FLIGHT SAFETY FOUNDATION

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A Safe Flight into the Next Millennium

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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.

A Safe Flight into the Next Millennium

The National Civil Aviation Review Commission, created by the U.S. Congress, reviewed the U.S. aviation system in terms of both public funding and safety. In the safety portion of the report, the Commission emphasized the need for new forms of industry-government cooperation and the value of flight operations quality assurance (FOQA) programs and nonpunitive incident-reporting programs.

National Civil Aviation Review Commission

[Editorial note: The U.S. Congress created the National Civil Aviation Review Commission in the Federal Aviation Reauthorization Act of 1996. The Commission report said that its mission was "to discuss and identify problems in the (U.S.) aviation system and to provide recommendations on improving the current situation." The Commission included two task forces, one concerned with funding issues and the other with safety issues.

[The Commission's 21 members included specialists in aircraft manufacturing, airline operations, airport management, financial management and general aviation-industry issues. Its chairman, former U.S. representative Norman Y. Mineta, opened the Commission's deliberations on April 28, 1997. During several meetings, the Commission was briefed by officials from the U.S. Department of Transportation (DOT), the U.S. Federal Aviation Administration (FAA) and aviation industry officials. Flight Safety Foundation (FSF) Chairman, President and CEO Stuart Matthews gave a presentation to the Commission on Sept. 10, 1997. The Commission conducted public hearings on May 28, 1997, and Oct. 8, 1997.

[The Commission released its report, *Avoiding Aviation Gridlock & Reducing the Accident Rate: A Consensus for Change*, in December 1997. It consists of Part I, Executive Summary; Part II, Funding Report; Part III, Safety Report; and Part IV, Attachments. Edited for style, Part III of the Commission report is printed below.]

Introduction

Commission's Mandate

The legislation that established the National Civil Aviation Review Commission (the Commission) directed that three areas relating to the U.S. Federal Aviation Administration's (FAA's) safety mission be assessed in the context of analyzing aviation safety in the United States and emerging trends in the safety of particular aviation sectors.

1. The adequacy of staffing and training resources for safety personnel of the FAA, including safety inspectors;

2. The FAA's processes for ensuring the public safety from fraudulent parts in civil aviation and the extent to which the use of suspected unapproved parts requires additional oversight or enforcement action; and,

3. The ability of the FAA to anticipate changes in the aviation industry and to develop policies and actions to ensure the highest level of aviation safety in the 21st century.

This report addresses each of these issues. The first two are important but are relatively narrow and definable in scope, while the third is relatively broad and invites an assessment of safety regulation policy or philosophy. This report will be largely organized around the third issue, with the first two addressed in more of a stand-alone fashion.

No "Silver Bullet" Exists for Further Safety Improvements

Virtually every facet of the safety of the civil aviation industry is highly regulated by the U.S. federal government. Safety regulation of aviation exceeds that found in any other industry or sector of the economy, including food, medicine, nuclear power and other modes of transportation. Every person who operates an airplane, designs and manufactures an airplane and its component parts or repairs or modifies an airplane does so under detailed standards prescribed by the FAA. Only in relatively limited circumstances does a commercial airplane move through U.S. airspace without permission and direction from an FAA air traffic controller. This high level of safety regulation is expected by the public. While there are differing views on some specific issues of regulatory policy and approach, the aviation industry accepts the regulatory relationship it has with the FAA.

While the FAA wields strong regulatory powers over the industry, the law also requires the industry, irrespective of FAA oversight, to conduct its activities in a manner consistent with the highest degree of safety. This means that the FAA's standards are minimums below which no one in the industry should dip. In day-to-day practice, the industry typically exceeds FAA standards. However, when the FAA's standards are not met, the agency has broad powers and authority to take enforcement action, including stopping a flight from being made or even grounding an airline's fleet until the FAA is convinced that its standards will be met.

When compared to almost any other human endeavor, aviation industry practices, whether they be in manufacturing, operations or maintenance, coupled with the FAA's strong regulatory role have resulted in an extraordinarily high level of safety since the mid-1960s. Nevertheless, when an airplane has an accident, there can be a catastrophic loss of life involving scores or even hundreds of people. Apart from war and natural disasters, a large airplane accident can cause more deaths in an instant than almost any other type of event; hence, there is tremendous public and media interest in aviation safety.

For the past 30 years, the annual, worldwide rate of catastrophic [hull-loss] accidents (e.g., when the aircraft is destroyed) has been one accident to three accidents per one million departures of large jets (Figure 1). In the United States, the annual rate has been consistently around one accident or less per million flights. These rates have been relatively constant over the 30-year period. By comparison, in 1959, the rate worldwide was over 30 accidents per million flights, and in the United States the rate was approximately 26 per million flights. The rapid improvement during the 1960s was due to the introduction of jet aircraft with far more reliable engines than piston engines.

During the past 30 years, the number of departures by airline jet aircraft has more than quadrupled from approximately four million worldwide in 1967 to approximately 16.3 million in 1997. Similarly, the number of jet aircraft operating worldwide has climbed from approximately 3,000 to more than 12,000 today.

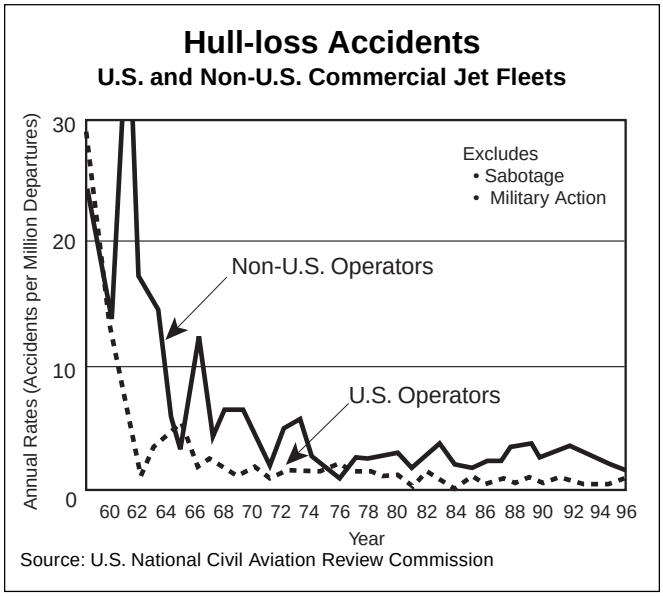


Figure 1

As was found in developing the Commission's report on funding and financing of the federal aviation programs, growth in aviation activity is anticipated to be healthy and steady for the foreseeable future (if the aviation system is able to accommodate this demand with new management and funding approaches for the FAA). Worldwide flights are expected to increