through the discovery process. Similar concerns have been expressed in connection with other programs under which information is submitted voluntarily to FAA.

Enforcement

Representatives from each of the major airlines as well as the unions that represent pilots from the major airlines — Air Line Pilots Association International (ALPA); Allied Pilots Association; Independent Association of Continental Pilots; and Southwest Airlines Pilot Association — said that the airlines and pilots fear the possibility that FOQA data might be used against them in FAA enforcement proceedings. In addition to these concerns, pilots' representatives were concerned that airline managers could use FOQA data to punish or discipline pilots.

FAA Enforcement

Many U.S. airlines and their pilots appear frustrated with FAA's delay in issuing a regulation implementing the nonenforcement policy articulated in a February 1995 policy letter from [then] FAA Administrator [David R. Hinson] to ALPA and the Air Transport Association of America (ATA). FAA's letter said that no enforcement action will be taken on the basis of the information gained through FOQA.

Specifically the letter stated:

> [FOQA entails the collection of digital flight data from line operations on a routine basis. This is achieved by an onboard flight-data recording system other than that required by the Federal Aviation Regulations (FARs). We are in full agreement that FOQA programs can substantially enhance aviation safety and that their introduction into U.S. air-carrier operations would clearly be in the public interest. This letter is intended to clarify FAA enforcement policy with regard to such programs.
>
> It will be FAA policy to encourage voluntary airline collection of digital flight-recorder data to monitor line operations on a routine basis, concomitant with the establishment of explicit internal procedures for taking corrective action that analysis of such data indicates is necessary in the interest of safety. For policy purposes, the FAA shall consider only programs obtaining both of these elements to constitute FOQA.]
>
> The FAA commits that it will not use information collected by a carrier in a FOQA program to undertake any certificate or other enforcement action against an air carrier participating in such a program or one of its individual employees. Notwithstanding, the FAA reserves its right to use, for any other purpose, information obtained from sources other than FOQA, including flight-recorder parameters specifically required by the FARs. The limitation on the use of information applies only to information collected specifically in a FOQA program.
>
> [The FAA understands that the airlines plan to retain all information that is gathered pursuant to the FOQA program, but that the FAA would be able to examine de-identified aggregate information at the carrier's

(continued on page 10)

Pilot Union Encourages Use of FOQA Programs

FSF Editorial Staff

The Air Line Pilots Association International (ALPA) has strongly endorsed flight operations quality assurance (FOQA) programs, said John O'Brien, ALPA's director of engineering and air safety. A principal reason is that analyses of FOQA data help to corroborate reports by individual pilots about safety and operational issues.

"In the past, we sometimes had no information to scientifically or rationally back up our reports, so we were looking for some way to substantiate the safety issues that we brought to the airlines or to the [U.S.] Federal Aviation Administration [FAA]," said O'Brien. "To do that properly, we wanted to have a direct role in the collection and analysis of the data that create the information. That's one of the reasons why you see heavy participation by ALPA pilots in FOQA programs."

O'Brien said that one example of how FOQA information can support pilot reports would be showing how handling of flights by air traffic control (ATC) has caused unstabilized approaches. ALPA has been able to document exact altitudes, airspeeds, and how unstable approaches occurred by comparing FOQA information with ATC-facility radar and communications data, he said. Similar documentation prompted FAA to install a glideslope on a runway at one airport when the information showed that safety would be enhanced, said O'Brien.

"There will always be something we can learn from FOQA."

Among the greatest advantages of FOQA is that it becomes a built-in tool to monitor virtually any change in the aviation system, said O'Brien.

"There will always be something we can learn from FOQA," said O'Brien. "Any time you introduce something new into the system — whether it's a new airplane, a new airport or a new operating technique — the inherent capability to analyze any change produced is a benefit in itself. Before FOQA, we did not have a good way to do the kind of analysis that's necessary to truly evaluate what impact a procedural change, or a new piece of hardware or software installed on an airplane or at an ATC facility, might have — or even something as simple as a change in terminology."

In airline training departments, FOQA information also has helped to reconcile differences of opinion about training priorities between FAA or airline training staff and line pilots.

"At times, we don't feel that the type of training given is appropriate for the task, or that the amount of training or priority [placed] on a particular type of training is appropriate," said O'Brien. "As a result, there have been some very contentious discussions. We felt that if we were able to document some of the concerns, there would be a significant improvement in understanding and in the overall line operations."

Although investigating exceedances in FOQA data can lead to significant safety improvements, O'Brien said that there is interest in learning more about the entire range of normal flight operations.

"We don't have a good grasp today of what is normal," said O'Brien. "When we start getting more airplanes equipped with quick-access recorders (QARs), we could more accurately define normal operations. We use the air traffic controller's handbook, the flight operations manual and the standard operations specifications to define normal today."

The reason this is important is that airlines and pilots have perceived differences between actual flight operations and "operating by the book," said O'Brien.

"We need to define what's normal before we can define what is outside the normal tolerance," he said. "Then we would need to go in and maybe rewrite the controller's handbook. If what we're doing out there normally, 99 percent of the time, is safe, maybe we should write that into our standards. Maybe we would need to change our standards, and if we did, then we would need to change our training, and our training would become much more realistic for the operating environment."

Part of the acceptance of FOQA among line pilots, said O'Brien, has been the pilot-to-pilot approach in taking action based on the analysis of data. The communication among pilots has been an integral part of the FOQA process, which is negotiated with airline management by any ALPA-represented pilot group, he said.

"FOQA works well as long as there's a positive response when exceedance issues are identified and handled by the pilots," said O'Brien. "With such a process, there's very little chance for any undeserved attention on the part of management to an employee based upon FOQA information. Even where an individual pilot or a whole crew might be referred for some additional training or some discussion on a particular topic, it is handled under the existing union processes. As far as we're concerned as an organization, that's not a problem, and that will never be a problem for the pilot groups that we represent. Otherwise, there would be no FOQA program."

ALPA also has been concerned about the ability of vendors to provide software for FOQA data analysis that enables airlines to capture different sets of parameters without costly or time-consuming programming.

"Out of 600 or more potential parameters, you may have a basic list of 100 parameters to 150 parameters that you can or may want to set up," said O'Brien. "You should be able to adjust that list to choose from any of the 600 that are available depending upon what area you want to look at, based upon some information that came from analysis. Right now, it may cost thousands of dollars to change a parameter."

Air carriers that have not implemented FOQA programs often benefit directly or indirectly from other carriers' programs, he said.

"If I were an operator that only had three airplanes, I'd be pushing for FOQA like crazy — but for someone else to do it and to share the information," said O'Brien. "Some FOQA-derived information could be sold — such as the information that a particular carrier would have in developing and implementing an [FAA Advanced Qualification Program (AQP)] training program or engineering information used in developing a supplemental or special type certificate."

O'Brien said that FOQA programs also have the potential to validate the safety and effectiveness of proposals to enhance air traffic flow.

"A lot of capacity-enhancement techniques are out there today — land-and-hold-short operation, PRM [precision-runway-monitor operation], closely spaced parallel-runway operation," he said. "In today's evaluation and demonstration programs, we get a flight crew to fill out a narrative report and get a controller to write something, after the fact. That's not very good, but if you have FOQA, you can do a full evaluation of the cost and the benefits of implementing some of the techniques. That's not something that the airline or the FAA can do by itself; it's something that can be achieved only through a partnership [involving] the pilots, the airline and the FAA."

Benefits of FOQA programs must be balanced with concerns about regulatory enforcement, public disclosure or exposure of data to civil litigation, said O'Brien. He believes that uncertainty about how FOQA data could be used in civil litigation, however, has the greatest potential to impede the implementation of FOQA programs among U.S. airlines.

"Airline management and airline-management pilots who work in safety departments are extremely concerned — much more concerned than we are — about FAA access to their FOQA data," said O'Brien. "However, if a FOQA program is constructed properly, implemented and run the way it should be run, the data stay in the hands of the people who own the data — the airlines. We are all interested in sharing information, as opposed to granting access to data.

"Even though the industry does not yet have a rule concerning the use of FOQA data by the FAA, it only took a matter of a couple of days to get a policy letter [stating that the FAA will not use FOQA data for regulatory enforcement]. So we think we know where the FAA wants to go, [but] only time will tell … we have been working on this for more than four years now."

ALPA has objected strongly whenever airline pilots have been characterized as people who do not want FOQA and who are more concerned about protecting their careers and concealing mistakes from FAA than safety, said O'Brien. He said that pilots see improved safety as the greatest benefit and have concerns about issues that could jeopardize all FOQA programs.

"Recognizing that we can't do much about the discovery process, we've decided that it's a risk we have to take because the potential benefits justify that risk."

"Data protection in civil litigation is of some concern to us, not because it's going to affect an individual ALPA member directly, but because it could kill the FOQA program and all the attendant safety benefits," said O'Brien. "Civil litigation is the most difficult of all of these data-protection issues to address. Recognizing that we can't do much about the discovery process, we've decided that it's a risk we have to take because the potential benefits justify that risk. So we've been encouraging everyone to try to keep FOQA moving."

O'Brien said that everyone debating FOQA issues should keep in mind that in an accident or serious incident, all available information will be obtained by FAA and the U.S. National Transportation Safety Board (NTSB) regardless of pending rules about FOQA.

"There is hesitancy, from the legal perspective, even to collect and have this data available, no matter what the purpose is, unless you can put some protections around the data," said O'Brien. "[Airlines should] analyze the raw data as soon as possible and just keep the trend information. The other part of the FOQA program is to have corrective processes available and to exercise those processes as soon as you find something. So the only information you're keeping shows that you found something, but that also you took action. It's all positive information.

"If you run your FOQA program properly, the identifiable data are going to disappear in a very short period of time. If you do your analysis promptly and properly, all that data then becomes trend information that you would keep on hand. It's not subjective and it's not biased. And it is, in a sense, much more statistically pure [than some data sources] because you have a known population with a known database and parameters. It is information on which discussion can be based and actions can be taken."

O'Brien said that ALPA members have been aware of successful pilot-monitoring and flight-data-analysis programs at European and Asian airlines, and have been in favor of similar safety programs in the United States. Some U.S. airlines, however, have concerns about FOQA becoming part of a punitive mechanism of FAA to enforce regulations, said O'Brien, but he believes that effective use and sharing of FOQA information have the potential to replace a punitive approach to regulatory enforcement.

"If you are demonstrating to the certificating authority that you have the ability on your own to improve your operation, you probably are going to be able to convince the authority to reduce the big-stick approach," said O'Brien.♦

> offices, which information could be used by the FAA for nonenforcement, e.g., safety purposes. We look forward to working with the airlines in this manner.
>
> In 1995, the FAA will initiate a two-year FOQA-concept demonstration study in partnership with industry. Based on the results of that study, the FAA will issue an advisory circular on FOQA programs. The FAA will use information from the demonstration study, as well as experience gained, as a basis for determining appropriate future action regarding the need for and appropriateness of rule making to codify the limitations on the FAA's use of FOQA information.
>
> I hope that this statement of FAA policy on FOQA will be instrumental in encouraging airline participation in such programs. I believe we are all in agreement that the potential benefits to safety are substantial.]

In an April 1997 letter to the ATA's FOQA Steering Committee, the director of FAA's Flight Standards Service said that the 1995 policy letter will remain in effect until the regulation on enforcement is issued. The letter stated that a proposed rule making setting forth FAA's enforcement protection policy should be ready by the end of 1997.

[FSF editorial note: In October 1997, FAA Administrator Jane Garvey said that the agency would issue an NPRM to codify the limitations on the FAA's use of FOQA information; federal officials said in August 1998 that work was continuing on a solution to the regulatory issues of FOQA.]

According to airline officials and a pilot union's representative, FAA's delay in promulgating an enforcement regulation has hampered efforts to reach agreement with some pilot unions and threatens the continuance of agreements already reached. One of the issues facing FAA is how broad the enforcement protection should be. FAA attorneys have concluded that it is beyond the scope of FAA's authority and in violation of its statutory duties to issue a regulation that precludes the agency from taking action if FOQA data reveal that an airplane was not in a condition for safe flight or that a pilot lacked [required] qualifications.

Pilots' representatives, however, have cited the precedent of FAA's cockpit-voice-recorder (CVR) regulation that prohibits the agency from using the record in enforcement actions without exceptions. (The CVR regulation provides that: "the [FAA] Administrator does not use the CVR record in any civil penalty or certificate action." FAA's regulations also provide enforcement protection with some qualifications to information collected under the ASRP. Specifically, the regulation provides that "the Administrator of the FAA will not use reports submitted to [NASA] under the ASRP [or information derived therefrom] in any enforcement action except information concerning accidents or criminal offenses, which are wholly excluded from the Program.")

FAA officials [said] that the agency is trying to find the proper balance between carrying out its enforcement responsibilities and providing incentives for implementing safety programs and sharing information with FAA. In similar programs, such as the [ASRP], Air Carrier Voluntary Disclosure Reporting Procedures (ACVDRP) (see Appendix IV [page 33] for a description of this program) and ASAPs under which safety information is voluntarily submitted, the agency has a policy of addressing alleged violations through administrative actions or forgoing and/or waiving the imposition of any legal enforcement if certain qualifying criteria are met.

These programs are intended to encourage prompt reporting of violations, sharing of important safety information and pilot training to enhance future compliance. While the qualifying criteria differ for each program, these programs exclude actions that are deliberate or [that] demonstrate or raise questions of qualifications. Generally, the parameters of the programs, including the qualifying criteria, are described fully in the governing advisory circular. It is FAA's belief that by offering incentives, such as forgoing legal enforcement actions under certain conditions, more problems may be reported and ultimately corrected than could be discovered through other means, such as inspections.

Airline Enforcement

Airline managers are working with their respective pilot unions to enter into data-use agreements that include individual protection provisions. According to the Foundation study, data-use agreements with pilot associations have existed since FDRs were first implemented by airlines in the late 1950s. Having such an agreement is a precursor to becoming a full partner in the FOQA demonstration project. Generally, these agreements provide, among other things, the company's assurance not to use the recorded flight data for punitive or disciplinary action against a crewmember, or as evidence in any proceeding. Also, to ensure the protection of the company's employees, the data-use agreements generally provide for the de-identification of the information as soon as possible, usually within seven days. This practice ensures the confidentiality and anonymity of the flight crewmembers participating in the program.

[FSF editorial note: Airlines contacted by the Foundation in August 1998 said that concerns remain about enforcement policies in FAA's anticipated NPRM. See "U.S. Airlines in FOQA Demonstration Project Expect Regulations to Protect Uses of Safety Data," page 12.]

FOIA Requests

Both airlines and pilots are concerned that FOQA data could become public and available to the media through FOIA, if such data are provided directly to FAA (currently airlines provide no FOQA data to FAA; rather, FAA reviews aggregated trend information on the airlines' premises).

FOIA sets forth a policy of broad disclosure of government documents to ensure "an informed citizenry, vital to the functioning of a democratic society" (U.S. National Labor Relations Board vs. Robbins Tire & Rubber Co., 1978). The Congress understood, however, that "legitimate governmental and private interest could be harmed by release of certain types of information" (U.S. Federal Bureau of Investigation vs. Abramson, 1982). Accordingly, the act provides for nine categorical exemptions.

In the past, safety information voluntarily submitted to FAA, for example under ACVDRP, has been protected under exemption four of FOIA. Exemption four protects trade secrets and commercial or financial information obtained from a person that is privileged or confidential. Airline officials and pilots' representatives expressed concern that FOQA data may not be protectable under this exemption.

Recently, the Congress enacted the Federal Aviation Reauthorization Act of 1996, which contains a provision that protects voluntarily submitted information under certain circumstances. Specifically, under the provision, notwithstanding any other provision of law, the FAA Administrator is barred from disclosing voluntarily provided safety-related or security-related information if the [FAA] Administrator finds that:

> the disclosure of the information would inhibit the voluntary provision of that type of information and that the receipt of that type of information aids in fulfilling the [FAA] Administrator's safety and security responsibilities; and withholding such information from disclosure would be consistent with the [FAA] Administrator's safety and security responsibilities.

A similar provision was included in the NTSB Amendments of 1996 to protect information that is voluntarily submitted to the Board.

The provision also requires the [FAA] Administrator to issue regulations to implement the section.

The U.S. House of Representatives report accompanying this legislation noted with approval the data-sharing programs such as FOQA and the [U.S. House of Representatives Committee on Transportation and Infrastructure's] intent to encourage and promote these sorts of innovative safety programs. The report provides that information submitted under these programs would arguably be protected from release under exemption four of FOIA; however, the report notes that such a decision to withhold the information would be discretionary with the agency.

The report states that to provide assurance that such information is not publicly released, the legislation would prohibit FAA from disclosing voluntarily submitted safety information. According to the report, this protection should "alleviate the aviation community's concerns and allow the data-sharing safety programs to move forward." Moreover, the report noted that the provision would not reduce the information available to the public, because the public does not receive the data. Rather, the report states that public safety will be enhanced by the increase in FAA's understanding of ongoing trends in operations and technologies.

FAA is currently working on a rule-making procedure that will prohibit the release of voluntarily submitted safety data through FOIA.

(In the Final Report of the White House Commission on Aviation Safety and Security, dated Feb. 12, 1997, a recommendation was made that FAA should work with the aviation community to develop and protect the integrity of standard safety databases that can be shared in accident-prevention programs. The report [said] that FAA needed to expeditiously complete rule making to implement the voluntary-disclosure protection provision, and that the agency should assess the adequacy of the new legislative authority and implementing regulation one year after the regulations take effect. The report [said] that any necessary regulatory or legislative modifications identified at that time should be promptly addressed.)

It is expected that the rule making will provide the procedures that the agency will use in making the required determinations. It is also expected that FOQA data will be proposed as qualifying for the protection. According to an FAA attorney, the determinations for the FOQA program may be included in

U.S. Airlines in FOQA Demonstration Project Expect Regulations to Protect Uses of Safety Data

FSF Editorial Staff

Several U.S. airlines have initiated flight operations quality assurance (FOQA) programs under terms of a 1995 policy letter from the U.S. Federal Aviation Administration (FAA). The policy letter, in general, said that FAA encourages voluntary collection and analysis of digital flight-recorder data with explicit airline policies for taking corrective action to enhance aviation safety. The letter said that FAA would not use FOQA information in punitive regulatory enforcement:

> The FAA commits that it will not use information collected by a carrier in a FOQA program to undertake any certificate or other enforcement action against an air carrier participating in such a program or one of its individual employees. Notwithstanding, the FAA reserves its right to use, for any other purpose, information obtained from sources other than FOQA, including flight recorder parameters specifically required by the Federal Aviation Regulations [FARs]. The limitation on the use of information applies only to information collected specifically in a FOQA program.
>
> The FAA understands that the airlines plan to retain all information that is gathered pursuant to the FOQA program, but that the FAA would be able to examine de-identified aggregate information at the carrier's offices, which information could be used by the FAA for nonenforcement, e.g., safety purposes.

Based on subsequent FAA announcements, the U.S. airline industry has been anticipating changes to the FARs that will codify the limitations on FAA's use of FOQA information. FAA announced in October 1997 that a notice of proposed rule making (NPRM) on FOQA would be published, but federal officials said that as of August 1998, efforts were still under way to reach a satisfactory solution to the need for a more detailed FAA policy on FOQA.

Thomas M. Longridge, manager of the FAA's Advanced Qualification Program (AQP) and the FOQA demonstration project, said that basic issues, including limitations on FAA enforcement based on FOQA information, remain the same as those discussed in the December 1997 report on FOQA by the U.S. General Accounting Office (GAO).

"The GAO report is an accurate presentation of the legal position within the FAA," said Longridge. "Other governmental entities have their own legal positions. There could be differences. The FAA is trying to work out the proper balance."

One NPRM drafted by FAA — known as the Safety Data Protection Rule on public requests for FAA information under the federal Freedom of Information Act (FOIA) — is in direct response to a 1997 recommendation by the White House Commission on Aviation Safety and Security, said Longridge.

Longridge also said that an announced FAA advisory circular on FOQA was almost complete as of August 1998, pending related policy decisions on FOQA. Drawing from the experience of the FOQA demonstration airlines, he said, the FAA is ready to provide useful guidance to other airlines in all areas, except for any regulatory changes that may be proposed.

Three of the 11 U.S. airlines participating in FAA's FOQA demonstration project said that various concerns have been raised in the nine months since FAA announced that there would be an NPRM on FOQA. Managers of the FOQA programs at Alaska Airlines, Continental Airlines and United Airlines made the following comments:

Alaska Airlines expects that FOQA will encourage partnership. Capt. Terry Clark, director of flight safety at Alaska Airlines, said, "Working with the FAA as a partner is extremely appealing to me. The European airlines have used FOQA to solve problems, not to place blame. FOQA will allow us to solve problems with information we have never analyzed before. We're not interested in using FOQA in any context other than flight safety. I have a list of FOQA-based safety recommendations that goes from floor to ceiling — improvements that we have made to our operational system and efficiency."

Clark said that his company has been waiting to see if the advice of the 1997 White House Commission on Aviation Safety and Security will predominate when the FAA issues an anticipated NPRM on FOQA.

"There won't be a single QAR left on any airline if an NPRM comes out the wrong way," said Clark, "The second that FOQA data are available outside of flight safety, it could be very damaging. The flying public deserves a FOQA program at every airline, but only if it is instituted in an atmosphere of open communication with the FAA, which in turn acts responsibly to correct safety issues."

Good communication about safety issues and identification of hazards are the inherent advantages of properly designed FOQA programs, he said. Clark said that Alaska Airlines, however, is concerned that without adequate regulatory protection against inappropriate uses of FOQA data, there is a risk of misunderstanding by people who are not qualified to interpret the data.

"European airlines, which have been analyzing this type of data for the last 30 years, tell us that it takes at least five years to know what your analysis indicates, after an airline starts to collect FOQA [data]," said Clark. "Having been involved in this project at [Alaska Airlines] for only three years, I can say that they are absolutely right."

Continental Airlines expects FOQA to improve flight safety. First Officer Al Baldwin, FOQA program manager at Continental Airlines, said that members of the Independent Association of Continental Pilots have been comfortable with how FOQA data are used to this point.

"The security of FOQA data is a big issue under agreements we have with our pilot union. We are waiting for an FAA NPRM on FOQA rules to protect the confidentiality of FOQA data and govern their use in enforcement," said Baldwin. "It melts down at the legal level to what the FAA's required role is. Some lawyers are not comfortable knowing that an airman transgressed without punishment. Can you abrogate enforcement for the broader goal of a safer aviation system? It's a major battle right now. All the carriers are waiting for regulatory changes before we make big plans for the future. We have a great advocate for FOQA in FAA Administrator Jane Garvey. If we voluntarily submit this kind of data, [aviation will be] a much safer place to be."

United Airlines pilots support the FOQA demonstration program. Capt. Jeff Bayless, manager of FOQA at United Airlines and a former member of the FOQA Committee of the Air Line Pilots Association International, said that he has been "pleasantly surprised" by the high level of FOQA acceptance among line pilots during the FAA demonstration project. One of the reasons, he said, is that flight crews have been protected from FAA enforcement actions based on FOQA data.

"The minute you want to use FOQA for enforcement action, that's the minute the FOQA program is going to end," said Bayless.♦

the notice of proposed rule making on the FOQA nonenforcement policy. The anticipated FOIA rule making and the subsequent findings to include the FOQA program within the protection should help mitigate or resolve the industry's fears about the possible disclosure of FOQA data through FOIA requests if FOQA data are provided directly to FAA.

[FSF editorial note: FAA said in August 1998 that the NPRM on FOQA and the NPRM on FOIA are separate but interrelated, and that the rule-making process continues for both issues. See "Freedom of Information Act Ensures Public Access to Certain Records Held by U.S. Agencies, " page 14, and "Information Secrecy Works Against Public Interest in Aviation Safety," page 18.]

Discovery Process in Civil Litigation

Some airline officials have said that although they want to improve aviation safety by implementing a FOQA program, the voluntary collection of data may potentially expose airlines to greater liability in civil litigation. FOQA data may indicate conditions outside of desired operating procedures. Airline officials and pilot representatives said that they are concerned that through broad discovery rules, FOQA data could be inappropriately used or disclosed to the public. The general purpose of discovery is to remove surprise from trial preparation so that parties may obtain the evidence necessary to evaluate and resolve their dispute. Because FOQA data are retained at the airlines and are not currently provided directly to FAA, the focus has been on the airlines' ability to protect the information.

Under federal rules, parties in litigation in federal court are authorized to obtain discovery of any matter, not privileged, which is relevant to the subject matter involved in the pending action, whether it relates to the claim or defense of the party seeking discovery or to the claim or defense of any other party. Generally, privileges are narrowly construed and in some cases are qualified. Nevertheless, even in the absence of a privilege, a district court has broad discretion under the federal rules to issue an order to protect a person from annoyance, embarrassment, oppression or undue burden or expense if there is a good cause for issuance of the order. Courts generally invoke a balancing test to decide when a protective order is appropriate and how it is to be applied.

In two recent cases, the airlines have tried to convince federal courts that voluntarily collected safety data similar to FOQA data should be protected from discovery or, at the very least, covered under a protective order.

(Court Order of Oct. 26, 1995, In re Air Crash at Charlotte, North Carolina, on July 2, 1994, MDL Docket No. 1041 [D.S.C. 1995] [the court rejected the claim of self-critical evaluation privilege]; but see Court Order of Nov. 14, 1995, In re Air Crash at Charlotte, North Carolina, on July 2, 1994, MDL Docket No. 1041 [D.S.C. 1995] [the court issued a protective order]; and In re Air Crash Near Cali, Colombia, on Dec. 20, 1995, 959 F. Supp. 1529 [S.D. Fla. 1997] [the court rejected the claim of self-critical evaluation privilege but recognized a new qualified privilege for the American Airlines [Aviation Safety Action Partnership program]. For a more detailed discussion of these court cases, see Appendix V [page 34].)

In both cases, the courts sought to achieve a balance between the airlines' desire to protect the information and the plaintiffs' right to a fair trial. In the first case, the court rejected a claim that the information should be protected

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Freedom of Information Act Ensures Public Access To Certain Records Held by U.S. Agencies

FSF Editorial Staff

Some U.S. airlines and pilots have expressed concern that data collected for flight operations quality assurance (FOQA) programs could become accessible to the news media and the public via the federal Freedom of Information Act (FOIA) if the data are obtained by the U.S. Federal Aviation Administration (FAA). The December 1997 report on FOQA by the U.S. General Accounting Office (GAO) said that this concern has been one of the impediments to wider FOQA implementation by U.S. airlines. The airlines currently operate their FOQA programs under terms of a 1995 FAA policy letter on FOQA, which provides for FAA access to "de-identified aggregate information at the carrier's offices, which information could be used by the FAA for nonenforcement, e.g., safety purposes."

As of August 1998, FAA had not issued a notice of proposed rule making (NPRM) on FOQA or an NPRM on FOIA that would prohibit the FAA Administrator from disclosing voluntarily provided safety information in specific circumstances. The following facts about FOIA, published by the U.S. Department of Justice (DOJ), generally describe how and when FAA, and other executive-branch agencies of the federal government, provide records to the public.

Both FOQA and FOIA underscore issues that arise in balancing important interests of society as a whole with the interests of groups within society — such as airlines and regulators working to improve aviation safety through voluntary disclosure of operational information.

DOJ said:

> To be sure, achieving an informed citizenry is a goal often counterpoised against other vital societal aims. Society's strong interest in an open government can conflict with other important interests of the general public — such as the public's interest in effective and efficient operations of government; in the prudent government use of limited fiscal resources; and in the preservation of the confidentiality of sensitive personal, commercial and governmental information. Though tensions among these competing interests are characteristic of a democratic society, their resolution lies in providing a workable formula that encompasses, balances and appropriately protects all interests, while placing emphasis on the most responsible public disclosure possible. It is this task of accommodating countervailing concerns that the FOIA seeks to accomplish.

Since 1966, FOIA has provided a statutory right of access to U.S. government information — based on the ideals of government openness and accountability, and the need for informed citizens in a democracy. The law has been used as a research tool by private individuals, news media, academic researchers, advocacy groups, corporations and others who need information to understand the actions and policies of the government. FOIA, and amendments to the law, have been particularly helpful to people who monitor government regulation in health and safety — including aviation safety.

FOIA generally provides that any person has a right of access, enforceable in court, to federal agency records, except to the extent that these records (or a portion of these records) are protected from disclosure by one of nine exemptions, or by one of three special law-enforcement-record exemptions.

As to who may file FOIA requests, the law generally has defined "any person" as comprising individuals (including non-U.S. citizens), partnerships, corporations, associations and non-U.S. or domestic governments (excluding federal agencies but including state agencies). The law defines

FOIA Described in Brief

The federal Freedom of Information Act (FOIA) allows any U.S. citizen or foreign national U.S. resident to request any records (including letters, reports, photographs, audio recordings, computer media, etc.) from the executive branch of the federal government, including the Federal Aviation Administration. *Local and state governments, as well as Congress and the federal courts, are not covered by FOIA.*

Making a request under FOIA is reasonably simple. Nevertheless, under nine *nonobligatory* exemptions, the affected agency can elect to withhold the requested information. The withholding, for example, might be outright or in the form of a document with obliterated text. Requesters can file administrative appeals for the withheld information. A newspaper reporter might cite the public's right to know versus privacy, along with appropriate legal precedents, all aimed at persuading a government employee to waive the exemption(s). Of course, a host of court cases has been generated by agencies' decisions to withhold information. Cases have been won and cases have been lost, so court action does not guarantee disclosure.♦

— FSF Editorial Staff

"agency" as nearly all executive-branch entities. FOIA defines "record" as information, including information in electronic form, but not tangible evidentiary objects that cannot be reproduced. Records under FOIA, however, do not include records maintained by state governments, by municipal corporations, by courts, by the U.S. Congress or by private citizens. An "agency record" is a document that is created or obtained by an agency and under agency control at the time of a FOIA request.

FOIA provides the following nine exemptions, and an agency may use any one as the legal basis for withholding requested records:

1. Properly classified documents related to national defense or foreign policy;
2. Internal personnel rules and practices of an agency;
3. Information specifically exempted from disclosure by other statutes, provided that the statute requires that the matters be withheld from the public in a manner that leaves agencies no discretion on the issue, or establishes particular criteria for withholding, or refers to particular types of matters to be withheld;
4. Trade secrets and commercial or financial information obtained from a person and that is privileged or confidential;
5. Interagency or intra-agency memorandums or letters that would not be available by law to a party other than an agency in litigation with the agency;
6. Personnel and medical files and similar files if disclosure would constitute a clearly unwarranted invasion of personal privacy;
7. Records or information compiled for law-enforcement purposes (with six limitations);
8. Reports for or by agencies responsible for the regulation or supervision of financial institutions; and,
9. Geological and geophysical information and data, including maps, concerning wells.

DOJ said, "The nine FOIA exemptions ordinarily provide the only bases for nondisclosure, and generally they are discretionary, not mandatory, in nature." Therefore agencies generally may release documents under FOIA even if they could be withheld legally under an exemption.

The GAO report said that in the past, safety information voluntarily submitted to FAA — for example, under Air Carrier Voluntary Disclosure Reporting Procedures (ACVDRP) — has been protected under exemption four of FOIA. Despite this precedent, airline officials and pilots' representatives have expressed concern that FOQA data may not be protectable under this exemption, said GAO. New FAA regulations to exempt voluntarily disclosed safety information (including FOQA information in FAA records) from FOIA requests, however, could remove this uncertainty. Without some form of legal protection in place, the submitter of information — an airline, for example — would have to prevail in a "reverse" FOIA lawsuit in federal court under the Administrative Procedures Act to prevent an agency from disclosing information to a third party. (Generally in this type of lawsuit, the agency already has determined that the information should be disclosed to comply with FOIA or, if exempt from FOIA, that the agency is willing to make the disclosure as a matter of administrative discretion.)

Records under FOIA, however, do not include records maintained by state governments, by municipal corporations, by courts, by the U.S. Congress or by private citizens.

"Exemption four [of FOIA] … is intended to protect the interests of both the government and submitters of information," said DOJ. "Its existence encourages submitters to voluntarily furnish useful commercial or financial information to the government, and it correspondingly provides the government with an assurance that such information will be reliable. The exemption also affords protection to those submitters who are required to furnish commercial or financial information to the government by safeguarding them from the competitive disadvantages that could result from disclosure."

Aviation safety information — such as FOQA data — has not been addressed specifically by FOIA, but exemption four involves a similar principle: protecting the interests of people who submit reliable information that, in turn, enables government agencies to fulfill their responsibility to protect society from harm.

DOJ said that the following two-part test now is applied to determine whether information — such as FOQA data — should be considered "privileged or confidential" for purposes of FOIA exemption four. One court ruling said, "To summarize, commercial or financial matter is 'confidential' for purposes of the exemption if disclosure of the information is likely to have either of the following effects: (1) to impair the government's ability to obtain necessary information in the future; or (2) to cause substantial harm to the competitive position of the person from whom the information was obtained."

FOIA requests can be made for any reason. The requester does not need to show relevance or provide the purpose of the request. DOJ said, "As a result, despite repeated Supreme Court admonitions for restraint, the FOIA has been invoked successfully as a substitute for, or a supplement to, document discovery in the contexts of both civil and criminal litigation." Providing the reason for a FOIA request, however, may be required to perform certain procedures, such as assessing requests for expedited access, waivers or reductions of search or copying fees for certain qualified requesters, or the award of attorney fees and/or court costs to a FOIA requester whose request is substantially granted after appeal to a federal court.

FOIA specifies that access requests must "reasonably describe" the records sought by the requester and that the requests must comply with each agency's FOIA procedural regulations. Since 1974, a description has been considered sufficient if it enables a professional agency employee familiar with the subject area to locate the requested record using a "reasonable amount of effort." Various court rulings have refined this requirement and provided examples of unreasonable requests that agencies may deny. Since a 1973 court ruling, agencies have been required to release "segregable nonexempt portions of a partially exempt record" under FOIA. To do this, the agency edits out the exempt portion.

Some people think of FOIA only in terms of a written request for information to an agency, but the law provides a much broader structure of information disclosure.

Unlike some earlier public-records laws in the United States, the underlying concept of FOIA is that virtually every record possessed by a federal agency should be made available to the public in one form or another, unless the record specifically has been exempted from disclosure or the record has been specifically excluded from coverage by FOIA.

Among the most significant FOIA developments during the 1990s have been 1993 policy statements by U.S. President William J. Clinton and U.S. Attorney General Janet Reno calling upon all federal agencies to follow "the spirit" as well as the letter of law in FOIA, and enactment of the Electronic Freedom of Information Act Amendments of 1996 by the U.S. Congress.

The attorney general's memorandum to federal agencies, among other things, rescinded the previous standard for the defense of litigation by DOJ; established a new "foreseeable harm" standard applicable to the use of FOIA exemptions both in litigation and at the administrative level; and strongly urged agencies to make discretionary disclosures of exempt information "whenever possible under the act."

The 1996 amendments governing electronic access to agency information under FOIA generally specified that documents created by an agency on or after Nov. 1, 1996, and required to be available in agency reading rooms, also must be published electronically. Agencies generally met this requirement by creating "electronic reading rooms" as Internet sites as of Nov. 1, 1997. Agencies also began providing online indexes of reading-room records (compliance will be mandatory at the end of 1999).

In another 1996 change with wide effect, agencies have 20 days to respond to requesters after receipt of a FOIA request that conforms to agency procedures (the basic time limit had been 10 days). FOIA also provides for extensions of time limits under unusual circumstances, and sets time limits for agencies to handle administrative appeals.

Agencies also were authorized to categorize and prioritize FOIA requests to expedite processing and to reduce backlogs using new "multitrack processing" systems. Since Oct. 2, 1997, agencies also have been adopting new regulations for expedited processing of FOIA requests when requesters show "compelling need," defined as situations where failure to obtain records quickly "could reasonably be expected to pose an imminent threat to the life or physical safety of an individual," or if the requester is a "person primarily engaged in disseminating information" and can demonstrate that there is an "urgency to inform the public concerning actual or alleged federal government activity."

DOJ said that the electronic FOIA amendments also require that an agency "provide the [requested] record in any form or format requested by the person if the record is readily reproducible by the agency in that form or format" and "make reasonable efforts to maintain its records in forms or formats that are reproducible" for such purposes. Court rulings have said that agencies are not required, however, to acquire or use the most sophisticated and expensive technology available to accommodate FOIA requesters.

FOIA amendments, and related court rulings, have addressed many situations in which the requesters sought to use FOIA inappropriately. For example, FOIA does not require agencies to create records to respond to requests for records. FOIA also does not require agencies to answer questions that have been submitted to agencies as FOIA requests.

Some people think of FOIA only in terms of a written request for information to an agency, but the law provides a much broader structure of information disclosure.

FOIA establishes, for example, requirements that agencies routinely make certain types of records available for public inspection and copying without a formal request, in both paper and electronic form. These types of records include final opinions rendered in the adjudication of cases, specific policy statements, certain administrative staff manuals, and some records previously processed for disclosure under FOIA. Under the last provision, added in 1996, when an agency has disclosed records in response to a FOIA request, the agency must determine whether the records have become the subject of subsequent FOIA requests or whether, in the agency's best judgment based upon the nature of the records and the types of requests regularly received, the records are likely to become the subject of multiple requests in the future. In either situation, these records (as processed for FOIA requesters) must become part of the agency's reading-room records that are made available automatically (without a FOIA request). Even if records are available in physical or electronic reading rooms, agencies must respond to requests for them according to conventional FOIA processes.

Various court rulings have helped to clarify whether or not certain categories of documents at any executive-branch federal agency fall under FOIA. For example, regulations pertaining solely to internal personnel matters that do not affect the public need not be published, and agencies are not required to publish substantive rules and policy statements of general applicability that they have not adopted.

Finally, FOIA provides any person whose request has been denied (or delayed beyond established limits), and who has exhausted the administrative appeal procedures, the right to sue the agency that denied the request in federal court. In these cases, the agency involved has the legal burden of showing why the records were withheld from the requester.

DOJ said, "Dissatisfied record requesters [under FOIA] are given a relatively speedy remedy in the United States district courts, where judges determine the propriety of agency withholdings *de novo* [as if new], and agencies bear the burden of sustaining their nondisclosure actions."♦

FSF editorial note: This article is based primarily on the *Freedom of Information Act Guide & Privacy Act Overview, September 1997 Edition,* published by the Office of Information and Privacy, U.S. Department of Justice (U.S. Government Printing Office publication no. 1997-427-949/80335; 755 pages) and *Aviation Safety: Efforts to Implement Flight Operational Quality Assurance Programs,* published in December 1997 by the U.S. General Accounting Office (publication no. GAO/RCED-98-10; 38 pages).

under the self-critical-evaluation privilege but limited the possible uses of the documents that it ordered to be produced (the self-critical-evaluation privilege, when recognized, protects documents that reflect an internal self-analysis). This determination was effected through a protective order.

In the other case, the court also rejected the claim of self-critical-evaluation privilege but at the same time recognized a new qualified privilege for information collected under a partnership program with FAA, the American Airlines [Aviation Safety Action Partnership] program (thus, the court provided that the plaintiff could come forward with a persuasive showing of need and hardship; in such case, the court would review the voluntarily collected information *in camera* [in a judge's private chambers] and evaluate whether the plaintiff's interests overcome the powerful interest that weighs in favor of preserving the confidentiality of the information; no such showing was made in this case).

Although airlines are generally pleased with the court's decision to grant a qualified privilege to ASAP materials, it is not clear whether other courts will recognize this new privilege or extend it to other safety and security information that has been voluntarily collected. Nor is there a guarantee that FOQA data or other similar information, if found not to be privileged, would be covered under a protective order. However, [the GAO] found no instances [as of late 1997] in which FOQA data have been subject to a discovery request. This situation may be because airlines are just beginning to institute FOQA programs. Nevertheless, some of the pilot-union officials noted that discovery is a concern because of the potentially large amounts of data that will be collected. While some in the aviation community believe that one way to ensure protection would be through legislation, there does not appear to be a consensus to seek legislation at this time (limited legislative protection has been provided for CVRs). Concern has been expressed that the failure of a legislative effort may adversely affect how courts treat voluntarily collected safety information.

In the event that FAA does receive FOQA data directly, according to FAA attorneys, it has provisions in place for dealing with requests from private litigants for documents in the agency's possession. FAA attorneys noted that a request for records from a private litigant, when the agency is not a party to the action, will generally be treated as a FOIA request. If the agency is a party to the litigation, FAA will seek to protect the information, if appropriate, under a claim of government privilege and, if that fails, to release the information under a protective order.

[FSF editorial note: See "U.S. Federal Discovery Procedures Must Be Reconciled with FOQA Confidentiality," page 20.]

(continued on page 22)

Information Secrecy Works Against Public Interest in Aviation Safety

Don Phillips
The Washington Post

One of history's most frequent blunders is the belief that information can be kept secret. The leaders of the fallen Soviet Union and today's China have learned that information not only can't be kept secret, it can't even be controlled for more than a short period, historically speaking. Just ask almost anyone on the streets of Beijing what happened in Tienanmen Square, and you will hear powerful testimony to the failure to keep a lid on something about which people want to know. In the end, the efforts to control information made these leaders appear far less powerful and only hastened the information-based changes that they were struggling to prevent.

As a longtime aviation-safety reporter, I have developed great respect for most of the leaders of the aviation industry. But I fear that I am seeing some smart airline people stumble toward the same trap of secrecy.

"It gives me great concern to hear people I respect say that information sharing may never happen if the information can't be kept secret from reporters and lawyers."

I find it strange that one of the great concerns of aviation leaders, as they prepare for information sharing through flight operations quality assurance (FOQA) and other programs, is that reporters and lawyers might gain access to the information. Everyone, including many of us who report about aviation, has been persuaded that the very heart of FOQA — sharing detailed safety information — is the most promising way to improve an already sterling aviation safety record. Therefore, it gives me great concern to hear people I respect say that information sharing may never happen if the information can't be kept secret from reporters and lawyers. That is the equivalent of saying, "We know how to save more lives, but we will let people die unless we can be assured that we won't be embarrassed or sued."

Let me define the sort of information that an aviation reporter would want from an information-sharing program. I can't speak for all reporters, but I believe that many experienced aviation reporters will agree with me.

First, I do not want access to every byte of data that flows from any given flight data recorder or quick-access recorder. My newspaper does not want to hire a lab and experts to interpret the data. Besides, it would mostly be a waste of time to look at individual data. One of the central philosophies of FOQA is to compare many hundreds or thousands of events to uncover unsafe patterns and trends. And in any serious incident or accident, I know that eventually I will have access to data through the U.S. National Transportation Safety Board.

Second, I am not looking for operational or business information that has nothing to do with safety. If you find a new way to save fuel or abate noise, you'll probably share that information anyway because you'll want to brag about it. And if you don't, so be it. Your marketing processes also are safe. It would be nice to know, for instance, how a successful airline decides on what city is ripe for expansion. If I find out, I'll print it. But you won't find me claiming to have a "right" to the information.

What I do want is your end product. If you discover an unsafe practice through information sharing, I would argue that the flying public who has trusted you to see them safely through the skies has a right to know. Safety is not a marketing decision. It is a matter of life or death. And in our society, we the people have decided that safety is one of the most important functions of government at every level — from small-town sheriffs to the U.S. Marine Corps. And although the [U.S.] Federal Aviation Administration sometimes forgets this, one of the chief functions of government is to make that information public.

Presumably you would be in the process of fixing any problems anyway, or perhaps already would have fixed them, by the time the information is disclosed publicly. That would give you bragging rights, the sort of grist that warms the hearts of public relations professionals.

What happens if you discover an unsafe practice and tell no one, hoping to fix the problem and make it quietly go away? You may get away with it, but if the problem is — or was — serious enough, you certainly won't. And when the story finally breaks, you will look guilty.

It may work this way: Dozens, perhaps hundreds, of your own employees know about the problem. So may several government officials. One or more of your employees believes that you are not moving fast enough to solve the problem, and that begins to concern him or her. He or she begins to feel powerless. The employee begins complaining to a spouse, who mentions the problem to a friend, who happens to be the friend of a reporter. With any luck, that reporter will be me. With only a tiny amount of tentative information, I have broken some of my best stories.

You simply can't hide information that has a vital public-interest component. You can sit on it until the lid blows off. Or you can make it so readily public that you can use it as a public-relations coup: "Look what we found, and look what we did about it. Aren't we great?" Frankly, I would probably write the latter story in a positive way unless I discovered something you weren't telling us. A free flow of information often produces positive reporting, or at least neutrality.

Leaked stories, on the other hand, are almost always negative. They are usually leaked by people who are upset and give only the negative side of the story. And that is the side that gets reported if you stonewall [hide] information.

No matter how hard a good reporter tries to be fair, we can't ignore when you attempt to hide something, nor can the public. You need public confidence in the safety of your operation, and you must resign yourself that the public will get its safety information through reporters, imperfect though we may be. And don't forget the public's influence on its elected representatives to the U.S. Congress.

I would also submit that with a mass of FOQA information readily available, you would find a surprising lack of interest among reporters a few months later. After a while, editors will ask, "Haven't we done that story?"

Also keep in mind that the way you handle information says a lot about your corporate and safety cultures. Reporters pick up on this much faster than you might think. ValuJet's constant denials of responsibility after the Everglades accident only raised reporters' suspicions. But American Airlines management, after the accident in Cali, Colombia, asked, "What did we do wrong? How could we have prevented this?" Reporters and the public reacted positively to aviation leaders who cared deeply and weren't dodging responsibility.

[FSF editorial note: The ValuJet accident near Miami, Florida, U.S., on May 11, 1996, involved a McDonnell Douglas DC-9-32. Soon after takeoff from Miami International Airport (MIA), an intense fire erupted in the forward cargo compartment. As soon as the crew detected the fire, they turned back toward MIA, but the fire burned through the aircraft's control cables and the crew was not able to maintain aircraft control. The aircraft collided with terrain about 17 miles (27.4 kilometers) northwest of MIA. All 110 persons on board were killed. The U.S. National Transportation Safety Board said that the probable causes of the accident were the failure of ValuJet's maintenance contractor to properly prepare, package and identify unexpended chemical oxygen generators before presenting them to ValuJet for carriage; the failure of ValuJet to properly oversee its contract maintenance program to ensure compliance with maintenance, maintenance-training, and hazardous-materials requirements and practices; and the failure of FAA to require smoke-detection and fire-suppression systems in class-D cargo compartments.

The accident in Cali, Colombia, involved an American Airlines Boeing 757-223 that struck mountainous terrain on approach to the Cali airport on Dec. 20, 1995. Of the 163 persons on board, four passengers survived. The Aeronáutica Civil of the Republic of Colombia said that the probable causes of the accident were the flight crew's failure to adequately plan and execute the approach, and their inadequate use of automation; the failure of the flight crew to discontinue the approach, despite numerous cues alerting them of the inadvisability of continuing the approach; the flight crew's lack of situational awareness; and the flight crew's failure to revert to basic radio navigation at the time when use of the flight management system for navigation became confusing and demanded an excessive workload in a critical phase of flight.]

I will readily acknowledge that there are incompetent reporters and greedy lawyers in the world. In fact, I am one of the greatest critics of aviation reporting. In general, it stinks. I often cringe in the first few days after a major aviation accident as I watch the torrent of misinformation and incorrect assumptions.

"I think we would all recognize that you do need some form of protection in data sharing. Secrecy, however, is not a solution."

James T. McKenna, transport and safety editor of *Aviation Week & Space Technology*, spoke earlier this year about this issue, and one paragraph sums up his belief about placing a secrecy blanket over shared information. I doubt you would find one responsible reporter who would disagree with him.

"I think that this is a red herring," said McKenna. "Some of the real skeptics among us — you might even call us cynics — would say that this is just an excuse for not sharing data. You share data or you condemn your crews and passengers to die. They'll die in accidents whose causes were — or should have been — known to you and corrected by you. It's your job to run a safe aviation operation. It's your lawyer's job to explain to a civil jury why you need to share data to be safe. Don't hide behind the excuse that you won't share until the data is protected from discovery and from the [federal] Freedom of Information Act."

There are a lot of good reporters out there. And the good reporters usually drag the rest of the media along toward some semblance of adequate reporting, usually within a day or two.

Responsible though we may try to be, our job is not to promote you or to make you comfortable. Our job is to inform the public. My role in assuring transportation safety is to be a bulldog in getting the facts. Moreover, for me, it is the rare privilege of reporting on people with whom I can share a goal: transportation safety.

I think we would all recognize that you do need some form of protection in data sharing. I am not smart enough to draw up a protocol that would satisfy everyone, but at a minimum you should have at least limited protection from FAA enforcement action as a result of information sharing. Secrecy, however, is not a solution.

I had the honor a few months ago to address Flight Safety Foundation's Icarus Committee, and I made some of these same points. In a stimulating question-and-answer session, one member expressed concern that after years of devotion to aviation safety, he would be peppered with accusatory questions following an accident. I hadn't really thought about that from his point of view, and my answer surprised even me a little.

This is not precisely what I told him, but the point was this: You have chosen a job in which anything short of perfection is a failure. No matter how hard you have worked and how dedicated you are to safety, one death means you have failed to do your job. You can't expect praise for failure. It should be enough for you to know that you gave your best. And with any luck, good reporters may acknowledge that you tried.♦

About the Author

Don Phillips is a member of the financial reporting staff of The Washington Post*, specializing in transportation safety and transportation as a business. Phillips joined the newspaper in 1985 as weekend national editor, and three years later returned to reporting. After two years helping to cover Capitol Hill, Phillips became the* Post's *transportation reporter, responsible for aviation, railroads, highway matters and waterborne shipping. He has covered every major U.S. airline accident and train accident in the 1990s. Before becoming a transportation reporter, Phillips also had written articles about several aviation and train accidents. His journalism career began in the early 1960s as editor of the* Auburn Plainsman*, the student newspaper at Auburn University in Alabama, U.S. Phillips also had positions at the* Lee County Bulletin *(Alabama), the* Tuskegee News *(Alabama), the* Atlanta Constitution *(Georgia, U.S.) and United Press International. Phillips received the Foundation's 1996 Cecil A. Brownlow Publication Award in recognition of his contribution and commitment to excellence in aviation reporting.*

U.S. Federal Discovery Procedures Must Be Reconciled with FOQA Confidentiality

Carl W. Vogt
Fulbright & Jaworski L.L.P.

Few aspects of the U.S. civil litigation system strike foreign lawyers and U.S. nonlawyers as being as intriguing, or as threatening, as federal "discovery." Discovery, under the U.S. Federal Rules of Civil Procedure, is the process prior to a civil trial by which parties obtain relevant information from each other and from third parties.

In some federal courts, the exchange of information between parties is partially automatic — the opposing side does not need to request the information formally or, indeed, even be aware of its existence. Parties also can request access to even highly confidential memos, documents, medical examinations, product-design specifications and a host of other material, provided that the information requested is relevant to the case and not "privileged" or otherwise protected from discovery.

U.S. courts rely on an adversarial system. In civil cases, an independent and unbiased judge and jury hear evidence and legal arguments presented by two highly biased sets of lawyers representing the interests of their respective clients.[1] In theory, such a process is more likely to expose the facts of the matter than would a judge-based fact-gathering system because both sides have the strongest incentive to be diligent in researching and presenting their case.[2]

In reality, such a system can easily allow wealthy and legally sophisticated parties to trample on those without such advantages.

The modern system of discovery is designed to rectify such an imbalance by requiring that the two sides make available (almost) all information relevant to the dispute. In theory, discovery gives each side the opportunity to put forward its best argument and prevents evidentiary surprises during the trial. Likewise, in theory, discovery lowers the cost of litigation by firmly establishing before trial which facts are uncontested and which contested facts are truly important to the dispute.

Nonetheless, discovery is often expensive and laborious. "Initial" disclosure rules applicable in many federal courts require that, near the start of the lawsuit, both parties automatically release four categories of information:

- The names of individuals likely to have important information regarding the case;

- Copies or descriptions of all documents relevant to the specific facts in dispute;
- A computation of damages claimed by the disclosing party; and,
- Information about insurance policies that might cover any part of a final judgment.[3]

The parties must also disclose the names of any expert witnesses that they might call to testify on their behalf as well as written reports stating the expert witnesses' opinions and the reasons for their opinions.

These initial disclosures rarely satisfy the parties, who usually seek more specific information in the form of additional documents, written and oral depositions, interrogatories, physical inspections of property, etc. The documents generated by larger discovery requests are frequently voluminous.

Some information is either privileged or otherwise protected from the discovery process. Privileged information is evidence that is officially off-limits for discovery and other evidentiary purposes because it is protected by the U.S. Constitution (e.g., self-incriminating testimony), by acts of Congress (e.g., trade secrets), by certain rules (e.g., certain types of documents prepared by attorneys and clients in anticipation of a lawsuit), or by common law tradition (e.g., attorney-client privilege).[4]

In addition, a judge may issue a protective order and either completely exclude certain information from discovery or subject it to limiting rules (such as ordering that some questions not be asked or that the information be shown only to persons designated by the court, etc.).[5] Courts often issue protective orders when the information being sought is highly confidential (such as trade secrets), highly personal, potentially embarrassing in ways that have nothing to do with the dispute or just too costly to unearth for purposes of the lawsuit. Nevertheless, when a party claims that information is either privileged or protected, it must expressly make this claim to the other party and describe the nature of this information in a way that does not reveal the information itself.[6]

Given the complexity of the discovery process, it is no surprise that it is often misunderstood. It is a unique feature of the U.S. judicial system — one designed to solve certain historical abuses, yet subject to abuses of its own. The reconciliation of judicial discovery with the confidentiality of data-collection programs designed to improve flight safety is of vital importance.♦

Notes and References

1. U.S. criminal trials also rely on an adversarial system.

2. One reason that discovery seems so ominous to non-U.S. companies is that most of the world's democratic legal systems use a procedure by which an impartial judge is charged with gathering and controlling evidence. Such systems tend to be far less intrusive and less costly than in the United States. See John H. Langbein, "The German Advantage in Civil Procedure," *The University of Chicago Law Review* Volume 52 (Fall 1985), pp. 823–866.

3. *Federal Rules of Civil Procedure* (*F.R.C.P.*) 26(a)(1).

4. Haydock, Roger S.; Herr, David F. *Discovery Practice.* New York, New York, United States: Aspen, 1997, sections 2.1–2.5.

5. *F.R.C.P.* 26(c).

6. *F.R.C.P.* 26(b)(5).

About the Author

Carl W. Vogt is a senior partner resident in the Washington, D.C., U.S., office of Fulbright & Jaworski L.L.P., a law firm that has more than 600 lawyers with offices in seven U.S. cities, the United Kingdom and Hong Kong. His legal practice primarily involves general civil litigation in federal and state courts, alternative dispute resolution, and employment, labor and administrative law. His commercial litigation practice has ranged from cases in state and federal trial and appellate courts involving copyrights to the defective manufacture of aircraft components.

Vogt served as chairman of the U.S. National Transportation Safety Board from 1992 to 1994. He also has served as a member of the board of directors of the National Railroad Passenger Corporation (Amtrak), a member of the U.S. Federal Aviation Administration's (FAA) Aviation System Capacity Advisory Committee, a member of FAA's Ninety Day Safety Review Committee, a member of the White House Commission on Aviation Safety and Security, and general counsel/secretary and member of the FSF Board of Governors. Vogt also is chairman-elect of the American Bar Association Forum on Air and Space Law. He received an undergraduate degree from Williams College and a law degree from the University of Texas, Austin. Vogt served as a jet fighter pilot in the U.S. Marine Corps and has a commercial pilot license.

Appendix I: The FOQA Concept and Its Implementation in the United States

FOQA's Background

FOQA [in the United States] had its origin in the use of FDRs as mandated by the [U.S. Civil Aeronautics Administration] CAA in 1958. Although the first FDRs captured only six parameters — time, airspeed, heading, altitude, vertical acceleration and time of radio transmission — they were a valuable tool for reconstructing what had occurred before and during accidents. By the 1960s, airlines had begun to monitor data on routine flights. Initially, the monitoring systems captured airworthiness data, but over time they have expanded to include operational data. In the late 1960s, Trans World Airlines began a program to monitor a limited number of parameters related to approaches and landings as FDRs received periodic maintenance.

At least eight non-U.S. airlines have had FOQA-type programs in operation for more than 25 years. A program using data from FDRs was begun by British Airways (BA) in 1962 to validate airworthiness criteria. Although limited by today's standards, BA's program contained the seeds of a modern, safety-oriented FOQA program. Currently, BA analyzes the flight data from all of the aircraft in its fleet through its Special Events Search and Master Analysis program.

Over the years, the number of [non-U.S.] airlines that have implemented a FOQA-type program has risen steadily. Japan Airlines' FOQA program of over 15 years includes a printer in the cockpit so that pilots can monitor their own performance. All Nippon Airways began a program to analyze flight data in 1974. Other [non-U.S.] airlines with established FOQA programs include KLM-Royal Dutch Airlines, Lufthansa German Airlines and Scandinavian Airlines System. Many of these airlines are convinced that FOQA is a critical component in their respective safety efforts and that the program has paid valuable safety dividends.

Recognizing the value of operational flight data and the critical nature of flight crews' performance in incidents or accidents, the Foundation proposed and was selected by the FAA in 1991 to study FOQA. In its [report completed in 1993] on FOQA, the Foundation said:

> The proposal was based on [the Foundation's] conviction, formed by the positive experiences of its international member airlines using FOQA, that the appropriate use of FOQA data by airlines, pilot associations, and aircraft and equipment manufacturers would result in a significant improvement of flight safety by identifying operational irregularities that can foreshadow accidents and incidents.

The FSF [report] concluded that FOQA must proceed in the United States and that the implementation of FOQA by U.S. airlines would have a more positive impact on [FARs] Part 121 operational safety than any other human factors program included in FAA's research and development plans. The Foundation recommended that FAA promote voluntary FOQA programs by instituting a demonstration program in partnership with industry. In 1992, FAA's Flight Standards Service proposed funding for a demonstration program. On Feb. 9, 1995, FAA announced its plans for an FAA-industry demonstration project, and the [FAA] Administrator sent a policy letter to ATA and ALPA stating that FAA would not use FOQA data for enforcement purposes, provided that the airlines met certain requirements.

How FOQA Works

At a minimum, FOQA involves the analysis of flight data on a routine basis to reveal situations requiring corrective actions before problems occur. To institute such a program, airlines need methods to capture flight data, transform the data into the appropriate format for analysis, and generate reports and visualizations to assist personnel in analyzing the data. Although different methods are available, the following describes how a representative FOQA program operates; the descriptions are based on the experience of the four U.S. airlines that have implemented FOQA.

Management

A typical program is managed and operated by a FOQA manager, one or more analysts and a FOQA monitoring team (sometimes referred to as the exceedance guidance team) comprising airline pilots who work on FOQA on a part-time basis. Generally, the majority of the monitoring team's pilots are also representatives of a pilot union. These individuals manage the FOQA program in strict adherence to the agreements made with the pilot union, most notably on ensuring the confidentiality of pilots' identities. This group is responsible for defining and refining exceedances and parameters, reviewing and analyzing data, and determining and monitoring corrective actions.

Data Capture

The first step is the capture of data over the duration of the flight. Flight data comprise snapshots of values or measurements from various aircraft systems. Each data item represents information from a discrete source, such as an instrument or sensor. Generally, these data items are referred to as "parameters." Examples of parameters are "altitude" or "landing-gear position." Recording rates vary, depending on the parameter, ranging from many times per second to about once per minute.

Although FDRs continuously record, at a minimum, FAA-mandated parameters during every flight, they typically are not designed to provide frequent access to their data but rather to survive the extreme conditions during and after aircraft accidents to preserve flight data for accident investigations. These devices are housed in impact-resistant, sealed containers designed to withstand high [gravity] forces, submersion in water and fire. Obtaining frequent access to FDRs for FOQA purposes, however, would produce increased wear on internal mechanisms and result in shortened mechanical life and increased expense for a very specialized device. (Newer, solid-state FDRs, however, have no moving parts and would not experience wear problems. Transferring data from these devices [to recording media for analysis] takes several minutes to perform.) Also, FDRs may not capture a sufficient number of parameters to be useful for FOQA purposes.

Currently, FAA requires from 16 parameters to 29 parameters to be recorded on FDRs in transport aircraft (under a recently issued rule, FAA requires the recording of 16 parameters to 29 parameters by the FDRs on all existing transport aircraft, depending on the aircraft model, its internal systems and its date of manufacture. Aircraft manufactured after the [1997] rule, however, will be required to record 88 parameters within five years. [A FOQA program would likely capture many more parameters.]) Typically, the 200 parameters to 500 parameters available on modern digital aircraft allow a more comprehensive set of conditions to be monitored.

On the basis of the trend analysis, airline managers can take corrective action to reduce or eliminate … exceedances by focusing on the root causes and making or recommending changes.

Finally, FDRs hold about 25 hours of flight data, a relatively short time period. Instead, some U.S. airlines use a device called a QAR to record FOQA data to a removable optical disk or PCMCIA (Personal Computer Memory Card International Association) card (other airborne data-collection systems in use around the world include QARs using tape cartridges and solid-state devices). QARs record flight data that are output from the aircraft's digital flight-data acquisition unit (DFDAU), the same device that feeds parameters to the FDR. On average, QARs hold from 100 hours to 200 hours of flight data.

Data Transfer

As aircraft receive periodic servicing, the medium (optical disk, etc.) storing flight data is removed from the QAR and sent to a central location for analysis. A new disk or card is inserted into the QAR for the next round of flights. Airlines retrieve the data on schedules ranging from three days to 20 days.

An alternative to physical recording media is the use of data-link systems to transmit information directly to the ground-based system, eliminating the need to retrieve [manually] data from the aircraft. Two participating airlines are investigating the use of automatic wireless data transfer upon landing at specially equipped airports. Data would be transmitted on a radio-frequency link from the aircraft to a receiving station after the aircraft lands. In turn, a local-area network would transfer the data to the ground analysis station. Data encryption and other methods would be used to ensure the security of the transmitted FOQA data.

Data Processing and Analysis

Each airline has a ground analysis system where collected data are processed and analyzed. The ground analysis system transforms the raw digital flight records into usable form for processing, analyzes the flight information and generates information on any detected exceedances that represent deviations from normal operating practices or exceptional conditions.

The flight-data-analysis component of the ground analysis system categorizes operational events to be flagged by defining a set of parameters that indicate normal operating envelopes. The associated thresholds for these parameters vary by the type of aircraft and associated operating limits, accepted practices for safe operations, the phase of flight and the duration of any irregularity. For example, the threshold of selected parameters may be defined for various altitudes, e.g., 1,000 [feet], 500 [feet], 250 [feet] and 100 feet, during landing-mode events. Typically, 40 events to 80 events are defined and analyzed for a particular aircraft. For example, events might be the groundspeed during taxi or the descent rate during approach. The analysis software will track the descent over time to calculate a rate in feet per minute. Depending on the aircraft's altitude, a descent rate in excess of specified thresholds will trigger an exceedance.

Various categorization schemes are used to classify the seriousness of the exceedance. U.S. airlines use two categories or three categories to describe the seriousness of exceedances, ranging from minor deviations to major deviations. Exceedances are typically specified on the basis of a strategy for identifying those that have the greatest potential for safety and performance considerations. After the initial exceedance categories and associated parameters have been defined and utilized, they are subject to an ongoing evaluation-and-refinement process.

The ground analysis software also validates the quality and integrity of the collected data and filters out any marginal or transitory irregularities. Ground analysis systems also include protective mechanisms, such as the de-identification of pilot and specific flight information, and user-access privileges based on assigned passwords. As the data are processed, the flight number and day of the month are removed and saved into a separate, controlled file. This step de-identifies the FOQA data.

The FOQA monitoring team investigates each exceedance to determine what occurred and the magnitude of the exceedance. An analyst will review the parameter values surrounding the event and other information to determine if the exceedance was valid or if the exceedance was based on bad data, a faulty sensor or some other invalidating factor. For example, one flight had excessive rudder input on landing that correctly registered as an exceedance. On closer examination, it was determined that because the aircraft was making a crosswind landing, the use of large rudder input was justified. In this example, the exceedance was deemed invalid and was removed from the exceedance database.

Depending on the particular circumstances of the exceedance, the pilot association's representative may contact the flight crew to gather more information. After reviewing the situation to determine the exceedance's cause, the FOQA monitoring team and pilot association's representative will determine any necessary corrective action. Corrective action can range from additional flight-crew training to revisions of the operating procedures, to redesigns of equipment.

Trend Analysis

On a periodic basis, airlines aggregate and analyze exceedances over time — for example, the number of unstabilized approaches at a particular airport per month, over the last 12 months. This type of analysis provides valuable information to the airline, especially in terms of whether the airline's performance is improving, holding steady or deteriorating. This look at aggregate exceedances over time provides airline managers with a new perspective on problems that would not be visible otherwise. On the basis of the trend analysis, airline managers can take corrective action to reduce or eliminate these exceedances by focusing on the root causes and making or recommending changes.

Data Retention

Detailed FOQA data, including exceedances, are destroyed in 30 days or less by three of the four U.S. airlines with FOQA programs. Trend data, however, are kept indefinitely.

Aircraft Equipping Decisions

The U.S. airlines with active FOQA programs have each equipped a portion of their available fleets with QARs. They began their programs by equipping their more modern, technically advanced aircraft with QARs — late-generation aircraft already contain the sensors and advanced digital systems that acquire and control many more flight-data parameters than earlier-generation aircraft. Generally, these airlines do not plan to equip any of their older, analog-based aircraft, such as Lockheed L-1011, McDonnell Douglas DC-9 and DC-10, and Boeing 727, 737-100 and 737-200, with QARs to record flight data because these aircraft would be expensive to retrofit and because the airlines plan to retire many of them in the near future.

Several U.S. airlines plan to equip all new aircraft with QARs or other technology to capture FOQA data. Some new aircraft, for example, are delivered with QARs as standard equipment. Airlines cited several advantages in having new aircraft delivered with factory-equipped QARs. One advantage is that aircraft are not taken out of service to be retrofitted with the equipment. Another advantage is that the additional cost of a QAR can be spread over the finance period of the new aircraft.

Depending on the specific goals of a FOQA program, an airline may wish to equip some or all of its fleet to collect flight data. If a program's goal is to identify broad trends in flight operations and safety, the airline may choose to equip only a portion of its fleet. If a program's goal, however, is to more closely monitor the flight operations and performance of individual aircraft, the airline may want to equip more or all of its fleet. For an airline that begins by equipping only a portion of its fleet, more aircraft will likely be added to the program so that these data can be monitored as its FOQA program matures and efficiency and maintenance functions are added to the program. Some U.S. airlines, for example, are planning to use FOQA data to reduce aircraft-maintenance costs by more closely monitoring engine conditions and fuel consumption.

FOQA Demonstration Project

On July 11, 1995, FAA awarded a two-year contract (the term of the contract later was revised to three years) to execute a FOQA demonstration project, referred to as DEMOPROJ by FAA, to [UTRS.] The contract said:

> The goal of DEMOPROJ is to facilitate the start-up of the FOQA initiative and to comprehensively assess the cost-benefits and safety-enhancement effectiveness of an implemented FOQA program in which airlines voluntarily employ in-flight recorded data to routinely monitor their flight operations.

UTRS facilitated the establishment of collaborative partnerships between FAA, UTRS and interested airlines. Airlines may participate in DEMOPROJ at one of three levels within the project, ranging from attending meetings and expressing interest to a full partnership with FAA. Level-3 participation refers to the airlines that have not yet established an official FOQA program but attend meetings to learn about FOQA. At Level 2, the airlines already have their own equipment or will acquire equipment using airline funding, but they allow UTRS to monitor and document their program. Level 1 describes a full partnership in which equipment and software are provided through DEMOPROJ. [As of December 1997,] 11 airlines are participating in DEMOPROJ. The airlines participating at Level 1 are Continental, United and US Airways. All other participating airlines in DEMOPROJ are at Level 3: Alaska Airlines, America West, Continental Express, Delta, Northwest, Southwest, Trans World and United Parcel Service Co.

[FSF editorial note: Alaska Airlines became the fourth Level-1 participant in April 1998.]

The airline participants were selected on the basis of a number of characteristics, including financial stability, management commitment, resource commitment, fleet characteristics, fleet size, aircraft availability, and an approved implementation and operation plan. Additionally, airlines are required to sign nondisclosure and cooperation agreements that define the treatment of confidential and proprietary information, enumerate data-access control and security provisions, and specify the responsibilities and contributions of each party. Participating airlines also had to secure agreements with their pilot associations for the collection and analysis of flight data. These airlines made the commitment to record and process FOQA data on all scheduled flights that are equipped with FAA-supplied equipment, participate in periodic project reviews and allow UTRS to interview airline personnel during the project to document procedures, problems, issues and solutions.

UTRS assisted airlines in determining the equipment best suited to their needs, acquiring the equipment and delivering it for installation by the airlines. Hardware and software were selected from commercially available, off-the-shelf sources. As part of this effort, the contractor developed an equipment overview to facilitate the airlines' analysis and selection of available equipment.

UTRS also monitors and documents the airlines' FOQA demonstration programs' policies, procedures, usage and effectiveness. The contractor is collecting and analyzing information on how each airline is implementing FOQA, including data processing and analysis; the retention of detail and trend data; the selection of flight-data parameters; and the adjustment of threshold values, system effectiveness, technical problems, and resource information for establishing and maintaining a FOQA program. These findings are integrated and disseminated among participants throughout the study. UTRS is also collecting information about the projects' costs and anticipated benefits. The contractor is determining how each airline transforms FOQA data into information and how this information is used in the airline's decision making. UTRS holds periodic meetings for all partners to promote the sharing of information and lessons learned.

UTRS, with airlines' and pilot associations' involvement, is developing a FOQA advisory circular to provide information and guidance to airlines on how to design, implement and maintain a FOQA program. This document is scheduled to be issued approximately 90 days after FAA issues its proposed rule making on enforcement policy in connection with FOQA.

[FSF editorial note: FAA's Longridge said in August 1998 that work on the advisory circular has been completed except for portions affected by any proposed changes in the FARs.]

UTRS is also developing a cost-benefit analysis that will provide estimates of the costs that an airline would incur when starting and maintaining a FOQA program and potential savings. The cost-benefit study is scheduled to be completed in January 1998.

UTRS will issue a technical report and a set of FOQA guidelines in June 1998. The technical report will be an overall description of the technical effort to implement FOQA, summarizing the airlines' experiences with commercially available equipment and systems. The FOQA guidelines will synthesize the airlines' experiences in implementing FOQA with a view toward helping other airlines learn from the airlines that have implemented a FOQA program. The guidelines will include information on designing a FOQA program; the start-up and initial operation of a system; the use of FOQA for trend analysis, knowledge building, and decision making; and critical success factors for implementing a FOQA program.

[FSF editorial note: FAA's Longridge said in August 1998 that the cost-benefit study will be part of a DEMOPROJ technical report and FOQA guidelines drafted by UTRS and awaiting government review and the FAA's decision on FOQA regulations.]

In fiscal years 1995 through 1997, according to [Longridge,] the FAA FOQA program manager, FAA allocated $5.5 million for DEMOPROJ. [He] stated that, as of Sept. 26, 1997, DEMOPROJ had expended $2.1 million, including $1.1 million for the purchase of hardware and software for the three Level-1 airline participants.

FAA plans to pursue follow-on development focused on the acquisition and use of FOQA information by FAA for safety monitoring purposes.

[FSF editorial note: FAA's Longridge said in August 1998 that the $5.5 million budget covers DEMOPROJ and various subprojects, such as assessing the cost and benefits of a radio-frequency data link for automatically downloading digital flight data. "No additional expenditures are planned for the demonstration project," he said.]

U.S. Airlines with Active FOQA Programs

[FSF editorial note: See "Airlines Report Benefits from FAA FOQA Demonstration Project," page 26.]

[As of December 1997,] four U.S. airlines have active FOQA programs: Alaska Airlines, Continental, United and US Airways.

(continued on page 30)

Airlines Report Benefits from FAA FOQA Demonstration Project

FSF Editorial Staff

A three-year-old program that encourages the adoption of flight operations quality assurance (FOQA) programs at U.S. airlines has enabled several of the 11 participating airlines to improve the performance of both flight crews and the environment in which they fly, FOQA program managers said. The airlines said that they have been sharing the results of their data analysis, their analytical methods and their practical applications of analysis with other airlines to some extent, but the raw data from aircraft flights have not been shared.

The U.S. Federal Aviation Administration (FAA) awarded and later extended the contract for the FOQA demonstration project, called DEMOPROJ, which has been funded out of a $5.5 million budget allocation that includes this project and subprojects, said Thomas M. Longridge, manager of FAA's Advanced Qualification Program (AQP) and DEMOPROJ. Longridge said that FAA has not published reports on the costs of DEMOPROJ since a December 1997 report by the U.S. General Accounting Office (GAO). The contractor is Universal Technical Resource Services Inc. (UTRS).

"The goal of DEMOPROJ is to facilitate the start-up of the FOQA initiative and to comprehensively assess the cost-benefits and safety-enhancement effectiveness of an implemented FOQA program in which airlines voluntarily employ in-flight recorded data to routinely monitor their flight operations," FAA's contract said.

The airlines have participated at one of three levels within the project, ranging from participation in FOQA meetings (Level 3) to an extensive collaboration in which FAA has funded some of the required equipment and software (Level 1). At Level 2, the airlines provide equipment and facilitate monitoring and documentation of their programs by UTRS.

As of August 1998, four airlines had Level-1 status: Alaska Airlines, Continental Airlines, United Airlines and US Airways. During quarterly demonstration-project meetings, the four airlines have shared methods, procedures and analytical tools, such as data-analysis techniques with spreadsheets and databases. Longridge and FOQA representatives at the four Level-1 airlines recently briefed Flight Safety Foundation about the status of their FOQA programs. US Airways requested that the Foundation not publish updated details about the airline's FOQA program at this time, citing uncertainty about a notice of proposed rule making (NPRM) by FAA on FOQA data protection.

Longridge said that as of August 1998 there were no Level-2 airlines and the Level-3 participating airlines were America West Airlines, Continental Express, Delta Air lines, Northwest Airlines, Southwest Airlines, Trans World Airlines, and United Parcel Service Co. Several status changes are pending in the near future, he said.

The airlines that have Level-1 FOQA demonstration programs equipped some of their aircraft with quick-access recorders (QARs) and performed data collection, analysis and trending. The numbers of FOQA demonstration aircraft at these carriers range from seven aircraft at Alaska Airlines to 100 aircraft at United Airlines. The number of FOQA parameters recorded per second on QARs ranges from about 38 to more than 1,000 depending on the QAR and the type of aircraft.

FAA expects to continue supporting FOQA as a voluntary safety program that airlines may choose to adopt, rather than mandate the program.

Longridge said that FAA expects to continue supporting FOQA as a voluntary safety program that airlines may choose to adopt, rather than mandate the program. The demonstration project has provided practical information, including approximate start-up and operating costs, that airlines will be able to use in considering FOQA, he said.

"The [FOQA] demonstration project has been the principal source of FAA's cost information," said Longridge. "We are getting better estimates of what it costs from experience, but cost information in the [December 1997] GAO report has been accurate — the information has not changed much." Demonstration-project participants have met quarterly with FAA to share lessons learned and provide updates concerning obstacles and solutions, he said.

FAA has planned to publish an advisory circular about FOQA programs, he said, but is waiting for final decisions concerning proposed regulatory changes.

"The advisory circular is almost complete, and would be valuable to the airlines now," said Longridge. "We could provide useful guidance to the airlines without getting into regulatory issues. The current plan remains to issue the advisory circular after release of an NPRM. The timing may be appropriate, however, to revisit that strategy in the interest of fostering these programs. The question is whether to include any section that depends on whether an NPRM has been issued."

Since 1994, a U.S National Aeronautics and Space Administration (NASA) program has focused on FOQA-related research and development, primarily in the area of aircraft-data-analysis software.

"The [NASA Ames Research Center's Aviation Performance Measuring System (APMS)] project looks at what might be possible in the future while FAA's FOQA demonstration project is a demonstration in which the airlines are using commercially available, off-the-shelf hardware and software," said Longridge. "R&D [research and development] doesn't produce a product for use by the airlines, it produces and tests a prototype. Technology-transfer agreements have been reached with industry to develop the prototypes for commercial application, including continued development and support."

[FSF editorial note: See "Aviation Performance Measuring System Develops FOQA Software Prototypes," page 30.]

Longridge said that FAA, NASA and airlines in the demonstration project have identified needs that differ from non-U.S. carriers that have FOQA programs.

"We have learned from NASA's work and ours," said Longridge. "Commercial FOQA data-analysis systems have looked only at exceedances at a few preprogrammed points. APMS prototype software allows much more detailed searches and types of data analysis to extract the full information value. NASA is working very closely with Alaska Airlines and United Airlines to develop APMS prototypes and try them in real conditions. We are comparing the prototypes to the commercially available systems in the FOQA demonstration."

Alaska Airlines finds FOQA data valuable to improve training. In April 1998, Alaska Airlines became the fourth Level-1 participant in the FAA FOQA demonstration program. As a result, UTRS will buy quick-access recorders (QARs) for the airline to install on additional aircraft, said Capt. Terry Clark, director of flight safety. Begun in July 1996, the program had analyzed QAR data from more than 15,000 flights as of June 1998. At that time, Alaska Airlines had equipped six McDonnell Douglas MD-80s and one Boeing 737-400 with QARs. Alaska Airlines also equipped a flight simulator to record flight parameters for comparative studies of flight-crew performance.

The carrier received six QARs and a ground analysis system from the FAA's Structural Loads Program, and uses the equipment for both the Structural Loads Program and FOQA. Its program comprises data collection, analysis and trending. Alaska Airlines has been collecting flight-simulator data similar to the QAR-captured data and compares the simulator results to how pilots fly on the line. Clark said that the airline has not approached individual crewmembers, however.

"We have had great successes comparing QAR data to flight-simulator data — it should be the same — and we have made improvements and changes in our training department," said Clark. "FOQA is not the end-all answer. To be able to access this data, to find out what happened and talk with the crew about why it happened, and if there is a hazard, identify it and make a positive change — that's the proper way to use it. In the proper context, FOQA can be used all kinds of great ways. [But] if you take steps to shut down communication, to treat safety data inappropriately, you are in effect shutting down safety programs ... [and] we would be better off to stay with the status quo. The whole idea is to identify hazards."

Clark believes that the flying public deserves a FOQA program at every airline and that airlines and regulators need to work together to improve the aviation system.

"We are competitors in business, but there are no competitors in flight safety."

"We are competitors in business, but there are no competitors in flight safety," said Clark. "We are working hand in hand in the FOQA demonstration program with other airlines that are members of the Air Transport Association [of America], for example. We have no safety secrets. We talk. We work at this together. The biggest hurdle was to get pilots to buy in to FOQA. We approached that by getting the people involved who were dead set against it. We said, 'If we can't win them over, we don't deserve to have a FOQA program.' They became the checks and balances in the program. They are people you absolutely want involved. It took two and a half years of contract negotiations to get this ironed out."

Continental Airlines analyzes descent rates on approaches. First Officer Al Baldwin, FOQA program manager for Continental Airlines, said that the air carrier has equipped 38 Boeing 737-500s, -700s and -800s with QARs. Continental Airlines has more than 100 QARs on order from the recorder manufacturer to be installed in all new aircraft, said Baldwin, including B-737-500s, -700s and -800s, as well as some Boeing 757s, 767s and 777s. Begun in December 1996, Continental's program has analyzed the flight data from more than 30,000 flights as of July 1998 and continues to perform data collection, analysis and trending, said Baldwin.

Continental primarily uses Penny & Giles QARs, but has two Dassault Electronique QARs on loan for testing.

Capturing more than 1,000 parameters per second on B-737-700s and -800s, and 328 parameters per second on B-737-500s, QARs store FOQA data from the digital flight-data-monitoring unit (DFDMU) on optical disks. The airline removes disks from the aircraft every seven days to 10 days during maintenance checks. Disks containing FOQA data move by secure company mail to a maintenance facility where the airline performs the analysis.

"FOQA carriers are going through the data using computers to flag only certain events automatically, such as throttle position, high rates of descent on approach, high V_{REF} speeds on approach or landing, or late flap configurations," said Baldwin. "We look at a total of 63 events." Computers used by FOQA data analysts then flag the events of interest.

"Computers flag approaches less than 500 feet above ground level if the rate of descent exceeds 1,000 feet per minute, for example," said Baldwin. "Other maximum descent rates apply to aircraft at altitudes between 500 feet and 1,000 feet and altitudes between 1,000 feet and 2,000 feet. Sometimes there is a valid explanation. We look at winds, for example, and we consider whether the flight crew was flying a visual approach to one runway while using the localizer of a parallel runway for reference."

"We are just scratching the surface using an incredible tool. We are discovering new potentials every day. We are dealing with things we didn't know were problems two years ago — and making some dramatic progress."

Baldwin said that Continental has analyzed trends from the data over time to consider any safety implications. The airline's vision for the future is to be able to review FOQA data with pilots in a training and safety-improvement context, he said.

"We have been favorably impressed by the reception of FOQA in our pilot union," said Baldwin. "We have the Independent Association of Continental Pilots on board. Pilots have been feeling very comfortable about how the data are used to this point. We haven't talked to any flight crews about the identifiable FOQA events we have seen. Within the Continental Airlines FOQA program, we are responsible for assuring that data are not misused or mismanaged."

Baldwin said that the airline's initial focus was identifying the causes of unstabilized approaches in FOQA data, involving certain approaches and runways at specific airports.

"We have had pretty remarkable results ... showing improvements in 1998 at the targeted airports or runways," said Baldwin. "We developed a top-10 list of airports where FOQA data showed unstabilized approaches. When we first started, one airport was our most serious concern. It had the highest percentage of unstable approaches by far compared to the others on the list.

"We started a flight-crew-education program a year ago. We wrote several articles about how to fly these approaches and included information in recurrent training. We put notices for Continental flight crews in our navigational-chart binders so that flight crews would be aware of the issue. We inserted a FOQA alert on the charts for five of those approaches. We are seeing a lot of improvement. We also published articles for pilots in our [Boeing] 737 monthly magazine. We passed what we learned down the line. As a result, in just one year, the airport where the most unstabilized approaches had occurred now has dropped off our top-10 list."

Baldwin said that Continental Airlines also was able to identify several situations in which flight crews exceeded aircraft-placard airspeeds [maximum airspeeds approved for normal operations by the aircraft manufacturer] and to assure that appropriate aircraft checks and maintenance were performed.

"If the airspeed was exceeded by 15 knots above placard or more, the manufacturer says that the aircraft should be inspected," said Baldwin. "FOQA has driven inspections of aircraft that maintenance personnel otherwise would not have known to perform."

FOQA data also have assisted the airline's maintenance department in troubleshooting problems such as engine-vibration and engine-temperature problems, said Baldwin.

"FOQA data have helped us analyze engine failures on relatively new aircraft by showing what happened immediately before and after the engine failure," said Baldwin. "That capability has broad implications for recently delivered aircraft. We also have used FOQA analysis for warranty claims ... some information from FOQA augments our ability to analyze data from the aircraft-condition-monitoring system, which is built into the Teledyne DFDMU on board."

Continental's FOQA analysts also have performed special fuel-consumption studies based on flight-control drag, he said. They are based on correlation of flight-control-drag events and fuel data that show aircraft using more fuel than normal.

Baldwin said, "There is potential for significant cost savings. We are on the cusp of fully using FOQA information — such as looking at rigging problems and excessive drag — that may or may not make its way back to the aircraft manufacturer. From the safety standpoint, if you burn more fuel [than planned], then your calculations are off for alternate airports under instrument flight rules."

Baldwin said that trend information derived from FOQA data has been shared among U.S. air carriers, but identifiable FOQA data have been guarded securely within airlines, with most airline programs erasing identifiable data within seven days.

Continental FOQA analysts have focused their time on the safety uses of the data. Baldwin said, however, that he expects the most obvious economic benefits will come from operational and maintenance uses of the data.

"That's how FOQA will succeed. It's difficult to quantify that you are saving money by avoiding accidents," said Baldwin. "Personally I am concentrating on safety. We are just scratching the surface using an incredible tool. We are discovering new potentials every day. We are dealing with things we didn't know were problems two years ago — and making some dramatic progress. We've gone from discovering problems to almost having them fixed within two years."

United Airlines expands focus to system performance. Capt. Jeff Bayless, manager of FOQA and an Airbus A320 pilot at United, said that the air carrier's FOQA program, begun in 1995, has 100 aircraft equipped with QARs and had collected FOQA data for more than 33,240 flights as of June 1998. The participating aircraft include Boeing 737-500s and 777s, and Airbus A319s and A320s. Bayless said that United also has been working to equip all Boeing 767-300s with QARs for a B-767 FOQA program under development.

United plans to equip 200 or more aircraft by 2000, including all new aircraft on order, he said. All United FOQA aircraft have been equipped with Penny & Giles QARs using optical disks, except Airbus A319s, which record FOQA data on PCMCIA (Personal Computer Memory Card International Association) cards.

The FAA demonstration project funded the purchase of QARs to equip 15 Boeing 737-500s and additional data-analysis equipment for computer systems that United previously had developed. Other hardware and software were funded by United, said Bayless.

"We have expanded our FOQA program since last fall," said Bayless, "and we absolutely have expanded our focus, moving from the pilot's performance to system-performance issues, including air traffic control and aircraft issues. In our FOQA program, we don't track flight crews. Only the ALPA [Air Line Pilots Association International] representatives on our exceedance guidance team can communicate with flight crews; this adds another perspective of the data that we need to have. FOQA analysts keep the de-identified roll-up data [data captured for analysis and trending from individual exceedance events, excluding flight data before or after an event]."

Bayless said that the appropriate way to communicate with all flight crews concerning FOQA findings depends on the type of exceedance event. United's data from many flights to Mexico City, for example, appeared to show glideslope exceedance events on instrument-landing-system (ILS) approaches. Further review, however, showed that normal maneuvers during visual approaches were causing the exceedance events, he said.

"United has the only FOQA program I know with three levels of exceedances," Bayless said. "Level 1 covers routine issues such as taxiing speed or taxiway roughness, where we use the data to tell air traffic control that they need to repave. We want our FOQA data to drive the process of fixing the [aviation] system. We have been working with NASA's APMS program. We want to capture the entire flight, not just the exceedance events at the ends of the envelope. We want to know what is normal for approach speeds, for example."

United's FOQA data analysis of exceedance events and trending has been similar to other airlines in the FAA demonstration project, he said. Collaboration with NASA's APMS to capture "full flights" in the analysis has been an additional focus at United.

"When we have it up and running, full-flight capture will be operational for the entire fleet," said Bayless. "Right now, stabilized-approach criteria are in a book that defines the exceedance values. We don't know how close every flight crew is to the exceedance, however. Now we're only trapping an exceedance. Next, we want to trap the entire flight. We want to know where the mean or the norm is. We want to look at the ends of the bell curve [in graphing results]."

"We want our FOQA data to drive the process of fixing the [aviation] system."

Another anticipated capability of United's FOQA full-flight concept will be the study of data — such as oil temperature for the last six or 10 flights — on a time line correlating maintenance parameters with flight parameters.

"Full-flight FOQA information is being recorded now," said Bayless. "We are waiting for software development to capture it in a way that we can use, but the software doesn't exist yet. We need the software to pull out specific parameters such as the last 15 days of oil-pressure data." United uses FOQA data-analysis software from Flight Data Company Ltd., he said. The software is modified to accommodate each type of QAR, he said.

Bayless said that United also has been creating special projects for using FOQA data, such as noise-abatement monitoring at John Wayne Airport, Orange County, California, U.S.

"We have been monitoring the Orange County airport's noise-abatement flight procedures for internal study," said Bayless.

In another special project, Bayless said that United's FOQA analysts documented several false ground-proximity warning system (GPWS) warnings indicating that aircraft had descended below the glideslope on approaches to Runway 31 at La Guardia Airport, Flushing, New York, U.S.

"We contacted the tower because Runway 31 doesn't have a glideslope," said Bayless. "We asked the flight crews if they had received the warning shown in the FOQA data and they said, 'Yes, we did get the warning and we told the airport we got a false GPWS warning.' We learned that the airport had left the glideslope signal turned on for Runway 13, [so the problem was identified]," said Bayless.

Reports by United's flight crews of false GPWS warnings on approaches to Monterey (California, U.S.) Peninsula Airport prompted another special study.

"We proposed a new visual approach, a flight management system visual approach, into Monterey," said Bayless. "To develop it, we used an enhanced GPWS terrain map to assist ATC in designing an approach that brings aircraft through a mountainous area in the safest way to avoid setting off the GPWS warning. Further development, approval and implementation are in the hands of FAA at this point."♦

[FSF editorial note: FAA's Longridge said that while there have been no new FOQA program implementations as of August 1998, several airlines have been planning for FOQA and are poised to implement their programs.]

These airlines have equipped a number of their aircraft with QARs, from seven aircraft at Alaska Airlines to 52 aircraft at United.

The number of parameters continuously recorded on the QARs ranges from about 38 to more than 300, depending on the airline and the type of aircraft.

Alaska Airlines

Alaska Airlines has equipped six McDonnell Douglas MD-80s and one Boeing 737-400 with QARs. In addition, Alaska [Airlines] has equipped a flight simulator with equipment to record hundreds of flight parameters. Begun in July 1996, the program has analyzed the flight data from over 5,000 flights [as of late 1997]. Still in the early stages of the program, Alaska [Airlines] plans to "go slow" and refine its program. Alaska Airlines' FOQA manager said that the airline may eventually equip every aircraft in its fleet.

Unlike Continental, United, and US Airways, which are Level-1 participants in DEMOPROJ, Alaska [Airlines] is a not yet a full partner in DEMOPROJ because it has only recently secured the required agreement with its pilot union on FOQA.

[FSF editorial note: Alaska Airlines became a Level-1 participant in April 1998.]

The airline, however, has received six QARs and a ground analysis system from FAA's Structural Loads Program. Alaska uses the equipment and analysis system for both the Structural Loads Program and FOQA.

Aviation Performance Measuring System Develops FOQA Software Prototypes

FSF Editorial Staff

The Aviation Performance Measuring System (APMS) is developing a new generation of software tools, algorithms and methodologies to convert flight-recorded data into useful information about the operational performance of the U.S. aviation system, said Irving C. Statler, APMS project manager at the Ames Research Center of the U.S. National Aeronautics and Space Administration (NASA).

The five-year-old APMS project is a collaborative research-and-development effort by NASA, the U.S. Federal Aviation Administration (FAA), participating U.S. airlines and vendors of flight-data-analysis software. Statler said that APMS developers maintain a close working relationship with FAA's flight operations quality assurance (FOQA) demonstration project, in which airlines use commercial, off-the-shelf hardware and software for flight-data collection and analysis.

"The data bus of a modern aircraft provides a gold mine of data about the aircraft and its performance," said Statler. "One objective of the APMS project is to demonstrate to U.S. air carriers that very large quantities of flight-recorded data can be monitored, processed and analyzed efficiently and usefully."

The APMS developers have been creating software that adds new data-analysis capabilities compared to current commercially available analytic methods that primarily count special events or exceedances (activities that exceed specified values) by users, he said.

"These existing capabilities, while of proven value, were created primarily with the needs of flight crews in mind," said Statler. "There is a great deal of valuable information that is being ignored when one focuses on special events or exceedances. Exceedances are rare events.

"A focus on the identification of exceedances can fail to convey the whole picture, and may, in some instances, present misleading information. The information that is being discarded in the other 97 percent of the data can tell us about reality — what is really happening during normal flight operations ... and can provide the bases for meaningful trend and statistical analysis."

The APMS project will help airline analysts to evaluate the operational performance of air carriers and flight crews in support of FOQA programs and Advanced Qualification Programs (AQP), said Statler.

APMS software acquires the flight data from quick-access recorders' recording media carried aboard aircraft, and stores these data in a database with a client-server management system. The database can be accessed by commercial software that automatically identifies exceedances.

APMS has added knowledge-based software to this process to help FOQA analysts to detect, verify, interpret and track specified aircraft events, said Statler.

The APMS database functions also enable FOQA analysts to study statistical characteristics of data and explore the database. Related flight-animation software provides feedback to flight crews and helps FOQA analysts to interpret the circumstances of an exceedance.

FAA provided most of the US$3 million that has been spent to date for APMS development, said Statler, and NASA has provided funding and technical management.

"Currently, APMS products are being developed in collaboration with Alaska Airlines and United Airlines," said Statler. "During fiscal year 1997, some of the software tools — including capabilities for statistical analyses of all flights to observe normal, routine operations of a fleet of aircraft — were demonstrated in the operational environment of Alaska Airlines using data collected aboard six McDonnell Douglas MD-80 aircraft. These software tools and new tools will continue to evolve in a series of [APMS revisions] customized to the needs of Alaska Airlines. APMS also will be demonstrated to United during fiscal year 1998 in an initial software build customized to the airline's fleet of about 40 Airbus A320 aircraft with special emphasis on the automated aids to assist in analyses of special events."

Statler said that during fiscal year 1998, FAA funding will support the continued development of the APMS database management and architecture, a search tool and a singular-value-decomposition (SVD) flagging filter. (SVD is a statistical concept that provides a way to characterize a complex multivariate process — such as one flight of an aircraft from push back to taxi in — using a few definitive features, he said.)

FAA also has funded the development of refinements to the APMS software for database management and architecture to process flight data routinely, said Statler. NASA funding will be used to document these capabilities, functionalities, and interfaces for APMS software, he said.

Statler said that the search tool enables analysts to search any portion of a FOQA database, or the entire database, for any pattern of flight parameters specified by the analyst.

The analyst can specify a complex set of criteria for identifying a data pattern of interest, such as an unstabilized approach by an aircraft. At the conclusion of the search, the analyst sees a tabulation of the flights in which the specified criteria have been found.

"NASA will fund further research to explore the feasibility of automated pattern recognition and pattern specification," said Statler. "We will also extend the capability of the current search tool to provide knowledge-based guided exploration."

With new funding by NASA's Aviation Safety Program, the concepts of APMS will be extended beyond the current emphasis on flight operations at major air carriers, said Statler. APMS concepts also would support airline engineering, maintenance and training; other aviation-industry segments; and air traffic control in collaboration with FAA and the National Air Traffic Controllers Association, he said.

Statler said that the SVD flagging filter automatically reviews each FOQA aircraft flight and alerts the safety manager if the flight is not considered typical when compared to a normal baseline.

"The concept of searching for atypical flights, as it was demonstrated at Alaska Airlines, complements the process of searching for exceedances," said Statler. "If the rules are often 'bent,' the consequences may be identified in the search for special events, but may not be found in the search for atypicality. On the other hand, the search for atypicality may reveal unexpected phenomena and/or emerging problems that cannot be detected by the existing prescribed definitions of exceedances. It is a tool to encourage exploration by FOQA analysts because it may bring unexpected occurrences to the attention of the analyst — even if it may be only some unusual manifestation of the failure of some sensor."♦

Continental Airlines

Continental has equipped 15 Boeing 737-500s with QARs. In addition, Continental plans to equip with QARs all new aircraft on order. These include Boeing 737-500s, -600s, -700s and -800s and a number of Boeing 757s. Begun in December 1996, Continental's program has analyzed the flight data from more than 11,000 flights [as of late 1997]. According to the program manager, this program is in the data-collection phase and will soon be making the transition to the data-analysis and trending phase.

United Airlines

United Airlines has the largest and longest-running FOQA program of any U.S. airline, begun in 1995. As of August 1997, United had 52 aircraft equipped with QARs and had collected FOQA data on more than 25,000 flights. The aircraft currently equipped include Boeing 737-500s and 777s, and Airbus A319s and A320s. United plans to equip over 120 aircraft by 1999, including all new aircraft currently on order. DEMOPROJ has funded the purchase of QARs to equip 15 Boeing 737-500s and additional data-analysis packages and computer equipment to run on systems that United had already established. The remainder of the hardware and software was purchased by United, which has been tracking and correcting exceedance events [in 1996 and 1997]. United has identified and taken corrective action to reduce the incidence of a number of safety-related and maintenance-related exceedances.

US Airways

US Airways has 23 QAR-equipped aircraft. Its program, begun in September 1996, has collected FOQA data on more than 18,000 flights [as of late 1997]. Aircraft equipped include Boeing 737-400s and 767s. US Airways, however, characterizes its program as being in the data-collection and troubleshooting phase and just beginning the data analysis and trending phase. DEMOPROJ has funded the purchase of QARs to equip 15 Boeing 737-400s and a ground analysis system. Six additional 737-400s have been equipped with QARs paid for by a separate FAA program, the Structural Loads Program. In addition to these aircraft, US Airways is in the process of purchasing QARs and equipping 12 Boeing 767s. Data from all QARs are being accessed by both programs. DEMOPROJ has also funded a trial program of a wireless ground data-link system with five specially equipped Boeing 757s.

Appendix III: FAA's Related Technical Programs

Aviation Performance Measuring System

In 1993, FAA contracted with NASA to establish and demonstrate the feasibility of developing [the APMS.] [See "Aviation Performance Measuring System Develops FOQA Software Prototypes," page 30.] The objective of the APMS effort is to develop tools and methodologies to allow large quantities of flight data to be processed in a highly automated manner to address questions relating to operational performance and safety. APMS is concerned with converting flight data into useful safety information in support of the national air-transport system, airlines and air crews. Although concerned with all aspects of flight operations, APMS primarily will develop an objective method for continuously evaluating air crews' technical performance in support of FOQA and the AQP (discussed below).

Current FOQA programs focus on exceedances; APMS, however, will expand FOQA's scope by using all collected flight data. The tools will facilitate multiple functions, including the acquisition of flight data, their storage in a database management system, the study of statistical characteristics and trends, the development of "data mining" techniques and better methods of visualizing flight data. APMS will also investigate flight animation capabilities to assist flight crews in replaying and understanding exceedances. Finally, APMS will facilitate the sharing of data among databases, products and interested parties. NASA said one of the most important components to be developed by APMS is a risk-assessment tool to measure how much risk is associated with certain activities, for example, the risk of flights to and from certain airports.

After APMS began in 1993, the project documented the status of the technologies, systems and software used by non-U.S. airlines with FOQA programs. According to [Irving C. Statler,] the NASA project manager, the project has conducted user needs studies at Alaska Airlines, United and US Airways and has commitments to conduct user needs studies at America West, Comair, Trans World and United Parcel Service. The APMS team is also building prototype systems at several airlines. Alaska Airlines is now in its third prototype APMS system. The project was scheduled to begin building the initial prototype system at United on Nov. 1, 1997. Eventually the developed technology will be transferred to industry so that a relatively low-cost system will be commercially available. APMS management hopes to initiate the transfer of this technology to commercial vendors in 12 to 18 months.

[As of late 1997], NASA has received $2.9 million in funding from FAA for the development of APMS. NASA contributed $300,000 to the project in fiscal year 1997. The extent of future NASA and FAA funding for further development and implementation of APMS has not yet been determined.

Structural Loads Program

As part of FAA's Aging Aircraft Research and Development Program, the Structural Loads Program is a cooperative FAA and NASA effort to collect information about the external loads to which airframe components are subjected during flight. The collected data will be used to develop and maintain an extensive database of transport-aircraft usage to continuously validate and update flight and landing-load airworthiness-certification standards on the basis of actual measured usage. As of late 1997, the Structural Loads Program has equipped with QARs six [McDonnell Douglas] MD-80s at Alaska Airlines and six Boeing 737-400s at US Airways. Data collected from these QARs are also being made available for FOQA analysis.

Advanced Qualification Program

FAA's AQP is an alternate method of qualifying, training, certifying and ensuring the competency of flight crewmembers and other operations personnel subject to the training and evaluation requirements of FARs Part 121 and [Part] 135. AQP's intent is to achieve the highest possible standards of individual and crew performance without undue increases in training costs. FOQA and APMS will be used to continuously evaluate air crews' technical skills and airlines' procedures and training in support of AQP. For example, FOQA data could be used to identify problems occurring during recurrent flight-simulator training and to highlight training areas for increased emphasis.

[FSF editorial note: During 1998, some airlines in FAA's FOQA demonstration project compared FOQA data from their aircraft to flight-crew-performance data captured from flight simulators. FAA's Longridge said, "This capability would be used to determine the extent to which performance on given maneuvers in the aircraft is representative of performance in the simulator, and vice versa. For major airlines, flight simulators are the primary tool for developing and checking pilot proficiency, (so it is) important that the simulator environment and associated pilot performance (represent) what occurs in actual flight operations."]

Global Analysis and Information Network

The Global Analysis and Information Network (GAIN) is a concept being actively explored by the aviation community to facilitate the analysis, sharing and dissemination of aviation-safety information with a goal of achieving zero accidents. GAIN would have many information sources — FOQA information would be one of the most important. Proposed by FAA in May 1996, GAIN will function as a "significantly improved operational early-warning capability that is sensitive enough to detect and alert the aviation community to existing and emerging problems." Information will be shared among airlines and manufacturers and at the different functional levels within organizations. Although GAIN is still in the conceptual phase, the aviation community and FAA are working to address the needs and concerns of prospective members as well as explore designs for a prototype system.

Appendix IV: FAA's Voluntary Safety Reporting: Selected Programs

FAA has implemented a number of voluntary programs involving the self-reporting of safety-related information to enhance aviation safety. Although these programs involve the reporting of information by people instead of by automated systems, they are similar to FOQA in that they involve voluntary efforts to identify and correct potential safety problems. [GAO has] highlighted three such programs.

Aviation Safety Reporting Program

Established by FAA in 1975 and administered by NASA, ASRP promotes the voluntary reporting of problems into the ASRS [database]. Under [federal regulations], FAA will not use reports submitted under the program in any enforcement action (except accidents or criminal offenses). Under FAA's policy, although a finding of a violation may be made, no sanction will be imposed if the violation was inadvertent and not deliberate; the violation did not involve a criminal offense or an accident or an action that discloses a lack of qualification or competency; the person filing the report has not been found in any prior FAA enforcement action to have committed a violation of FARs or law within a period of five years prior to the occurrence; and the report was filed within 10 days after the violation.

Air Carrier Voluntary Disclosure Reporting Procedures

Initiated by FAA in 1990 for air carriers (an assistant chief counsel at FAA said that the procedures have since been expanded to include production approval holders and repair stations), the [ACVDRP] encourage airlines to disclose promptly to FAA any instances of noncompliance with the requirements for maintenance, flight operations and security. FAA initiated a policy of forgoing civil-penalty actions if five conditions are met: The certificate holder immediately notifies FAA of the apparent violation after detecting it and before the agency learns of it; the apparent violation is inadvertent; the apparent violation does not indicate a lack, or reasonable question, of the basic qualification of the certificate holder; immediate action must have been taken, or begun, upon discovery to terminate the conduct that resulted in the apparent violation; and the certificate holder must develop and implement a comprehensive solution satisfactory to the FAA.

Aviation Safety Action Programs

FAA has established several demonstration ASAPs, including the USAir (now US Airways) Altitude Awareness Program, the Alaska Airlines Altitude Awareness Program and the American Airlines [Aviation Safety Action Partnership].

(The altitude awareness programs at US Airways and Alaska Airlines were joint programs with ALPA and FAA to eliminate altitude deviations. USAir's program, in operation from October 1990 through February 1992, and Alaska Airlines' program, in operation from August 1994 through February 1995, encouraged flight crews to report altitude problems so that corrective action could be taken. The American Airlines [Aviation Safety Action Partnership program] is a joint program with the Allied Pilots Association [American pilots' union] and FAA. Begun in June 1994, the program encourages pilots to report all types of potential safety problems.)

These programs established incentives to encourage the employees of the air carriers that are participating in the programs to disclose information and to identify possible violations of the FARs without fear of punitive legal enforcement sanctions. FAA has recently expanded the use of ASAP through the implementation of a two-year demonstration program. Under this program, apparent violations will normally be addressed with administrative action if the apparent violations do not involve deliberate misconduct, a substantial disregard for safety and security, criminal conduct or conduct that demonstrates or raises a lack of qualifications. For apparent violations not excluded under an ASAP, neither administrative action nor punitive legal-enforcement actions will be taken against an individual unless there is sufficient evidence of the violation other than the individual's safety-related report.

[FSF editorial note: See "Federal Court Ruling Praised, Safety Data Confidentiality Upheld," page 35.]

Appendix V: Discovery-related Court Actions

Airline officials and pilot unions' representatives are concerned about the use of discovery in civil litigation to reveal voluntarily collected safety information. In two recent cases, the courts have sought to find a balance between the airlines' desire to protect such information and the plaintiffs' right to a fair trial. In one case, the documents were required to be produced, but under a protective order. In the other case, the court recognized a new qualified privilege.

In 1995, the U.S. District Court, District of South Carolina, Columbia Division, rejected USAir Inc.'s (USAir changed its name to US Airways on Feb. 27, 1997) argument that certain safety data were protected under the self-critical-evaluation privilege. (Court Order of Oct. 26, 1995, In re Air Crash at Charlotte, North Carolina, on July 2, 1994, MDL Docket No. 1041 [D.S.C. 1995]). This privilege, when recognized, protects documents that reflect self-analysis.

The district court noted that the self-critical-evaluation privilege is a privilege of recent origin and one that is narrowly applied even in those jurisdictions where it is recognized. The court described the privilege by citing Dowling vs. American Hawaii Cruises Inc., 971 F.2d 423, 425-426 (9th Cir. 1992), which explained:

> (O)ther courts have generally required that the party asserting the privilege demonstrate that the material to be protected satisfies at least three criteria: first, the information must result from a critical self-analysis undertaken by the party seeking protection; second, the public must have a strong interest in preserving the free flow of the type of information sought; finally, the information must be of the type whose flow would be curtailed if discovery were allowed. … To these requirements should be added the general proviso that no document will be accorded a privilege unless it was prepared with the expectation that it would be kept confidential, and has in fact been kept confidential.

The court found that the safety documents did not meet the criteria for the privilege. According to the court, the most significant stumbling block for the airline was meeting the third criterion — that the flow of the information would be curtailed if discovery was allowed. Specifically, the court found that the airline industry is highly competitive and tightly regulated, and that airlines have a keen interest in advancing and promoting safety as well as services. Thus, the court reasoned that the airlines were likely to conduct internal audits. The court reasoned that while the disclosure of such audits to competitors would deter their use in the future, disclosure for limited use in litigation is unlikely to have such an impact.

Subsequently, the court limited the possible uses of the documents it ordered to be produced. Specifically, the court ordered:

> Plaintiff and their counsel shall be prohibited from disclosing, disseminating or communicating in any manner to any person or entity not involved in this litigation any portion of the information contained in those documents. … Plaintiff and their counsel shall be further precluded from utilizing these documents or the information contained in them for any purpose other than for this multidistrict litigation.
>
> In furtherance of this order, plaintiffs' counsel shall insure that each person who is to be given access to the referenced documents, including plaintiff and their attorneys, shall first sign a document acknowledging that they are aware of and will comply with this order. Plaintiffs' counsel shall maintain a list of those persons which shall be provided to USAir's attorney upon request, subject to protection upon application to this court for good cause shown. (Court Order of Nov. 14, 1995, In re Air Crash at Charlotte, North Carolina, on July 2, 1994, MDL Docket No. 1041 [D.S.C. 1995].)

In October 1996, the Supreme Court let stand the district-court order rejecting the airline's assertion of a self-critical-evaluation privilege. (65 U.S.L.W. 3221 [Oct. 8, 1996].)

Recently, in another case involving documents prepared by American Airlines' employees collected under the American Airlines [Aviation Safety Action Partnership], the U.S. District Court, Southern District of Florida, on a motion for reconsideration, also rejected the airline's self-critical-analysis privilege claim. However, in this case the court recognized a new qualified privilege to protect these documents. (In re Air Crash Near Cali, Colombia, on Dec. 20, 1995, 959 F. Supp. 1529 [S.D. Fla. 1997].)

[FSF editorial note: See "Federal Court Ruling Praised, Safety Data Confidentiality Upheld," page 35.]

With respect to the self-critical-analysis privilege, the court stated that "the touchstone of a self-critical analysis is that it is an 'in-house' review undertaken primarily, if not exclusively, for the purpose of internal quality control." In this case, the court rejected the application of the privilege, finding the following:

(continued on page 36)

Federal Court Ruling Praised, Safety Data Confidentiality Upheld

FSF Editorial Staff

A U.S. District Court judge's decision upholding the right of an airline to withhold information collected in nonpunitive safety-reporting programs is an important first step toward expanding the programs throughout the commercial aviation industry and reducing accidents, said Stuart Matthews, president, chairman and chief executive officer of Flight Safety Foundation.

"Nonpunitive reporting of inadvertent and nonegregious human errors and trend monitoring has proven itself a valuable tool in correcting problems before they lead to an accident," said Matthews. "The Foundation has supported such programs for many years as a means to learn and correct the reasons for errors."

Matthews said that such programs were put at risk in connection with federal civil court proceedings stemming from a December 1995 accident near Cali, Colombia, involving an American Airlines Boeing 757.

Attorneys representing relatives and the estates of some of the 159 people killed in the accident had demanded that American Airlines disclose 23 documents obtained from the airline's Aviation Safety Action Partnership (ASAP) program. American Airlines argued that the information was privileged and should not be disclosed.

[FSF editorial note: This article uses ASAP to mean American Airline's program, not all FAA ASAPs.]

U.S. District Judge Stanley Marcus ruled on Feb. 7, 1997, that ASAP data are "entitled to qualified privilege" and denied the plaintiffs access to them. "American has made a compelling argument for recognition of a limited common-law privilege for the ASAP materials," Marcus wrote in his opinion. Marcus noted that "some observers view [the ASAP program] as a 'prototype for future partnership programs between the airlines and the FAA [U.S. Federal Aviation Administration] to promote safety.'"

In a letter to the court before the ruling in the federal Southern District of Florida, Matthews said: "In the United States, there are a number of airline programs similar to American's ASAP that analyze flight data recorders to identify adverse trends and voluntary pilot 'error-reporting' systems. Fundamental to the success of such programs is the premise that the information disclosed is provided for the purpose of improving safety and is not to be used to penalize those making reports. This approach has been endorsed by pilots, their unions, management and the FAA.

"Such programs will remain successful only if their confidential nature remains intact. ASAP uses strict assurances of confidentiality to encourage pilots to voluntarily report all safety issues, including incidents or violations of regulations. Disclosure of confidential ASAP material would most assuredly reduce the willingness of pilots to report incidents, and would thereby decrease the availability of safety information, and the program would be less meaningful for safety trend analysis."

Matthews concluded: "The disclosure of confidential ASAP reports to outside parties would have a chilling effect on the program's future and could lead to its termination. The Foundation believes that the demise of the American Airlines ASAP program would be a setback not only for American Airlines, but also for other similar programs and would adversely affect their demonstrated potential for improving the overall safety of commercial aviation."

According to American Airlines officials, the ASAP program is designed "to identify and to reduce or eliminate possible flight safety concerns" and to minimize deviations from U.S. Federal Aviation Regulations, which could include "altitude, heading, speed and other deviations during flight, taxiway or runway incursions during ground operations and navigational or terrain-avoidance problems."

In the ASAP program, error reports are collected electronically, and de-identified reports are reviewed weekly by a "joint committee [comprising] representatives from American, FAA and APA [Allied Pilots Association]," the court decision said.

In his ruling, Marcus agreed with Matthews, American Airlines, and representatives of the Air Transport Association of America and pilot unions, and noted that "without privilege, pilots might be hesitant to come forward with candid information about in-flight occurrences, and airlines would be reluctant, if not altogether unwilling, to investigate and document the kind of incidental violations and general flight-safety concerns whose disclosure is safeguarded by the ASAP program."

Marcus concluded: "There is a genuine risk of a meaningful and irreparable chill from the compelled disclosure of ASAP materials in connection with the pending litigation."

But the court stopped short of ruling that the ASAP data were protected by an "absolute privilege."

Although Marcus said that plaintiffs' attorneys had not "made a showing adequate to overcome American's qualified privilege," he ruled that the court would reconsider its ruling if the plaintiffs "came forward with a persuasive showing of need and hardship." Marcus said that in that event the ASAP documents submitted to the court would be reviewed by the court alone, without disclosure, to "evaluate whether the plaintiffs' interests overcome the powerful interests that weigh in favor of preserving the confidentiality of the ASAP documents."

Matthews called on the U.S. Congress to enact legislation to protect data gathered by FAA-approved programs such as ASAP to ensure that such information remains confidential and is not subject to civil court opinions after accidents occur.

"Without this legislation, these prototype programs in the United States will never mature to allow a widespread network of safety-data exchange among airlines, manufacturers and safety regulators," said Matthews. "With air traffic expected to double or even triple in the next 15 years, programs like ASAP are vital. Without them we could see the number of aviation accidents each year double as traffic increases."♦

> Even assuming that the materials prepared by American's pilots in conjunction with the ASAP program may be of a type whose creation might be curtailed if discovery is allowed, these materials were prepared for dissemination to representatives of entities unaffiliated with American (a federal regulatory agency and a union).

The court, however, recognized a new, qualified common-law privilege for the ASAP materials. In recognizing a new privilege, the court considered the principles for evaluating claims of federal common-law privileges recently articulated in the Supreme Court case, Jaffee vs. Redmond, [518 U.S. 1] (1996): the "private interest" involved — in other words, whether the dissemination of the information would chill the frank and complete disclosure of fact; the "public interests" furthered by the proposed privilege; the "likely evidentiary benefit that would result from the denial of the privilege"; and the extent to which the privilege has been recognized by state courts and legislatures (the court recognized a psychotherapist-patient privilege in this case).

The court found that American had met its burden of proving that a qualified "ASAP privilege" is appropriate. Specifically, the court stated as follows:

> The ASAP materials in dispute … were prepared voluntarily, in confidence and for use in a discrete, limited context in cooperation with the FAA and the pilot's union. There is a genuine risk of meaningful and irreparable chill from the compelled disclosure of ASAP materials in connection with the pending litigation.

The court specified that the privilege should be qualified. Accordingly, the plaintiffs could overcome the privilege with a persuasive showing of need and hardship. The plaintiffs did not make such a showing in the case.♦

About this Report

This report was published in December 1997 as *Aviation Safety: Efforts to Implement Flight Operational Quality Assurance Programs*, GAO/RCED-98-10, a Report to Congressional Requesters. The 38-page report includes tables and appendixes. The report's information has been updated and/or changed (noted by brackets [ ]) by FSF editorial staff in this reprint.

To obtain the information in this report, [GAO] reviewed [the FAA] FOQA demonstration project's requirements, policies and plans to assist airlines in implementing FOQA programs. [GAO staff] discussed specific details of the project with FAA's deputy associate administrator for regulation and certification as well as the demonstration project's program manager and contractor. [GAO staff] conducted interviews with FAA and NASA officials responsible for developing the Aviation Performance Measuring System. [GAO staff] discussed FOQA issues with the NTSB. [GAO staff] interviewed representatives of each of the 10 largest passenger airlines: Alaska Airlines, America West, American, Continental, Delta, Northwest, Southwest, Trans World, United and US Airways; representatives of each of the four unions — ALPA, APA, the Independent Association of Continental Pilots and Southwest Airlines Pilot Association — representing the pilots of these airlines; and United Parcel Service. [GAO staff] also conducted interviews with the ATA, the Foundation and vendors providing hardware and software for the demonstration project. Last, [GAO staff] interviewed and collected information from [non-U.S.] airlines and [the United Kingdom's] Civil Aviation Authority on their respective FOQA efforts.

Major contributors to the [GAO] report were David E. Bryant Jr., Thomas F. Noone and Robert E. White of the GAO Resources, Community and Economic Development Division, and Mindi Weisenbloom of the GAO Office of the General Counsel.

[GAO] provided copies of a draft of this report to the U.S. Department of Transportation and FAA for their review and comment. [GAO staff] met with officials, including FAA's deputy associate administrator for regulation and certification and the [FOQA] demonstration project's program manager. They agreed with the report and provided several technical corrections, which were incorporated into the report.

FSF Study Report Urges Application of Flight Operational Quality Assurance Methods in U.S. Air Carrier Operations

Flight Safety Foundation completed a pivotal study in 1993 on the requirements, costs and implementation issues involved in initiating flight operational quality assurance programs at U.S. airlines.

John H. Enders

[FSF editorial note: Flight Safety Foundation submitted a final 252-page report, *Air Carrier Voluntary Flight Operational Quality Assurance Program*, to the U.S. Federal Aviation Administration (FAA), concluding a contract with the agency in 1993. This reprint of a summary of the report contains some updated accident data, including Figures 1–4.

The contract objectives were to conduct a study of air carrier usage of on-board data collection for analysis later, and to prepare a report on flight operational quality assurance (FOQA) program requirements, associated costs and implementation concerns. The report examined practices of airlines with FOQA programs and, based on these practices, developed technical and management information to guide airlines in voluntary FOQA implementation.]

During the past 15 years to 20 years, growing recognition of the important role that human error plays in establishing trends that may lead to airplane accidents has prompted more attention to understanding how accidents and incidents develop.

Analysis of primary causal factors in air carrier hull-loss accidents reveals that flight-crew performance is often cited as a primary factor in these accidents (Figure 1, page 38).

Many causes attributed to flight crews have their origins elsewhere: e.g., maintenance or management, manufacturer's designs that enable the crews' actions, and system errors (air traffic control [ATC] conflicts, inaccurate weather information, etc.). A program that focuses on the total scope of operational irregularities that may occur as a result of human actions throughout the system should be able to identify remedial actions that could contribute to the further improvement of safety.

Based on accident records according to the phase of flight, the vast majority of accidents occur at low altitudes and on runways during takeoff, and approach and landing phases (which together account for about 17 percent of average total mission time; Figure 2, page 39).

To maintain a perspective on air carrier accidents, it is necessary to note that the U.S.-airline accident rate improved rapidly during the 25 years following World War II, but after that period the accident rate leveled to a low, but fairly constant, rate that continues today (Figure 3, page 40). While travel risks by air are low in comparison with many other common human activities and other forms of transportation, accidents frequently are found to have been preventable, if all relevant factors had been known and acted on.

Because of this long-term steadying of the accident rate, the rate is not likely to change substantially without a new method of accident prevention. Despite the state of the economy [in the early 1990s], there is still confidence that the air transport industry will continue to grow. Thus, without an improvement in the accident rate, the number of accidents will increase and produce greater losses and a consequent loss of confidence in air travel safety (Figure 4, page 41).

One means of identifying factors that can be better controlled to reduce accidents and serious incidents is the use of digital flight data recorder (DFDR) capability in a FOQA program

Primary Cause Factors — Hull-loss Accidents*
Worldwide Commercial Jet Fleet, 1988–1997

Primary Factor	Number of Accidents	Percentage of total accidents with known causes
Flight Crew	105	70%
Airplane	15	10%
Maintenance	9	6%
Weather	7	5%
Airport/ATC	5	3%
Miscellaneous/other	8	5%
Total with known causes	149	
Unknown or awaiting reports	64	
Total	213	

* As determined by the investigative authority. ATC = air traffic control

Source: Boeing Commercial Airplane Group

Figure 1

that provides reliable data. This in turn helps in making decisions about product and procedural changes in the interests of safety improvement.

Some 25 or more non-U.S. air carriers have a form of FOQA program to analyze the safety quality of their operations and to detect subtle or insidious trends that can creep into daily operations. Experience has demonstrated that the detection of slight exceedances of flight parameters (e.g., descent rates, airspeeds, etc.) enabled operational managements to take action through such measures as information dissemination, training emphasis, ATC procedure changes, etc., to break the chain of events that sets the stage for an accident or serious incident.

The air transport industry’s long-established practice of discovering, understanding and eliminating factors that lead to incidents and accidents has been the major determinant in an impressive reduction of the civil air transport accident rate since the mid-1940s.

FDRs have been used for many years in accident investigations and in-flight structural-load-measurement programs, and have provided much of the information that has helped identify accident causes. Nevertheless, one element missing from the analyses of accidents, incidents and other events has been comprehensive, quantitative and objective information about operational trends and irregularities.

Technology now provides the means to collect and analyze a wider range of data. With the rapid growth of data-collection and data-processing capabilities, flight-data analysis has evolved rapidly during the past decade. Technologies presently used include FAA-mandated DFDR systems, airplane-condition and engine-condition monitoring, on-board data-storage hardware and software, air-to-ground data links and personal-computer data-processing capabilities.

Following a series of FSF international-seminar papers during the past decade, and two recent special workshops devoted to examining the usefulness of DFDR trend analysis, the Foundation and its International Advisory Committee concluded that the benefits attributed to properly established DFDR (or FOQA) analysis programs by user airlines should be brought to the attention of a broader air carrier audience, particularly in the United States, where the threat of liability or punitive actions against both companies and pilots has hampered beneficial safety-information transfer.

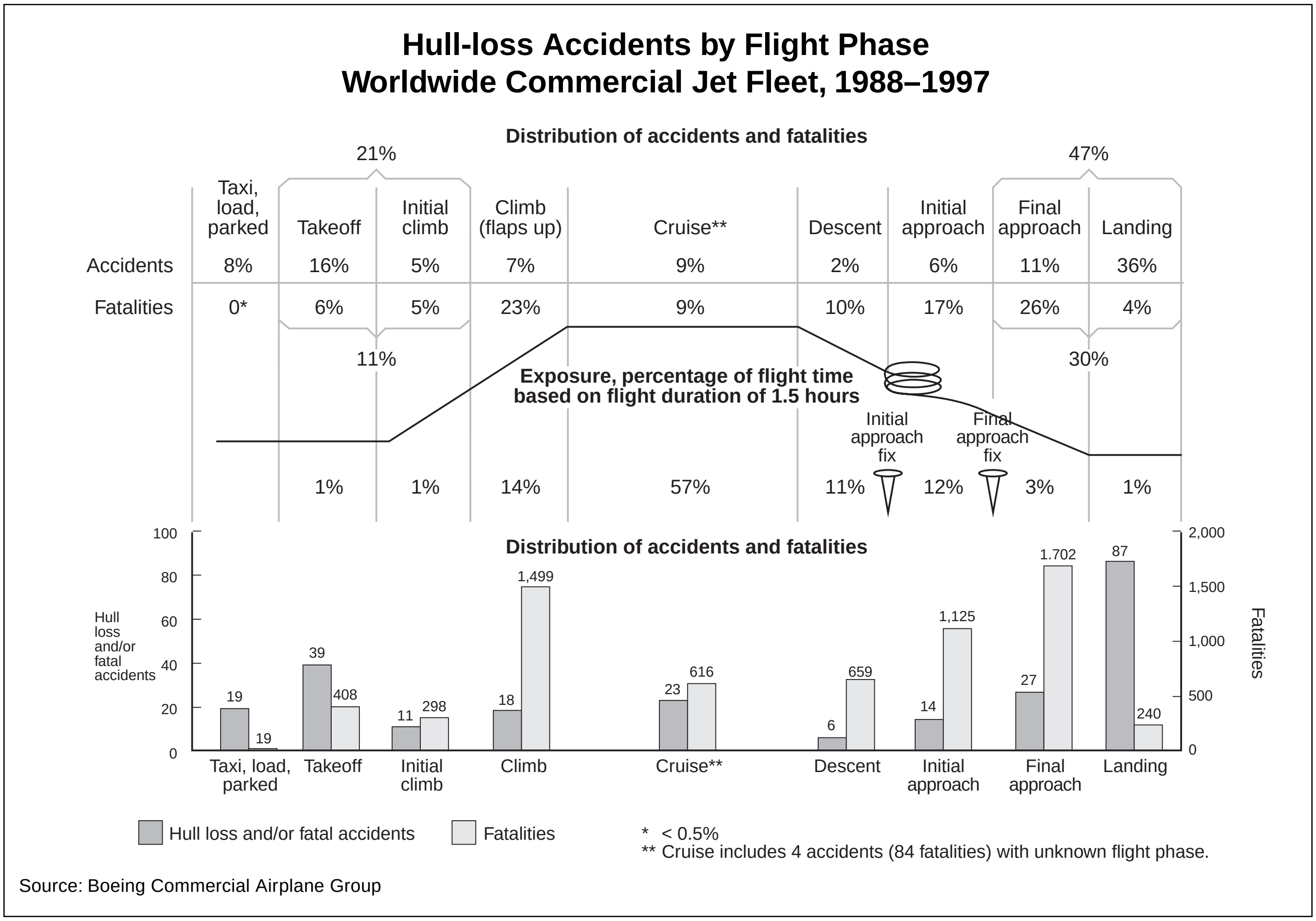


Figure 2

The concern by U.S. airlines and pilots is not unfounded. As the litigiousness of U.S. society has increased, more and more professionals find themselves at increased risk of litigation and thus desire to limit the sharing of collectively useful information because it could be used in a legal action for alleged damages.

In great part because of the FSF FOQA workshop in April 1990, in Washington, D.C., Air Transport Association of America (ATA)-member airlines, aircraft manufacturers and FAA further recognized the role that FOQA might play in improving operational flight safety. Government and the aviation industry have adopted major programs aimed at enhancing human performance in all facets of aviation, and FOQA programs can add greatly to their effectiveness.

Operational Information Remains Key to Preventing Accidents

Throughout aviation history, analysis of accident-investigation data has been a primary source of feedback to manufacturers and operators to improve safety by product and process modification.

It is a logical and desirable feature of systems that continuous safety improvement must make use of operational information of both successes and failures. Accident investigations yield much quantitative information. This information, taken together with the expert opinions of skilled and experienced investigators, can provide recommendations that organizations can depend on at a sufficient confidence level to justify the investment of the fiscal, material and human resources in product modifications and procedural changes that will lessen the likelihood of an incident or accident.

Realizing that incidents are frequently the precursors of accidents, the aviation community has been frustrated by an inability to systematically and comprehensively discover incidents that might reveal a pattern of human behavior or machine performance that could cause an accident.

A major step forward was taken 25 years ago with the establishment of the voluntary Aviation Safety Reporting Program (ASRP), which includes the Aviation Safety Reporting System operated for FAA by the U.S. National Aeronautics and Space Administration (NASA). The ASRS has permitted, on a confidential basis, the sharing of personal experiences that have compromised safety. The mere sharing

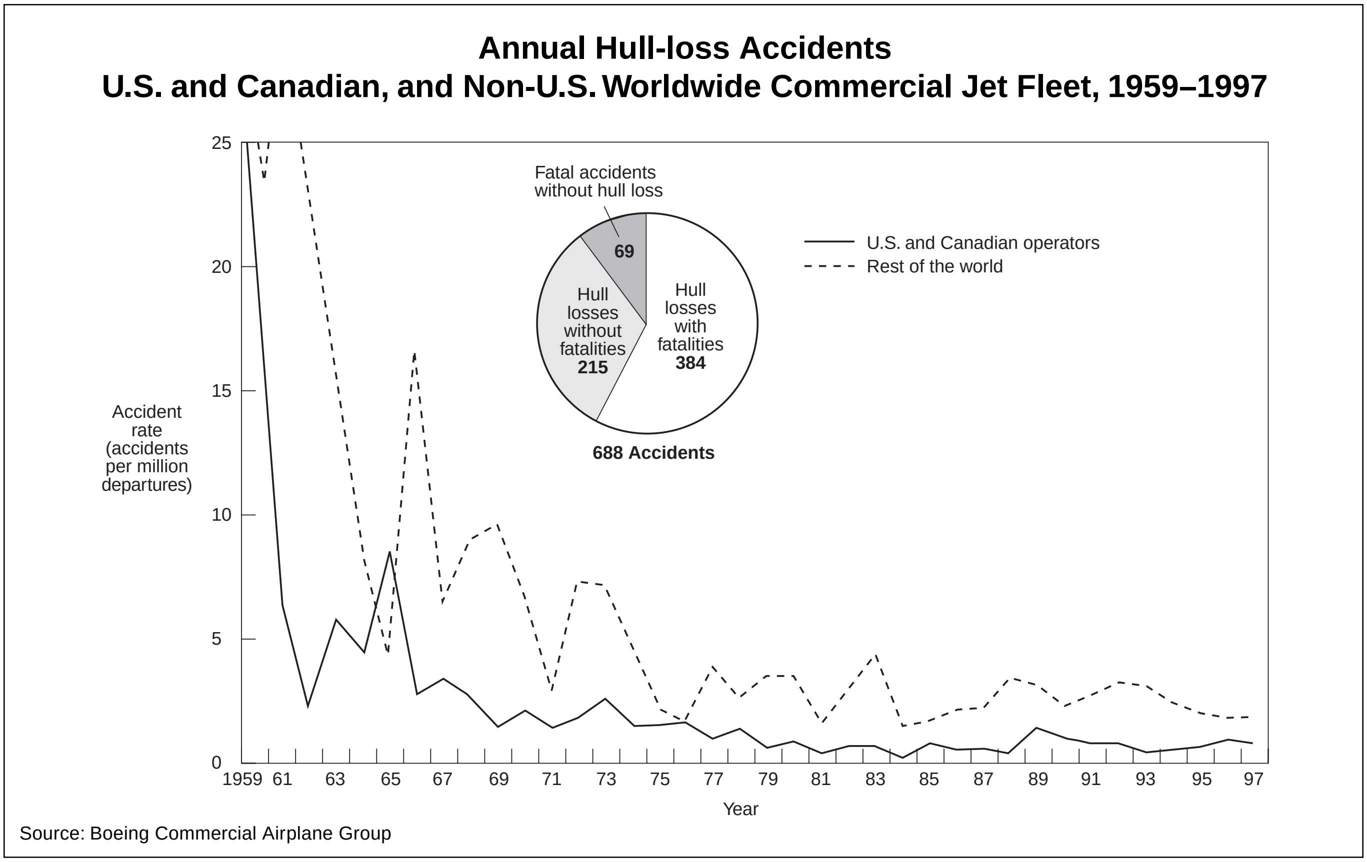


Figure 3

of these incidents has raised the awareness levels of peer aviators, [cabin crew] and controllers, with a consequent, but undetermined, reduction of risk. ASRS has yielded much useful information that has been factored into improved training, and into airspace and air traffic procedure modifications.

The advent of [DFDRs with higher capacity, removable media] has brought the ability to monitor aircraft systems for more effective and efficient maintenance.

More than 25 years ago, the U.K. Civil Aviation Authority (CAA) established its data-recording program (CAADRP), a pioneering effort that used the determination of certain threshold values for critical flight parameters to record exceedances in flight. Thus, the quantification of incident data began in a regular and rational way. The usefulness of this technique soon proved itself in identifying early indicators of erroneous actions caused by system faults, crew mistakes or design deficiencies. Corrective actions through training emphasis and changes in procedures or products can now be made confidently for accident-prevention purposes.

A major feature and underlying requirement of all successful FOQA programs is the confidentiality of information. Without protection of information, the parties involved in the cooperative effort (companies and pilots) would not accept an FDR analysis program, and a major tool for safety improvement would be lost.

Task Force Studied FOQA Implementation

The Foundation used a FOQA Task Force, organized under Technical Projects Director Robert Vandel, to study FOQA implementation issues. This task force consisted of a contract team comprising five subcontractors and an industry team comprising representatives from eight air transport industry segments. The industry team acted as an advisory panel and assisted with specific tasks.

The U.S. industry team consisted of representatives from Aeronautical Radio Inc. (ARINC), Air Line Pilots Association International (ALPA), Allied Pilots Association (APA), American Airlines, [NASA], ATA, Boeing Commercial Airplane Group, Delta Airlines, FAA, McDonnell Douglas, National Transportation Safety Board (NTSB), Northwest Airlines, and United Airlines.

Although the study's focus was on FOQA implementation among U.S. carriers, the information developed and the conclusions reached are also broadly applicable to air carriers throughout the world.

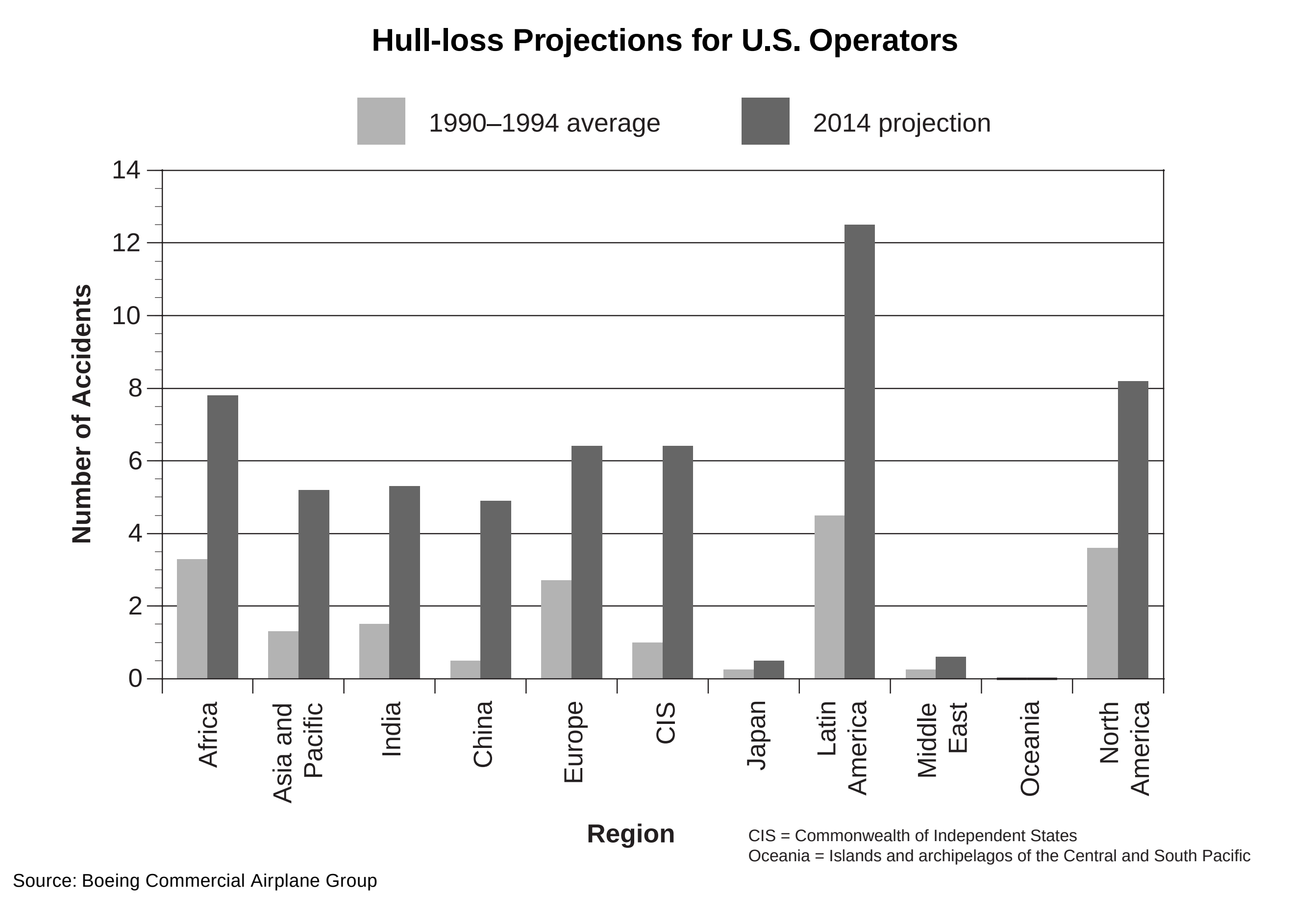


Figure 4

The FSF study recognized two main applications of the information developed: (1) the subjects pertaining to an individual airline contemplating FOQA implementation and (2) the broader issues pertaining to a national air transportation system.

The study's first objective was to collect information on all aspects of current in-flight recording programs in the air carrier environment (Table 1). This information was collected in a uniform format through selected on-site visits and questionnaires from user airlines; airframe, engine and equipment manufacturers; and from U.S. airlines using maintenance-data-recording programs. This information, augmented by a comprehensive literature survey of data-recording programs, provided a basis of information on all aspects of FOQA.

Table 1
FSF FOQA-study Sources

Organization	Total Contacted	Total Visited
Present User Airlines	25	7
Airframe Manufacturers	6	2
Equipment Manufacturers	16	8
U.S. Airlines	35	0
Engine Manufacturers	3	0

FOQA = flight operational quality assurance

Source: Flight Safety Foundation (FSF)

The study examined both the technical and the data-security aspects of FOQA. Technical aspects included the details of current FOQA programs in use among international airlines; past, present and emerging technologies in aircraft and data-system equipment; engine-data-system programs; and fleet-composition details and recording-system details. Cost data, where available, were also included.

Protection of Data Examined Carefully

Because data security is a critical issue to industry acceptance of FOQA, the approach was different for this part of the study. Acceptance of FOQA by the industry depends on the assurance that data will be handled with confidentiality.

The air carriers' concerns center on the potential for increased accident [litigation risk] and punitive actions by FAA for rule infractions that might be revealed by open sharing of FOQA data. Pilots' concerns center on punitive actions by airline management or by FAA. Both air carriers and pilots are concerned that data may become public through the federal Freedom of Information Act (FOIA) if FOQA data are given to FAA.

To deal with this critical and sensitive issue, the Foundation developed a special working group within the task force that used information derived from questionnaires about information security, identified the study objectives associated with information security, developed the issues, legal and otherwise, requiring resolution, and proposed a solution or course of action for each issue. This working group was formed under the direction of the ASRS representative of the task force and included representatives from ALPA, APA, ATA, FAA, nonunion pilots (through ALPA) and the Foundation. The working group concluded that a new FAA policy on compliance and enforcement should reduce airline and flight-crew concerns about use of FOQA data for other than safety and operational-enhancement purposes. The study also concluded the following:

- The success of the FOQA program ultimately depends on integrity and trust between management and pilots;
- An airline-management and pilot-association agreement is a key element of success because such an agreement would identify critical procedures for use and protection of data;
- Data security within airlines that proceed with a FOQA program can be optimized by:
  - Adhering to stringent agreements with pilot associations;
  - Strictly limiting data access to selected individuals within the company;
  - Maintaining tight control to ensure that linking of flight-crew names with their flight-data records is done only when absolutely necessary, and that crew identification with a particular flight is severed as soon as possible;
  - Ensuring that any operational problems are promptly addressed by management, resolved expeditiously and documented; and,
  - Destroying all identified data as soon as possible;
- Early participation of pilot associations in technical and other decisions promotes acceptance; and,
- Airlines without pilot unions should recognize the influence that a sudden announcement of a FOQA program might have on pilots if no preparatory action is taken to enlist their support. A policy statement that supports a pilot-and-management agreement is recommended.

The study recognizes that the possession of FOQA data by federal agencies makes it subject to provisions of the FOIA. Airline data therefore must be de-identified so that they cannot be linked with a specific air carrier. De-identification will prevent inappropriate and misleading comparisons of airlines that could adversely and incorrectly affect public confidence in a particular carrier.

The study also concludes that FAA's desire to use the data for safety assessments (Advanced Qualification Program [AQP]) and for other projects must be coupled with proper regulatory and, if necessary, legislative protection.

The data-protection issues are so critical to the acceptance and success of FOQA that the study concludes that such issues must be resolved before FAA releases an advisory circular on FOQA.

To this end, the study recommends that FAA vigorously address information-protection issues, and recommends that FAA:

- Continue the program begun by the FOQA Task Force to satisfy airline and flight-crew concerns about appropriate use of flight operations data;
- Require no data from any airline's FOQA program until airline and flight-crew concerns about the appropriate use of the data are resolved; and,
- Convene an industry conference to discuss the FOQA study and future plans as soon as means for resolution of the data-use and data-protection issues are developed.

FOQA Program Offers Many Benefits

FOQA programs offer a wide range of applications for recorded flight data. For the purposes of the study, FOQA was defined as:

> A program for obtaining and analyzing data recorded in flight [operations] to improve flight-crew performance, air carrier training programs and operating procedures, ATC procedures, airport maintenance and design, and aircraft operations and design.

In practice, a FOQA program is a subset of a total in-flight data system that includes engine, maintenance and aircraft-systems monitoring. FOQA is, however, separately managed, has separate data requirements, specific hardware and software requirements (some measurement-system hardware and recording-system hardware may be shared), and is subject to a separate, more secure management process. Characteristics that exemplified the FOQA concept include the following:

- An independent management and organizational structure;
- A defined set of operational events that are monitored and analyzed for exceedances;
- An airborne recording system to record data associated with operational events;
- Established data-use, control and retention policies and procedures;
- Pilot-association agreements relative to data-use policies and procedures;
- Data-analysis facilities and software; and,
- Formal data-trend, feedback and action programs.

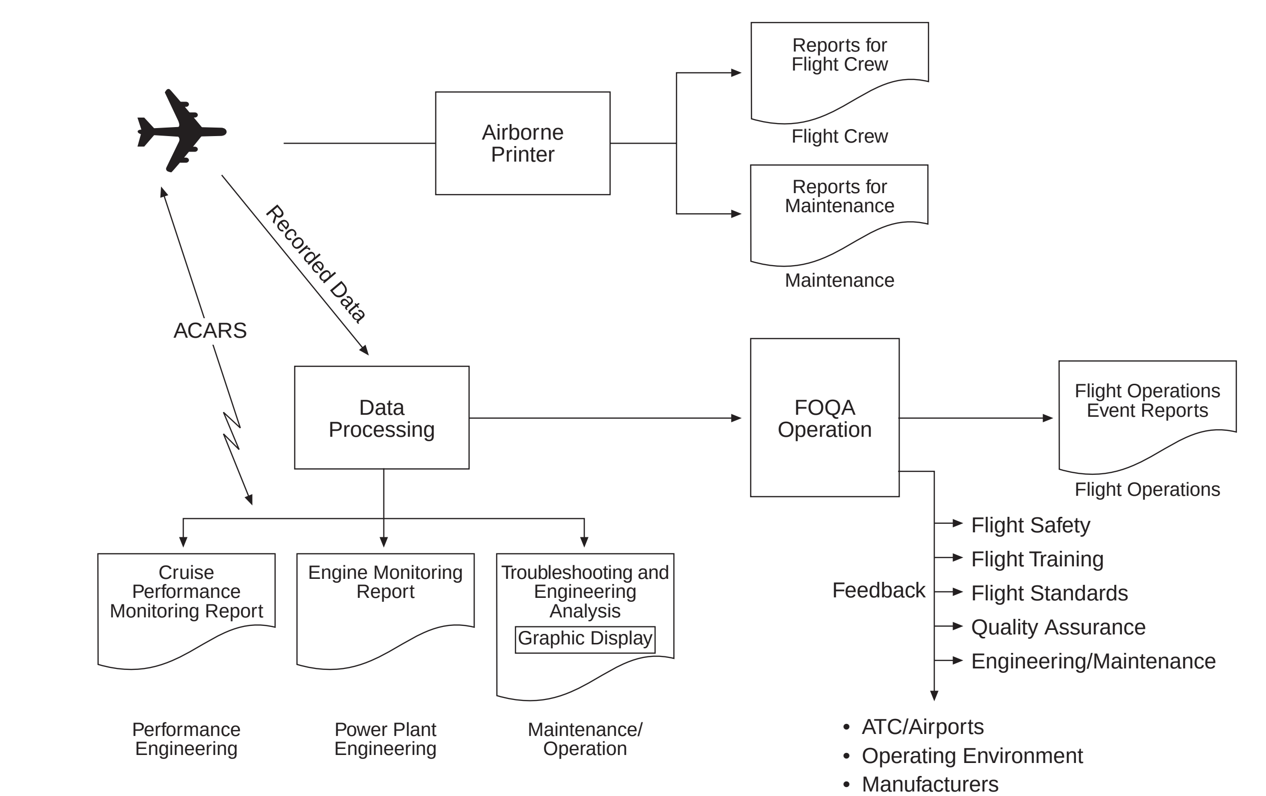
A FOQA program is made up of three major elements — airborne systems, ground systems and process systems (Figure 5). The airborne and ground systems include hardware and software elements. The process system supplies the methodology by which the data are captured, analyzed and protected.

The airborne system can have a variety of parts, depending on the hardware choices made by the airline, the airplane data systems provided by the manufacturer and the systems that were added to the airplane either at the time of purchase or later. Regardless of the configuration, the basic purpose of the airborne hardware and software is to record and store the data for later processing and analysis.

The ground system processes the recorded digital data into engineering units, performs analysis routines, and produces the required formats and reports for analysis and action by the user.

The process system is divided into two elements: the operational processes needed to make the FOQA program function, and the protection processes to ensure proper use of the data. Operating processes include those that enable the data system to produce the desired information. They also

Processes in a FOQA Program



ACARS = ARINC Communications Addressing and Reporting System
ARINC = Aeronautical Radio Inc.
ATC = air traffic control
FOQA = flight operational quality assurance

Source: Flight Safety Foundation

Figure 5

include management processes in which the information is evaluated and decisions are made on what action should be taken, as well as feedback and follow-up measures to ensure that problems are resolved.

In all FOQA applications, particularly in [aircraft with a digital data bus], the FOQA program relies on other data systems in the airplane. Even in older, less-sophisticated airplanes, many of the data measurements come from an interface with the DFDR system. Modern aircraft, as will those of the future, rely on aircraft digital data buses for data input. In these aircraft, the airborne system will select data from several hundred, or perhaps several thousand, parameters.

The FSF study report addresses all these aspects in detail, including management, hardware and software processes, program-staffing requirements, crewmember organizations, operations considerations, cost considerations and design drivers.

Design drivers are objectives and constraints that an airline should consider when designing a FOQA program. They lead to the fundamental decisions that must be made in formulating a design specification, in selecting hardware and software, and in developing the processes.

The study report also addresses system topics that apply at an interairline or national level. Major topics include overall aspects of information security, interairline [information] exchange, regulatory-agency participation, FOQA implementation in the United States, poststudy alternatives, FAA functional requirements, transition processes for national implementation, industry costs and other considerations.

FOQA Operation and Management Issues Outlined

The study report discusses FOQA management styles and reporting structure. Responsibilities for data processing, data control and data cross-utilization to support multiple program objectives were gathered and analyzed. This process provided insight into the issue of confidentiality within specific organization elements responsible for FOQA data.

FOQA fleet sizes and monitored flight segments of FOQA airlines are also addressed in the study. Aircraft varied from older McDonnell Douglas DC-9s to new Boeing 747-400s. The number of aircraft monitored per operator ranged from 11 aircraft to 203 aircraft.

Program-staffing requirements are important in evaluating program-implementation costs and operating costs. Costs of a program will vary widely, depending on the size of the airline, the number of aircraft monitored, the extent of analysis (e.g., read every segment or sample different flights) and the extent to which personnel can be cross-utilized. Information on initial implementation costs and annual operating costs is presented in the report and should be helpful to airlines contemplating a voluntary FOQA program.

The report gives examples of operational-event categories. This concept was examined and documented, including the selection process, events selected, parameters used and the operational-parameter limits that were established to trigger an event. Most operators have at least two defined levels of exceedance severity, and at least one operator has chosen four levels of severity. Action taken is based on the level of severity.

The report discusses airborne data systems and comparisons of features, and it documents all aspects of data retrieval, including identification of the [data-storage] medium, frequency of removal, location of removal and volume of data retrieved. The study team visited the [data-analysis] facilities of six users and three equipment manufacturers. Operational-event programs were examined to identify the common elements among the operators. Important program characteristics included evaluation of the monitored data, review of exceedance-event reports, required corrective action and procedures for ensuring data confidentiality.

Aircraft-integrated-monitoring-systems (AIMS) capabilities and DFDR system parameters that are standard on production aircraft were also examined.

Although all recorded aircraft data are used to support the operational quality of the airline operation, there is a clear distinction between flight-operational data and engineering or maintenance data. Flight data must be protected from unwarranted disclosure, and this concept is universal among the user-airline programs surveyed. Flight data requires special data-use rules and management policies.

Typical FOQA Management Structure Reviewed

The FSF study report discusses airline system applications, outlines the external interfaces and common FOQA functional elements, discusses typical FOQA management structure, and describes data-use agreements in general. The report also discusses airborne system configurations, retrieval systems and options. Because of the earlier availability of tape systems and data-use sensitivity, all FOQA operators [used] quick-access recorders (QARs) with magnetic tape. [FSF editorial note: Since this report, optical disks and memory cards based on the Personal Computer Memory Card International Association (PCMCIA) standard have been added.] The report examines ground [analysis] configurations, data collection and data retrieval.

The study report discusses assessment of exceedances and event trends utilized by FOQA user airlines and presents data-trending and records-retention options.

Relevant costs of a modern FOQA program are difficult to estimate because most programs [did] not use state-of-the-art technology [in the early 1990s], and many component manufacturers treat cost information as proprietary. Nevertheless, the report develops some conclusions about system costs.

The report discusses U.S. airline operational considerations and concerns as well as planning and implementation considerations.

Conclusions and recommendations were grouped into two areas, one pertaining specifically to airline systems, focusing on individual air carriers, and the other pertaining specifically to FAA and others in the U.S. air transport industry.

The FSF report included the following conclusions:

- FOQA implementation in the United States must move forward;
- Further analysis of FOQA program elements identified by this study must be undertaken to realize fully the benefits of FOQA in the United States;
- FOQA has more potential for improving operational safety than is being attained by current user airlines;
- FOQA will support both the internal audit program and the AQP;
- ARINC Communications Addressing and Reporting System (ACARS) transmission of FOQA data is not practical at this time because of costs and concerns about data security [FSF editorial note: Prototypes of FOQA ground data link have been developed];
- Separation of FOQA data and FAA-mandated data is easily accomplished;
- FOQA data recorded on aircraft with digital data buses are not affected by DFDR specifications [as of 1992];
- Airlines contemplating introduction of a FOQA system should use the FSF FOQA report as background information;
- Equipment just entering the marketplace or nearing production will have more features for FOQA systems than earlier hardware;
- Newer aircraft with digital data buses and complex integrated monitoring systems are more easily adapted to FOQA than older aircraft;
- Including older aircraft in the FOQA fleet may not be practical because of the cost of installation and operation considered against remaining useful life;
- Installing the airborne system used by FOQA operators [in the early 1990s] required retrofitting QARs. This can present a problem for fleets in excess of 200 aircraft because of the large volume of recording media generated by the QARs;
- Flight-operations policies, procedures and philosophies affect the selection of event categories and exceedance limits, which will vary among airlines, even for identical aircraft types;
- Airlines implementing FOQA should retain in-house software support during initial development and as subsequent changes are required;
- The greatest impediments to use of FOQA in the United States are associated with providing assurances of adequate protection from the use of FOQA data for other than safety and operational enhancements;
- FAA policy on compliance and enforcement, and indications of support for revision of the U.S. Federal Aviation Regulations (FARs) should alleviate airline and flight-crew concerns; and,
- Airlines, through adequate internal policies as mentioned earlier, can proceed with FOQA programs and alleviate data-security problems.

Based on the report's conclusions, FSF recommended that FAA encourage voluntary FOQA implementation by U.S. operators. A trial program should be instituted to demonstrate benefits and promote widest FOQA use; obtain flight-crew support; evaluate technology provided by manufacturers; evaluate emerging equipment and research and development at the module and system levels; evaluate event categories, limits and standardizations; develop cost-effective processes; and evaluate how airlines might formulate FOQA data for FAA in a way that does not compromise data security.

The FSF report included the following additional recommendations:

- FAA should vigorously address information-protection issues;
- FAA should begin a definition phase to outline additional needs and products of a FOQA program;
- U.S. airlines should implement FOQA programs as described in the study report;

- Airlines that implement FOQA programs should closely monitor actions taken by FAA and other FOQA users as FOQA policies and systems become clearly defined in the United States and as protection against misuse of data is ensured;
- Operators should take full advantage of the rapidly developing technical capabilities becoming available for both airborne and ground systems;
- Carriers must recognize the importance of early involvement of pilot organizations in FOQA-program development, and those without pilot unions should devise appropriate plans to involve their pilots;
- A FOQA program should be implemented in phases, beginning with [planning for each] new airplane purchased from the manufacturer and utilizing the full resources of the manufacturer and equipment and software suppliers in designing the system;
- The U.S. and international air transportation industry should develop common FOQA standards and specifications to allow the exchange of standardized information and the development of databases that will permit attention to be focused on subjects that require improvement, provide information that indicates the level of safety, and support joint industry-and-government research programs; and,
- The FAA should periodically re-examine the FOQA objectives and methodology defined by industry and government, and update them as required.

Report Includes Substantial Reference Material

In addition to the discussion of many aspects of FOQA as summarized in this article, the report's appendixes provide substantial reference material helpful to those contemplating implementation of a FOQA program.

Appendix A provides a glossary of FOQA acronyms, abbreviations and definitions.

Appendix B presents the survey form used to elicit information from FOQA-user air carriers [during the study completed in 1993].

Appendix C comprises the FOQA literature search, with brief summaries of significant resources and a complete list of references.

Appendix D is a chart depicting event categories used in current FOQA programs.

Appendix E presents in chart form the parameters associated with typical operational-event categories.

Appendix F summarizes operators' approach-airspeed event limits versus altitude.

Appendix G displays parameters used in current FOQA programs [of the early 1990s].

Appendix H presents, in flow-chart form, the process involved in FOQA event-review procedures and corrective-action procedures.

Appendix I presents event categories for FOQA programs by operational mode: taxi-out, takeoff, climb, cruise, descent and approach, landing, and taxi-in.

Appendix J lists parameters for programs in the study.♦

[FSF editorial note: This article first appeared in *Flight Safety Digest* Volume 2 (April 1993), 1–13. Copies of the report may be obtained from Flight Safety Foundation at a cost of US$50 each for FSF members; $75 each for nonmembers. To order the report: Ahlam Wahdan, Flight Safety Foundation, telephone +703-739-6700 ext. 102; fax +703-739-6708.]

About the Author

John H. Enders was FSF president from 1980 to 1991 and vice chairman of the FSF Board of Governors from 1991 to 1994. He is an independent aviation consultant.

Enders is a mechanical engineer with a degree from Case Institute of Technology, Cleveland, Ohio, U.S. Enders conducted rocket-engine research as a staff member of the U.S. National Advisory Committee for Aeronautics (NACA), the predecessor of NASA. He later served as a pilot and development engineer in the U.S. Air Force before returning to NASA as a research test pilot. He later became NASA's manager of aircraft-safety research and operating-problem research. He served as liaison member on the National Aeronautics and Space Council, and as a technical advisor to the associate administrator for aviation safety at FAA.

Flight Safety Foundation Icarus Committee Cites Advantages of FOQA for Trend Analysis, Knowledge Building and Decision Making

Created by the Foundation to explore methods to reduce human factors–related aviation accidents, the FSF Icarus Committee said that an effectively managed FOQA program is one of several tools that should be used by airline managers to improve safety.

FSF Editorial Staff
with
Jean Pinet and John H. Enders

The FSF Icarus Committee has been at the forefront in encouraging airlines to use flight operations quality assurance (FOQA) programs, and other safety-enhancement tools that can be integrated into FOQA programs, for more effective risk management.

"The data provided by a FOQA program help operators to evaluate the safety of flight operations," said the committee. "FOQA can become an essential ingredient in optimizing air-carrier training procedures and serve as a performance-measurement tool for company risk-management programs and for assessing training effectiveness."

The Foundation created the Icarus Committee in 1992 to seek philosophical and practical solutions to human errors that result in aircraft accidents. Although the analysis of human factors in aviation safety was already being pursued in many places in the world, the Foundation believed that it was important to initiate additional action to synthesize what had been learned. The intent was, and is, to augment and enhance — not to replace — the Foundation's core activities, by posing questions and suggesting actions.

Despite the increasing general level of understanding of accidents and their causes, the emergence of new technologies for aircraft design, the development of training methods and equipment, and the growing ability to analyze human behavior and decision-making factors, aviation accidents and serious incidents continue to occur. These events often result from the decisions and actions of well-trained and highly experienced pilots, although these decisions and actions may have been enabled by other human decisions within the system.

The Icarus Committee is addressing the reasons why the accident and incident rate has not declined proportionately to the advances in technique that the industry is making on many levels.

The committee has received support from major aircraft and equipment manufacturers, airlines, research organizations and regulatory agencies worldwide.

The committee comprises a small, informal group of recognized international specialists in aviation who have extensive experience in the human aspects of design, manufacturing, flight operations, maintenance, operating environments and research (Table 1, page 48). These individuals represent a cross-section of current human factors thinking in the international aviation community. While some of the world's regions are not directly represented, members of the committee are generally familiar with the many industrial, educational and social cultures that intersect aviation operations worldwide.

One international aviation leader applauded the committee's efforts as a "small group of wise people" addressing questions that are very important to the aviation community. He urged the committee to keep itself "lean" in numbers so as not to lose the ability to cut quickly to the cores of issues.

Jean Pinet and John H. Enders, who served as the first co-chairs of the committee, said that the challenge was to keep the group small enough to enable vigorous and candid debate, yet broad enough to bring as many viewpoints as possible into the discussion. Additional participants with special expertise are routinely invited to join the core committee to augment specific discussions.

Table 1
Active Members of the Icarus Committee

Co-chair:
Capt. Claude Bechet
Retired Flight Safety Advisor
Aero International (Regional)

Co-chair:
Capt. Chet Ekstrand
Vice President , Government and Industry Technical Affairs
Boeing Commercial Airplane Group

Capt. Jim Duncan
Retired Vice President, Technical Training
Airbus Service Co. Inc.

John H. Enders
President
Enders Associates International

H. Clayton Foushee, Ph.D.
Vice President, Regulatory Affairs
Northwest Airlines

Hon. Robert T. Francis
Vice Chairman
U.S. National Transportation Safety Board

Capt. Hugues Gendre
President
Syndicat National des Pilotes de Ligne

Maj. Gen. Francis C. Gideon
Chief of Safety
U.S. Air Force

R. Curtis Graeber, Ph.D.
Chief Engineer, Human Factors
Boeing Commercial Airplane Group

Capt. Urpo Koskela
Retired Chief Pilot
Finnair

John K. Lauber, Ph.D.
Vice President, Training and Human Factors
Airbus Service Co. Training Center

Stuart Matthews
Chairman, President and CEO
Flight Safety Foundation

Capt. Dan Maurino
Coordinator, Flight Safety & Human Factors Study Program
International Civil Aviation Organization

John McCarthy, Ph.D.
Manager for Scientific and Technical Program Development
U.S. Naval Research Laboratory

Capt. Edward M. Methot
Airline Executive

Jean Pinet
Consultant
SEDITEC

John W. Saull
Executive Director
International Federation of Airworthiness

Douglas Schwartz
Director of Flight Standards
FlightSafety International

Capt. Robert Sumwalt
Chairman, Human Performance Committee
Air Line Pilots Association International

Capt. Bill Syblon
AMR Sabre Consulting

Capt. Roberto Tadeu
Safety Advisor
Varig Airlines

Capt. Etienne Tamowski
Chairman, Flight Safety Board, Flight Standards Board
Airbus Industrie

The committee named itself for the ancient Greek god, Icarus, who was given a gift of wings by his father, Daedalus. Icarus proved to be such a "bold pilot" that he did not heed the warning of Daedalus not to fly too high. He plunged into the sea after his wax-and-feather wings came apart when he flew too close to the sun. Thus, in this mythical story, Icarus was the first aviator to suffer an accident because of his incorrect behavior, ignorance of the operational environment and design deficiencies. The name Icarus serves as a symbol of the committee's objective to reduce human factors-related aviation accidents.

In keeping with this objective, the first meeting of the Icarus Committee addressed the question: "Why do experienced and well-trained aircrews sometimes act against their experience and training, and have accidents?"

The meeting resulted in 18 findings that were released in a report, "Human Factors in Aviation: A Consolidated Approach," published in the December 1994 *Flight Safety Digest.* The report has been widely circulated among airlines, corporate and military flight organizations, and government agencies, and is used in aviation safety-training seminars. The committee considered cockpit behavior factors, decision making, management commitment to safety, operational directives, peer influence, standards and crew resource management (CRM) to develop solutions to problems and risk-reduction strategies.

Twenty-six practical guidelines developed by the committee to assist airline managers in assessing the costs of aviation accidents, analyzing their causes and preventing their reoccurrence were released in a report, "The Dollars and Sense of Risk Management and Airline Safety," also published in the December 1994 *Flight Safety Digest*.

A checklist developed by the committee to enable senior airline managers to conduct a self-audit, to identify administrative, operational and maintenance processes and related training that might present safety problems was released in a report, "Aviation Safety: Airline Management Self-audit," published in the November 1996 *Flight Safety Digest*.

The accomplishments of the Icarus Committee to date also include six briefings to senior airline managers on methods and tools that improve safety and support FOQA. (Reprints of the briefing papers begin on the facing page.)♦

Managing for
SAFETY
ICARUS COMMITTEE BRIEFING
A BRIEFING FOR AIRLINE SENIOR MANAGEMENT
Flight Safety Foundation
SEPTEMBER 1997 NO. 1

The Dollars and Sense of Risk Management and Aviation Safety

Statistics demonstrate that human error is the primary cause for the majority of aviation accidents and incidents. Does this mean that the only solution is to insist, with ever-increasing urgency, that those involved in aviation must be more careful, or demand that they be error-free? No.

"To err is human." Error must be accepted as a normal component of any system where humans and technology closely interact. (Aviation is an excellent example of such a system.) Because error cannot be eliminated, effective measures must be employed to minimize its effects on aviation safety.

Error Management

While not altogether avoidable, human errors are *manageable*. One method to contain or manage human errors includes improved technology, relevant training and appropriate regulations. This method is typically directed towards improving the performance of the front-line personnel, such as pilots, maintenance technicians, ramp crews and air traffic controllers. We must understand, however, that the performance of these personnel can be strongly influenced by organizational, regulatory and cultural factors affecting the workplace.

Because errors are unavoidable, another method of dealing with them is to minimize their effects. This method focuses on correcting the organizational processes that constitute the breeding grounds of human errors: inadequate communications, unclear policies and procedures, unsatisfactory planning, insufficient resources, unrealistic budgeting and any other process that an organization can control.

A combination of both of these error management strategies will increase system tolerance to errors and will help make errors evident before they can cause damage.

Safety Management

"Safety" is an abstraction, and in a sense a negative one — the absence of accidents and incidents — which makes safety difficult to visualize. Hazards and risks are usually easier to identify and to visualize, making them easier to address by practical measures. How many risks can be accepted and how many can be eliminated will depend on available resources. Identification of hazards and allocation of resources to minimize their associated risks is a managerial process — *safety management*.

Resources

Error management and safety management are the elements on which an aviation organization's integrity is built. The very top-level management of a company *must* take an active role in providing the organization with the resources to manage errors and safety. Some of these resources are listed below (and will be the subject of future briefings).

- **An independent company safety officer.** He or she should report directly to the highest level of management. The safety officer is a quality-control manager, acting on information obtained through internal feedback, trend monitoring and incident-reporting systems. He identifies *corporate safety deficiencies* (rather than individual human errors), and provides top-level management with the necessary information to take decisions in managing risks.
- **An internal confidential incident-reporting system.** Such a system favors active risk management, which can prosper only within a corporate atmosphere where personnel are not fearful of being admonished for reporting errors that might have led to incidents or accidents. Estimates cite that there are more than 300 incidents for every accident of the same type.
- **A formal internal feedback and trend-monitoring system.** This system anticipates failures and errors, and obtains early information that can be useful in controlling risks.
- **A formal risk-management structure.** Risks are inherent to aviation. Some risks can be accepted, some can be eliminated, others can be reduced to where they become acceptable, and some risks must be avoided. Risks can be managed.

Experience has proven these to be particularly effective resources in successful safety management, although other resources can be useful in achieving safe operations. To err is human … but errors, and safety, are manageable.♦

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Managing for SAFETY

ICARUS COMMITTEE BRIEFING

A BRIEFING FOR AIRLINE SENIOR MANAGEMENT

Flight Safety Foundation

NOVEMBER 1997 NO. 2

The Airline Safety Department: A Solid Foundation for Confidence

How safe is your airline? You have taken steps to achieve safety. You believe that your operations are safe. But unless your company has a *safety department*, your belief may be ill-founded. The company safety department performs a self-monitoring function that ensures that there is a solid foundation for confidence — that the airline's operations *are* safe.

Safety specialists agree that for an airline to accurately determine its safety quotient, a well-functioning safety department is a necessity. More than that, the department must be given a large measure of independence and command the attention of the company's top executives.

Begin the safety commitment at the top. Every airline should have a formal statement of its company safety policy. This helps create a "company safety culture" by sending the message that every person in the company is expected to make a commitment to safety, beginning with the highest levels of management. If top management takes safety seriously, the rank-and-file will be more likely to do the same.

Put the safety department behind a firewall. The safety function should be independent of the operations, marketing and other cost-driven departments. The head of the airline's safety department should report directly to the CEO or another top manager. This will ensure that decision-makers receive information about safety issues that is not compromised by operational or administrative concerns. This top-level reporting structure will also ensure that genuine attention is given to safety issues by those ultimately accountable for the safety and the reputation of the airline.

Establish system redundancy. The key to any safety program is redundancy. It is neither reasonable nor realistic to assume that every person within the company will perform day-to-day safety responsibilities without some oversight. The safety department must monitor the operations, maintenance and training functions within the airline to ensure that safety is a top priority. When deficiencies are noted, the emphasis should be on correcting the problem, not on assigning blame.

Maintain effective communications. Communicate safety information to the entire workforce, in as many ways possible (for example, through safety reports, newsletters and employee meetings). Identification of problems is meaningless unless employees know about them. Moreover, dissemination of positive safety news can reinforce the "emphasis-on-safety" message that top management has created to enable safety-conscious employees to know that their efforts are successful.

Use incident data and employee feedback effectively. Many airlines have found that an internal confidential incident-reporting system sheds light on "latent" or hidden safety problems. Without a proactive incident-reporting system, these latent problems can go undetected until they contribute to an incident or an accident.

For such a system to be effective, management must make clear to employees that reported information will be used only in a constructive and nonpunitive way. Additionally, establishing an internal database of incident and accident data can provide a basis for avoiding similar events in the future and can be enormously useful in spotting safety-related trends. Programs can be administered as "in-house" systems or on a larger scale. A good example of one such successful program is the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS). Since its beginning in 1976, the NASA ASRS has been credited with clarifying many problems, which led to their resolution.

Give the safety department an essential tool: a flight operations quality assurance (FOQA) program. A proactive approach to safety should include a FOQA, or digital flight data recorder (DFDR)–monitoring, program. Such programs, which have long been in use by some European airlines and which have recently been endorsed by U.S. Federal Aviation Administration Administrator Jane Garvey, can provide the airline safety department with a crucial early warning of potential trouble areas. With such a program, the safety department has an objective, quantitative basis for action that cannot be dismissed as speculation or worrying about extremely unlikely events. And management, which is accustomed to making decisions based on specific information, can understand the rationale behind safety-department initiatives.♦

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Flight Safety Foundation
JANUARY 1998 NO. 3

An In-house Incident-reporting Program: Overcoming Dormant Factors That Can Contribute to Accidents

Incidents are not accidents — so why collect data about your airline's incidents?

The lack of accidents does not accurately indicate safety within a complex system such as an airline. Policies, procedures and practices sometimes introduce unforeseen hazards into the airline operations system. If these hazards remain undetected and thus uncorrected, they might eventually interact with other conditions, leading to an accident.

Such undetected hazards are called latent, or "dormant" (from the Latin word for "sleeping"), factors. While they are dormant — which can be for a long period — the dormant factors do not result in an accident because "front-line operators" such as pilots, mechanics and air traffic controllers often employ last-minute, compensatory defenses, such as deviating from standard operating procedures.

These improvised defensive measures, based on each person's experiences and skills, may repeatedly overcome the accident potential. But if the dormant factors are not identified, then the problems in the system will persist. Sooner or later, the compensatory-defense mechanism will not work for some reason, and the dormant factor will awaken — hungrily.

Dormant factors' origins are often far removed in space and time from the incidents that reveal them. Examples of dormant factors include poor equipment design, management miscalculations, ambiguously written procedures and inadequate communication between management and line personnel.

Dormant factors are often introduced, unknowingly, with the best intentions. Line management can generate such dormant factors by issuing operating procedures that might be desirable in theory but do not function under "real-world" conditions. Besides incorrect action, inaction — for example, tolerance of conditions that are only marginally safe — can create dormant factors.

A properly managed in-house incident-reporting program can help identify many of these deficiencies. By collecting, aggregating and then analyzing incident reports, safety managers can better understand the specific problems encountered during line operations. Armed with this knowledge, they can create basic solutions instead of short-term fixes that only hide the real problems.

Management must take responsibility for uncovering and correcting dormant factors. The wrong response is denial — often signified by criticizing or punishing operational personnel involved in incidents while ignoring the underlying system failures. Better, but still not fully responsive, is repair, in which operational personnel are disciplined and equipment or procedures are modified to prevent recurrence of a specific problem. But the best preventive measure is reform, in which the problem is acknowledged, the system is reappraised in depth and the system as a whole is revised to eliminate the dormant factors as much as possible.

Costs are low. Benefits are high. An incident-reporting program can be implemented and maintained at relatively low cost using commercially available computer programs that can be run on desktop computers. Although the greatest benefit will be improving the safety of your airline, an incident-reporting program can provide measurable financial benefits, too.

For example, one airline required that all of its pilots' "go-arounds" be reported through the airline's incident-reporting program. As a result, a trend became evident: At one airport a disproportionate number of go-arounds was occurring. Investigators learned that the airline had recently begun exclusively using at that airport an aircraft type that could not descend as quickly as aircraft previously used on that route. Discussions with air traffic control management highlighted the problem. Airspace was redesigned so that descents could begin earlier. Not only did the airline eliminate the hazard of frequent unstabilized approaches, but there was also a reduction in costly go-arounds.

Confidentiality and immunity are essential. Before employees will freely report incidents, they must receive a commitment from top management that reported information will remain confidential and will not be used punitively against employees. The success of an in-house incident-reporting program depends largely on this management commitment.

Take an important step to further ensure that your airline's safety envelope remains intact — implement an incident-reporting system, or "fine-tune" the current one.♦

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Managing for SAFETY

Flight Safety Foundation

ICARUS COMMITTEE BRIEFING

A BRIEFING FOR AIRLINE SENIOR MANAGEMENT

MARCH 1998 NO. 4

Protect Employees Who Identify Safety Issues

Knowledge Is Power

"All men by nature desire knowledge," wrote Aristotle some 2,300 years ago. Today, mankind continues to seek knowledge. In an airline operation, knowledge enables strategies to enhance the airline's profitability, competitiveness, safety and ultimately, success. But, as the saying goes, "You don't know what you don't know." Although not as profound as Aristotle's words, that statement has its own wisdom: You may believe that you are aware of everything concerning your airline, but how can you be certain?

For expanding management's knowledge of safety issues, an airline has dozens, perhaps hundreds or thousands, of knowledge resources — employees. Employees are the "eyes and ears" of the airline. Like the sensor probes located strategically in an aircraft engine, employees are located throughout the airline, available to signal the system's strengths and weaknesses. These resources are available to management at no additional financial cost; the majority of employees would be willing — even eager — to report their observations and information about safety.

Nevertheless, reporters must be free from apprehension that they will suffer personally as a consequence of their reports.

A climate must be established to encourage employees to participate in expanding the knowledge base; employees need senior management's assurance that (1) they will not be disciplined, ridiculed or otherwise punished when they report information, and (2) the identities of the reporter and anyone involved in a safety-related event will remain confidential.

Nonreprisal Policy Required

Conveying this message to employees is best handled in a written "nonreprisal policy" statement signed by the top-level officer(s) in the company, such as the CEO and president. If employees are unionized, union representatives should be involved in drafting the statement. The following is the statement of one large international airline; but the words could be adapted to fit almost any air carrier:

> The airline is committed to the safest flight operation possible. Therefore, it is imperative that we have uninhibited reporting of all incidents and occurrences that in any way affect the safety of our operations.
>
> It is each employee's responsibility to communicate any information that may affect the integrity of flight safety. To promote a timely, uninhibited flow of information, this communication must be free of reprisal.
>
> The airline will not initiate disciplinary proceedings against an employee who discloses an incident or occurrence involving flight safety.
>
> The airline has developed a format for reporting incidents, whether in the air, on the ground or related to cabin safety, that protects to the extent permissible by law the identity of the employee who provided the information.
>
> We urge all employees to use this program to help the airline be a leader in providing our customers and our employees with the highest level of flight safety in our industry.

Actions Must Support Words

A written non-reprisal policy is important, but some employees will continue to be apprehensive until management *demonstrates* its commitment to adhere to the policy.♦

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Managing for SAFETY

Flight Safety Foundation

ICARUS COMMITTEE BRIEFING

A BRIEFING FOR AIRLINE SENIOR MANAGEMENT

MAY 1998 NO. 5

Safety — Costs Avoided and Benefits Gained

A strong safety program aims to prevent accidents and incidents that can cause loss of life and property, and serious injuries. The human losses in an airline accident are traumatic for surviving families and friends. But in addition to its moral duty to prevent accidental death, injury and suffering, the senior management of an airline is charged to protect the company's financial "bottom line." So questioning the cost/benefit ratio associated with implementing a new or strengthened safety program is reasonable and responsible.

There is a paradox, however, when trying to measure the benefits of a safety program: If the program is effective, there are few incidents and accidents. So, how does the company assign a cost savings to the incidents and accidents that did not occur?

Poor safety performance equals poor financial performance. The consequences that some airlines have suffered following highly publicized accidents leave no doubt that safety can strongly affect an airline's position in the marketplace. These unwelcome events can damage an airline's reputation, financial health and employee morale.

A few years ago, a major international airline suffered several fatal accidents; two of the accidents occurred within a 90-day period. Government, media and public scrutiny of the airline's management of safety increased, and for the three-month period immediately following the two accidents, the airline's revenues dropped by US$150 million; the public's perception that the airline was unsafe had frightened away customers.

Another fatal accident involved a highly profitable, low-fare airline. Following the accident, questions surfaced about a variety of safety issues; within weeks of the accident, the civil aviation authority grounded the airline's fleet amid public examination of the airline's safety practices. After an intensive review, which resulted in changes and improvements within the airline — and the industry — regulators found the airline fit to fly. Nevertheless, when the airline resumed service some three months later, its stock price had plummeted and its fleet was operating well below capacity.

"Poor safety performance equals poor financial performance" leaves little room for argument. Moreover, the industry at-large — airframe manufacturers, engine manufacturers, unions, insurers, regulators and the airlines — can pay a price too. The public can demand that government impose sweeping new regulations that would offer a *perceived*, but not necessarily an actual, improvement in safety, while resulting in *real* increases in costs and complexities for everyone. Thus, valuable resources could be diverted from where they could have the most positive influence on real safety.

Safety is a competitive advantage. A highly successful international airline recently conducted a survey of its customers. The survey showed that about 25 percent of the respondents chose the airline over its competition because of convenient flight schedules; another 25 percent preferred its generous frequent-flyer program. But the most significant finding was that about 50 percent selected the airline because of its excellent safety record. Safety is a competitive advantage that improves the airline's financial performance and stock values.

Safety is free. Implementation of a successful safety program costs money, but tremendous financial benefits often are the result of an airline functioning at peak safety levels. An effective safety program, for example, can lower workers' compensation expenses and aircraft-insurance premiums.

Costs avoided through safety programs are on one side; *benefits gained* are on the other side.

The CEO of a large, successful and safety-minded helicopter service openly states that safety increases the company's financial bottom line. For every dollar invested in its safety program, the company calculated that it receives eight dollars to nine dollars in savings. And because the safety program is credited with saving the company millions of dollars, the CEO says, "Safety is free, because the benefits are greater than the costs."♦

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Managing for SAFETY

Flight Safety Foundation

ICARUS COMMITTEE BRIEFING

A BRIEFING FOR AIRLINE SENIOR MANAGEMENT

JULY 1998 NO. 6

FOQA — Possibly the Best Safety Tool of the 21st Century

The U.S. Federal Aviation Administration (FAA) has said that an effectively managed flight operations quality assurance (FOQA) program can provide the highest possible level of safety management, and is potentially the best safety tool of the 21st century.

FOQA programs obtain and analyze data recorded in flight. Their objectives are to improve flight-crew performance, air-carrier training programs and operating procedures, air traffic control procedures, airport maintenance and design, and aircraft operations and design. During the past two decades, many non-U.S. airlines have used this technology to identify baseline criteria for everyday operations and to identify and correct adverse trends.

Flight Safety Foundation, under contract to the FAA, published in 1993 — based on the experiences of FSF's international membership — the first major study to call for the implementation of FOQA in the United States.

Early flight-data recorders (FDRs) installed on airliners recorded only a few basic parameters by etching data onto a metal foil. In contrast, today's digital flight-data recorders (DFDRs) capture hundreds of parameters each millisecond.

Originally, FDR data were used for accident investigation. But FOQA programs involve converting digitally recorded flight data into accident-preventive safety information. First, the programs identify and count unwanted events — for example, approach speeds too fast at specified altitudes or vertical acceleration at landing too high. Second, and equally important, FOQA promotes trend analysis, knowledge building and decision making.

Used this way, the DFDR is an effective tool, especially if the data are combined with a confidential, nonpunitive incident-reporting system where pilots report less serious problems and incidents.

If you can't measure it, you don't know about it. If you don't know about it, you can't fix it. The heartbeat of an airline is the day-to-day line operations. FOQA allows operators to "feel the pulse" of line operations. Data can be downloaded and analyzed periodically, such as each night or every several days. With this stream of information, operators are positioned to make decisions based on data, not on speculation or hunches.

The data provided by a FOQA program help operators to evaluate the safety of flight operations. They help identify operational problems specific to airports used by that carrier or to the aircraft in its fleet. FOQA can become an essential ingredient in optimizing air-carrier training procedures and serve as a performance-measurement tool for company risk-management programs and for assessing training effectiveness.

Data support improvements. FOQA programs now under way in the United States have already had successes. One air carrier noticed an excessive number of unstabilized approaches at a hub airport. Pilots had often complained of air traffic control (ATC) problems at the airport, but the air carrier had no way of determining specific details of the problem and how it could be resolved. But with FOQA data, the carrier demonstrated that the ATC problem was real. The airport's instrument approach was redesigned, resulting in an immediate reduction in unstabilized approaches at the airport.

That same carrier learned that pilots were routinely receiving ground-proximity-warning-system (GPWS) warnings while being radar vectored to an airport surrounded by mountainous terrain. The ATC vectoring altitude provided sufficient terrain clearance, but the altitude provided insufficient clearance to avoid nuisance GPWS warnings. Again, FOQA data demonstrated that vectoring altitudes should be increased until flights were past that particular terrain.

The carrier also learned, through analysis of the same FOQA data, that pilots were performing the GPWS escape maneuver, but not performing it in accordance with established procedures. The issue was brought to the attention of the training department for resolution.

The engineering departments of several airlines use FOQA data for fault diagnosis, engine-health monitoring and fuel-usage tracking. One large carrier estimates that it saves US$750,000 annually on one long-haul international route, by identifying specific aircraft that have an exceptionally high fuel-burn rate, thereby being in a position to adjust those aircraft's airframes and/or engines for greater efficiency. For the proven safety benefits, as well as demonstrated cost savings, the chairman of this airline praised FOQA as being "the most valuable management tool we have."

Pilot support and trust are essential. Successful FOQA programs have the support of the carriers' pilots, and if pilots are represented by unions, union involvement is essential.♦

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ATC Call-sign Confusion Incidents Usually Involved All-numeric Suffixes

A U.K. Civil Aviation Authority report found that nearly three-fourths of reported call-sign-confusion incidents added to controllers' workload.

FSF Editorial Staff

A large majority of call-sign-confusion incidents reported in 1997 by aircraft operators, pilots and controllers involved numeric call signs, including call-sign suffixes that were identical for more than one aircraft in the same airspace, a special U.K. Civil Aviation Authority (CAA) industry study group found.

The Aircraft Callsign Confusion Evaluation Safety Study (ACCESS) was undertaken by representatives from the U.K. CAA, National Air Traffic Services, British Airways, British Regional Airlines and British Midland Airways. The group collected safety reports from two sources about a total of 482 incidents of actual or potential call-sign confusion in the U.K. air traffic control system.

The first source, which included 175 incidents (36 percent), was the database of Mandatory Occurrence Reports (MORs), which must be filed by pilots or controllers concerning dangerous situations. The second source, comprising 307 incidents (64 percent), were ACCESS reports that did not fit the stricter reporting criteria for MORs but were about incidents of call-sign confusion or situations in which the reporter believed that there had been a strong potential for confusion.

The report[1] on the ACCESS said that 217 incidents of call-sign confusion (45 percent) "involved actual confusion of any party, including 99 [incidents] where ATC [air traffic control] were actually confused."

The report said that 353 incidents (73 percent) "increased reported controller workload by reducing controllers' thinking time, and increasing RTF [radio telephony] usage time."

ACCESS divided the call-sign confusion incidents among U.K., Irish and other operators. Analysis determined that:

- 319 incidents (66 percent) involved confusion between call signs of the same operator;
- 223 incidents (46 percent) involved U.K. operators only;
- 173 incidents (36 percent) involved non-U.K., non-Irish operators only;
- 22 incidents (5 percent) involved Irish operators only; and,
- 64 incidents (13 percent) involved a combination of operator origins.

ACCESS also analyzed the types of call signs that were involved in confusion incidents.

- 405 incidents (84 percent) involved numeric call signs only;
- 50 incidents (10 percent) involved alphanumeric call signs only; and,

- 17 incidents (4 percent) involved a combination of numeric and alphanumeric call signs. (Ten of the reports [2 percent] were not specific enough to determine the types of call signs.)

[A numeric call sign would be, for example, "(Airline name) 005." An alphanumeric call sign would be "(Airline name) 05AD." It was found that although the majority of U.K. airlines were still using numeric call-sign suffixes, 40 percent of British Airways call signs had alphanumeric suffixes and 95 percent of British Midland Airways had alphanumeric suffixes.]

Incidents involving identical call-sign suffixes were also recorded. Of the 134 such incidents (28 percent), all but three involved numeric call signs. The most common identical call-sign suffixes involved in confusion were: 101; 202; 333; 37; 837; 762; and 924.

Reports of call-sign confusion varied by month during 1997, from a high in April to a low in July (Figure 1). The study group could offer no explanation for the variation.♦

Reference

1. U.K. Civil Aviation Authority, Safety Analysis Department, Technical Services Division, Safety Regulation Group. *Data Plus* May 1988. Reference no. 98/DP1.

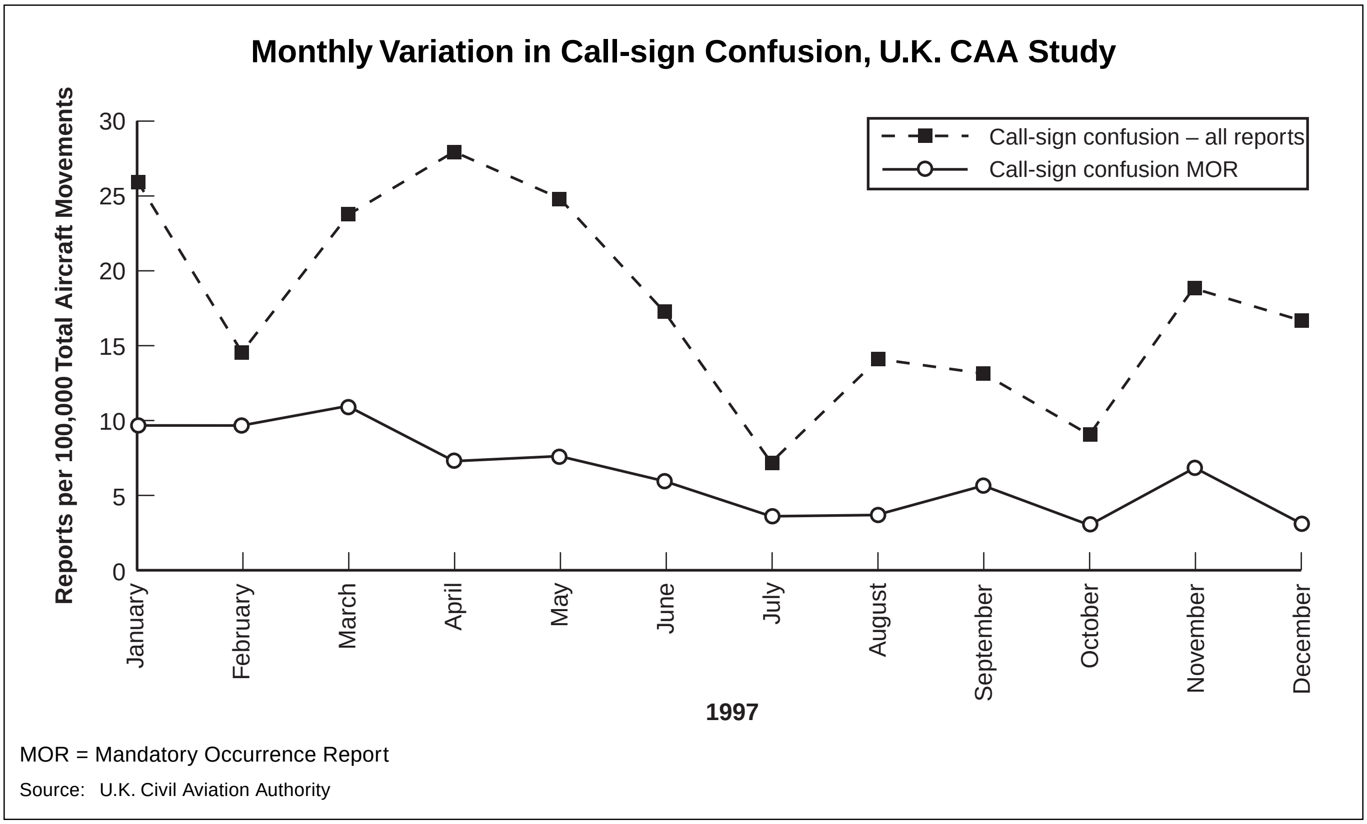

Figure 1

Combined Flight Count and Control Time Analyzed as Potential New Metric of Air Traffic Control Activity

Testimony before U.S. Congressional committee highlights aviation security weaknesses and system vulnerability.

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Reports

The Combination of Flight Count and Control Time as a New Metric of Air Traffic Control Activity. Mills, Scott H. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-98/15. May 1998. 15 pp. Figures, table, references. Available through NTIS.*

Keywords:
1. Air Traffic Control
2. Complexity
3. Workload
4. Aircraft Activity Index
5. Flight Count

Exploring measures of airspace activity is useful in a number of significant ways, including the establishment of baseline air traffic control (ATC) measures, as well as the development of tools and procedures for airspace management. This report introduces a new metric of ATC activity that combines two measures (flight count and the time aircraft are under control) and is more informative than either measure alone. The aircraft activity index (AAI) is more sensitive to changes in flight counts and flight lengths, and thus is a superior measure for comparing flight activity between epochs of airspace activity (all air traffic controlled by a certain ATC position during a specific period). In this study, the AAI was applied to 10 days of data from system-analysis recordings (SARs) obtained from the Seattle Air Route Traffic Control Center. The advantages of the AAI became apparent when different aircraft types consistently had different mean flight lengths. Results of this study revealed how objective measures such as the AAI can contribute to the evaluation of new technologies that will enhance the effective management of airspace. [Adapted from Introduction and Discussion.]

GPS Design Considerations: Displaying Airport Information. Williams, Kevin W. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-98/12. April 1998. 18 pp. Figure, tables, references. Available through NTIS.*

Keywords:
1. Global Positioning System
2. Human–computer Interface
3. Aircraft Displays
4. Applied Psychology

Thirty-six recruits (24 private pilots, 12 nonpilots) from the Oklahoma City, Oklahoma, U.S., area participated in an experiment designed to compare various methods for presenting nearest-airport information on a global positioning system (GPS) display and how each affects the applicant's ability to orient quickly and accurately toward the nearest airport. The flight simulator used was the Basic General Aviation Research Simulator (BGARS) located at the FAA Civil Aeromedical Institute in Oklahoma City. Results of the study show that use of the tabular, text-only GPS display format was significantly slower and less accurate than either the moving-map display of nearest-airport information or the enhanced-text display, which includes an orientation symbol. The study also found that even when a heading indicator was available to pilots, they did not make use of it for deciding relative direction. Pilots instead tended to fixate on the GPS display and failed to scan properly. The findings derived from this study of GPS-unit design features could potentially benefit any generic aircraft navigational display as well. [Adapted from Introduction and Results.]

Aircraft Importance and Its Relevance to Situation Awareness. Gronlund, Scott D.; Ohrt, Daryl D.; Dougherty, Michael R. P.; Perry, Jennifer L.; Manning Carol A. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-98/16. May 1998. 14 pp. Figures, references. Available through NTIS.*

Keywords:
1. Air Traffic Control
2. Situation Awareness
3. Memory

Eleven full-performance-level (FPL) controllers who were all instructors at the FAA Academy participated in this study. All had been FPL controllers for an average of 14 years and were familiar with the airspace used in the experiment. The experiment tested the participants to determine what they remembered about the aircraft in their sector. The study concentrated on important flight data such as aircraft altitude, groundspeed and the position of the aircraft on the radar screen. Controllers showed excellent recall of aircraft position and tended to classify aircraft into two categories: aircraft that were not traffic for any other aircraft (unimportant), or aircraft that were, or might become, traffic (important). This factor influenced memory for flight data, but not accurate recall of the radar position of the aircraft. Exact groundspeed was also poorly remembered. The results of this research can be applied to the further development of cognitive aids, the redesign of interfaces, and improvement of techniques to assess situation awareness. [Adapted from Introduction and Conclusions.]

An Analysis of Voice Communication in a Simulated Approach Control Environment. Prinzo, O. Veronika. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-98/17. May 1998. 30 pp. Figures, tables, references, appendices. Available through NTIS.*

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

Twenty-four full-performance level (FPL) controllers from two terminal radar approach control (TRACON) facilities were recruited to participate in this study. This report presents the results of an analysis of the message content of controller transmissions. The participants provided radar separation for simulated aircraft during periods of typical low and high traffic counts representing actual scenarios at their respective facilities. A TRACON simulator generated recorded, digitized pilot messages in response to communications initiated by the controller. If an appropriate pilot response was not generated by the simulator, a certified “ghost pilot” from the FAA Academy provided the correct response.

All communications were transcribed and parsed into communications elements, assigned a speech-act category (e.g., address, instruction, request or advisory), an aviation topic (e.g., altitude, heading or speed), then coded for irregularities. Irregularities in the simulated communications were identified and statistically compared with irregular communications identified from field tapes from two approach-control facilities. Overall, results indicated that controllers generally communicate with simulation pilots the same way they communicate with pilots at their TRACON facilities. Although proportionately fewer irregular communication elements were produced during simulation, the distribution of the inconsistencies was similar to the distribution of those in the field. The study also found that voice-recognition technology could be instrumental in teaching and reinforcing basic air traffic phraseology, but the current level of the technology is still somewhat limited. [Adapted from Introduction and Conclusion.]

Airport Financing: Comparing Funding Sources with Planned Development. Testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives, March 19, 1998. Report No. GAO/T-RCED-98-129. 9 pp. Tables, figures. Available through GAO.**

This testimony discusses airport funding issues covering the past two years since the Airport Improvement Program (AIP) was last reauthorized in October 1996. After considerable study of these issues, this present report focuses on three questions: How much are airports spending on capital development, and where is the money coming from? Will present funding levels be sufficient to meet airports’ planned development? What effect will various proposals to increase airport funding have on airports’ ability to fulfill capital-development plans?

In 1996, the 3,304 airports of the national airport system obtained about US$7 billion for capital development. More than 90 percent of this funding was derived from three sources: airport and special-facility bonds ($4.1 billion); the AIP ($1.4 billion); and passenger facility charges paid on each airline ticket ($1.1 billion). Airports planned up to $10 billion per year in development for the years 1997 through 2001, amounting to $3 billion per year more than they spent in 1996. About $1.4 billion per year is planned for the U.S. Federal Aviation Administration’s priorities of safety, security, environmental and reconstruction projects. Another $1.4 billion per year is planned for other high-priority projects such as adding airport capacity. The remaining funds would go to relatively low-priority projects. The difference between current and planned development is more acute for smaller airports that rely on AIP for more of their funding. A number of proposals to increase airport funding have emerged that benefit specific types of airports to varying degrees. Increased AIP funding would help small airports more, and raising passenger-facility charges would benefit larger airports. [Adapted from Summary and Conclusions.]

Aviation Security: Progress Being Made, but Long-Term Attention Is Needed. Testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives, May 14, 1998. Report No. GAO/T-RCED-98-190. 14 pp. Available through GAO.**

This report contains testimony concerning the progress achieved and the work that remains to be done to maintain and improve the security of U.S. civil aviation. Following the TWA Flight 800 accident in 1996, U.S. President William J. Clinton formed the White House Commission on Aviation Safety and Security. Congressional hearings also highlighted the fact that aviation security weaknesses continue to make the system vulnerable. The commission made a number of recommendations that are currently being implemented by the U.S. Federal Aviation Administration (FAA), other federal agencies and the aviation industry. This testimony focuses on implementation of the key initiatives. FAA has made progress in five critical areas: passenger profiling, explosives-detection technologies; passenger-bag matching; vulnerability assessments; and certification of security companies and the performance of security screeners. FAA has encountered delays of up to 12 months due to the complexity of these problems, relatively untested technologies, funding problems and contractor performance. Current initiatives to strengthen aviation security (such as detection of explosives concealed in checked baggage) will require additional financial resources and a sustained commitment by the federal government and the aviation industry. Commitment and oversight by Congress also will be necessary to ensure that momentum is not lost. [Adapted from Summary.]

Aviation Competition: International Aviation Alliances and the Influence of Airline Marketing Practices. Testimony before the Subcommittee on Antitrust, Business Rights, and Competition, Committee on the Judiciary, U.S. Senate, March 19, 1998. Report No. GAO/T-RCED-98-131. 21 pp. Tables, figures. Available through GAO.**

The testimony in this report deals with aviation relations between the United States and its largest aviation trading partner, the United Kingdom. The current bilateral aviation agreement between the two countries restricts the number of U.S. airlines that can serve Heathrow Airport to two carriers, American Airlines (AA) and United Airlines. In June 1996, AA and British Airways (BA), the U.K.'s largest airline, announced their intention to form an alliance to allow each carrier to market the other's flights as their own (known as "code-sharing"). At the same time they were seeking immunity for the alliance from U.S. antitrust laws. The U.S. Department of Transportation (DOT) must approve such an alliance, and antitrust immunity is granted only when there is an "open skies" agreement (removing all restrictions on air travel between two countries, with market-rate fares) between both countries. Negotiations with the British government were suspended in February 1997. Three questions are addressed by this testimony: What is the status of the various reviews of the AA-BA alliance by European regulatory agencies, the DOT and the U.S. Department of Justice? What competition issues are raised by the proposed alliance? How much consideration should be given to the sales and marketing practices of AA and BA in reviewing the alliance? [Adapted from Summary.]

Advisory Circulars

Application Guide for Obtaining a Supplemental Type Certificate. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) No. 21-40. May 6, 1998. 38 pp. Available through GPO.***

AC 21-40 is a certification guide and checklist for obtaining a Supplemental Type Certificate (STC). This AC describes procedures for typical aircraft-modification projects. The U.S. Federal Aviation Regulations and FAA Directives (Orders and Notices) are the final authorities and take precedence over this document. [Adapted from AC.]

Announcement of Availability – FAA-S-8081-6A, Flight Instructor Practical Test Standards for Airplane (Single-Engine and Multi-engine) – with Change 1. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) No.61-128. April 13, 1998. 2 pp. Available through GPO.***

"Flight Instructor Practical Test Standards for Airplane (Single-Engine and Multi-engine)" is published by the U.S. Federal Aviation Administration (FAA) to establish standards for flight-instructor-certification practical tests for the airplane category and the single-engine and multi-engine classes. These standards are used by FAA inspectors and designated pilot examiners when conducting practical tests. AC 61-128 announces the availability of the reprint for FAA-S-8081-6A, "Flight Instructor Practical Test Standards for Airplane (Single-Engine and Multi-engine)" with Change 1. The principal change is the use of reference AC 61-67, *Stall and Spin Awareness Training*, which replaces an obsolete reference. Ordering information for printed copies or electronic access is also provided. [Adapted from AC.]

* National Technical Information Service (NTIS)
5235 Port Royal Road
Springfield, VA 22161 U.S.
(703) 487-4600

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

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

Departing Aircraft Distorts Localizer Signal, Causes B-747 Using Autoland Approach To Bank Right, Veer off Runway

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

FSF Editorial Staff

Air Carrier

Distorted ILS Signal Causes B-747 to Veer Off Runway

Boeing 747-400. Damage unknown. No injuries.

The aircraft was on an instrument landing system (ILS) approach to an airport in Japan. The B-747 was at 1,000 feet altitude when the flight crew saw a large, turbine-powered transport airplane begin rolling for takeoff on the runway.

The pilot flying told the pilot not flying that he would use the autopilot's autoland mode for the landing so that they could maintain continuous visual contact with the aircraft that was departing.

The B-747 was at 200 feet when the other aircraft lifted off the runway. The B-747 crew then was cleared by air traffic control to land.

After the aircraft was flared for the landing, it began to bank to the right and head away from the runway centerline. The crew attempted corrective action with manual operation of the ailerons, but the aircraft, still flying on autopilot, continued drifting to the right.

The aircraft touched down and veered further to the right. The right main landing gear rolled off the right side of the runway for about 825 feet (250 meters) on the grass, after crushing two runway edge lights. The crew disengaged the autopilot and used rudder control to return the aircraft to the runway.

The B-747's drift was believed to have been caused by the autopilot's response to distortions of the localizer signal caused by the departing aircraft. The incident prompted the operator of the B-747 to prohibit the use of autoland when another aircraft is in the ILS critical area.

Cockpit Fire in B-757 Forces Return to Departure Airport

Boeing 757. Substantial damage. No injuries.

Fifteen minutes after taking off from an airport in Europe, the flight crew reported a fire in the cockpit of the B-757 and were returning to land. One of the flight crewmembers put out the fire with a fire extinguisher.

The aircraft then was landed without further incident. None of the 215 occupants was injured.

The aircraft was sealed for inspection by civil aviation authorities and airline engineers. A police spokesman said that the fire appeared to have started from a spark on the control panel.

Captain Rejects Takeoff after Engine Ingests Bird

Boeing 737. Minor damage. One serious injury.

The twin-turbine airplane's left engine ingested a bird after the first officer called V_1 (defined at the time as takeoff-decision speed). The bird strike caused a compressor stall in the left engine. The captain initiated a rejected takeoff at an airspeed 10 knots above V_1.

The airplane was brought to a stop on the runway-overrun area. The captain made a public-address announcement for the passengers to remain seated. Crash, fire and rescue (CFR) personnel determined that there was no fire, but that the airplane's tires had deflated because the fuse plugs were melted by excessive brake temperature. The flight attendants, who had armed the evacuation slides, de-armed the slides and opened the cabin doors for ventilation.

A fire then erupted in a wheel brake and was extinguished immediately by CFR personnel. "Hearing a fireman shout 'fire,' the flight attendants at the forward and aft entry doors commanded an evacuation without informing the captain that a fire had been reported, without communicating first with each other and without determining the location of the fire," said the report.

The flight attendants closed the cabin doors and rearmed the evacuation slides before beginning the evacuation. One passenger was seriously injured and four passengers sustained minor injuries during the evacuation.

No Wing-walkers in Use When Push-back Collision Occurs

Boeing 737, Boeing 767. Substantial damage. No injuries.

No wing-walkers were being used when a tug pushed a Boeing 737-322 from its gate at an airport terminal in the United States. The tail of the B-737 struck the tail of a Boeing 767-223 that was beginning to taxi under power after being pushed back from its gate by a tug. Damage to the B-737 was substantial. Damage to the B-767 was minor. None of the 221 occupants of the B-737 or the 221 occupants of the B-767 was hurt.

The driver of the B-737 tug said that she had observed a food-service truck nearby and slowed to ensure its passage. She then proceeded to push the aircraft toward its designated location in the alley. She said that she saw the B-767 for the first time when the collision occurred.

The report said that airplane wing-tip clearance in the alley does not meet the airport-operator's requirements. Nevertheless, nine months before the accident, the airport operator gave the B-737 operator permission to continue using the alley if the operator guaranteed the use of wing-walkers to assist in the movement of aircraft in the alley.

Air Taxi
Commuter

Passenger's Hand on Throttles During Low-visibility Takeoff

Piper Cheyenne. Substantial damage. No injuries.

The twin-turboprop airplane was being rotated for takeoff from a 2,700-foot (818-meter) runway when the airplane veered to the right. The airplane then struck a taxiway sign, a fence and a light pole, and came to rest between two buildings. Airplane damage was substantial, but the pilot and the two passengers were not injured.

Investigators found no evidence of any mechanical malfunctions that could have caused the airplane to veer to the right on takeoff.

The report said that visibility was one-eighth of a mile (0.2 kilometers). The minimum visibility prescribed for an instrument takeoff from the airport was one mile (1.6 kilometers).

A passenger who had a pilot certificate was in the Cheyenne's left front seat. The pilot said that the passenger was using a checklist to follow the pilot's actions. The other passenger, who was seated behind the pilot, said that the left-front-seat passenger's hand was on the power levers when the accident occurred.

Aircraft Landed on Sea Ice After Baggage Door Opens

Piper Chieftain. Substantial damage. Four serious injuries.

The Chieftain was on initial climb after takeoff when the baggage-compartment door on the nose section of the aircraft opened. Some of the contents of the baggage compartment were blown from the open compartment and struck the left propeller. The pilot made an emergency landing on sea ice.

The pilot and three passengers were seriously injured. Two other passengers escaped injury.

Deflated Strut in Dash 8 Causes Nose Gear to Jam on Extension

De Havilland Canada Dash 8. Substantial damage. No injuries.

The aircraft was on approach to an airport in Canada. The flight crew attempted to lower the landing gear, but received no indication that the nose gear was locked in the extended position. The crew used the alternate landing-gear-extension procedure, but again received no indication that the nose gear was down and locked.

The crew then flew the aircraft past the airport control tower, and the controllers confirmed that the nose gear was extended partially. The crew requested that emergency services be alerted and then proceeded to land the aircraft.

The aircraft came to a stop on the runway resting on the main landing gear and the nose wheel and nose-gear-bay doors. The passengers were evacuated without injury.

Examination revealed that the nose-gear strut had deflated in flight and that the tires had jammed against the aft nose-gear-bay doors when the crew attempted to extend the landing gear. The oleo-strut leak was caused by a defective seal backup ring that had been bent, possibly during reassembly after the strut was overhauled.

Duck Penetrates Windshield, Injures First Officer

Beech 99C. Substantial damage. One minor injury.

The aircraft was in cruise flight at 8,000 feet when a duck weighing 1.5 pounds (0.7 kilograms) penetrated the windshield and struck the first officer. The first officer sustained minor injuries. None of the other occupants was hurt.

The windshield-heating system was not being used when the bird strike occurred, and there were no pre-existing cracks in the windshield.

Corporate Executive

After Engine Fails, Pilot Lands MU-2 on Street

Mitsubishi MU-2B. Aircraft destroyed. No injuries.

The twin-turboprop airplane's right engine failed during initial climb, and could not continue to climb. The pilot elected to make a forced landing on a street with the landing gear retracted. The pilot maneuvered the airplane to avoid striking street-light poles and automobiles.

After touching down on the street, the airplane slid into a wall. The MU-2 was destroyed by impact damage and a postaccident fire. The pilot, alone aboard the airplane, was not hurt.

Investigators determined that the second-stage turbine rotor disk in the right engine had failed, and that fragments from the disk had penetrated the engine cowling. "Examination of the disk fragments revealed a low-cycle fatigue-fracture mode," said the report. "The fatigue initiated from multiple areas at and adjacent to the inside-diameter bore surface near the aft side of the disk. There were no material or casting defects detected."

Hydraulic Seal Failure Causes Brake Malfunction on Landing

Cessna 425 Conquest I. Substantial damage. No injuries.

The pilot said that he landed the twin-turboprop airplane on the approach end of the 3,100-foot (939-meter) runway and applied full reverse thrust. As the airplane slowed, the pilot discontinued the use of reverse thrust and depressed the brake pedals.

The right brake pedal moved to its full limit of travel, and the airplane veered to the left. The pilot feathered the right propeller and applied power to the left engine. Nevertheless, the airplane continued to veer to the left. The airplane traveled off the left side of the runway and struck a ditch.

Investigators determined that the brake pads and brake disk were in serviceable condition, but the O-rings in the brake housing were distorted. Hydraulic fluid leaked past the O-rings when the brake system was pressurized. When the O-rings were replaced, the brake system functioned normally.

Fuel Caps Cited in Aerostar Forced Landing

Piper 602P Aerostar. Aircraft destroyed. Three serious injuries.

The aircraft was cruising at 18,000 feet in instrument meteorological conditions when the pilot requested and received clearance to climb to 22,000 feet.

During the climb, both engines lost power. The pilot said that the aircraft began to descend rapidly. He made several attempts to restart the engines but was unable to restore power.

The aircraft descended below the clouds at 3,000 feet. Visibility beneath the clouds was about one statute mile (1.6 kilometers) in rain and fog. The pilot saw buildings below the aircraft and maneuvered toward an open area.

The pilot said that he attempted to land in a field, but that the aircraft struck trees at the edge of the field. The pilot and his three passengers were seriously injured.

Investigators determined that air leaking through the fuel-filler caps on both wing tanks created a pressure imbalance in the fuel system that caused the engines to draw fuel only from the fuselage tank. The engines stopped after the fuselage-tank fuel was depleted.

Other General Aviation

Napping Pilot Awakes to Find Aircraft over Water

Piper Seneca. Aircraft destroyed. No injuries.

The pilot was making a visual flight rules (VFR) cross-country flight of about 100 nautical miles (185 kilometers) over land early in the morning. The aircraft was cruising on autopilot at 3,500 feet when the pilot fell asleep 15 minutes from the destination.

The pilot awoke five hours later to find that the aircraft was over water and had about 20 minutes of fuel remaining. The pilot declared an emergency and requested ATC vectors to the nearest airport, which was about 180 miles (333 kilometers) away.

The pilot flew the aircraft to 9,500 feet and leaned the engines' fuel-air mixture for maximum endurance. Both engines stopped and the pilot ditched the aircraft about 70 miles (130 kilometers) from shore. He used two foam cushions from the airplane to float on the water until a rescue helicopter arrived 20 minutes later.

The pilot told investigators that he had insufficient rest before beginning the flight.

After Starting, Pilotless Luscombe Hits Pilot's Wife and Parked Aircraft

Luscombe 8A. Substantial damage. One serious injury.

The vintage aircraft was not equipped with an electric starter, so the engine required starting by hand. The pilot checked that the brakes were on but did not place chocks in front of the wheels.

The first attempt to start the engine by rotating the propeller failed. The pilot returned to the cockpit to reset the controls so that the engine would not fire when he rotated the propeller again to clear the engine cylinders of fuel. He apparently did not turn the magneto switch off, however, and the engine started when he rotated the propeller.

The aircraft, with no one at the controls, began to move with the engine operating at full throttle. The aircraft struck and injured the pilot's wife, and then collided with a parked Cessna 210. Both aircraft were substantially damaged.

Student Drowns After Power Loss Leads to Ditching

Avions Pierre Robin. Aircraft destroyed. One fatal injury.

The airplane was on a dual cross-country flight in England. Life-preserver jackets were available in the airplane, but neither the student pilot nor his flight instructor was wearing one. The airplane was cruising at 2,000 feet, about 1.5 nautical miles (2.8 kilometers) offshore in night, visual meteorological conditions when engine power decreased to 1,000 revolutions per minute.

The flight instructor attempted without success to restore cruise power. The airplane was descending at 500 feet per minute (fpm). The instructor was able to increase power and decrease the rate of descent to 50 fpm by pumping the throttle.

The pilots intended to land on a mud flat, but the airplane descended into the sea near an oil-terminal jetty. The pilots exited the airplane and clung to the airplane's wings. The airplane sank after about one minute, and the pilots began to swim toward the jetty wall, about 660 feet (200 meters) away. The instructor reached the jetty wall and climbed out of the water. The student pilot apparently drowned; his body was found several weeks after the accident.

Investigators determined that the most likely cause of the engine power loss was obstruction of the carburetor power jet by the carcass of an insect.

Rotorcraft

Turbulence Foils Attempted Landing on Mountain Helipad

Bell 206B. Aircraft destroyed. One serious injury, two minor injuries.

The pilot encountered turbulent wind conditions while approaching to land on a mountain helipad at an elevation of 8,500 feet. He aborted his first two landing attempts because of the turbulence.

The pilot said that, on the third attempt, he turned the helicopter downslope to avoid the upsloping terrain. During the turn, the helicopter struck tall vegetation and then the ground. One of the occupants was seriously injured; the other two occupants sustained minor injuries.

There was a significant meteorological advisory in effect for strong updrafts and downdrafts, and low-level wind shear.

Helicopter Strikes Power Lines During Aerial-application Flight

Hiller UH-12E. Substantial damage. One serious injury.

The helicopter struck power lines while approaching an onion field during an aerial-application flight. The power lines became entangled with the tail-rotor assembly. The helicopter struck the ground about 400 feet (121 meters) from where it struck the power lines. The pilot was seriously injured.

An investigator said that the helicopter, during the approach to the dark-green onion field, was flying over a newly plowed field that was light in color. The power lines were suspended along the border of the light-colored and dark-colored fields.

Pilot Loses Control During Attempt to Land on Trailer

Bell 47G2. Substantial damage. No injuries.

The pilot was in the process of purchasing the helicopter and had driven a trailer to the airport to transport the helicopter to his place of business. He said that he conducted a prepurchase acceptance flight and descended slowly to land the helicopter on the trailer.

After the helicopter touched down on the trailer, the pilot lowered the collective control. He felt the helicopter begin to drift to the right, and he added power and moved the cyclic control to the left to correct the drift. The helicopter then banked steeply to the left. The main rotor blades struck the ground and the helicopter's tail boom.

The pilot said that this was his first attempt to land on a stationary trailer. An investigator said that the width of the trailer was about four inches (10 centimeters) wider than the track of the helicopter's landing skids.♦

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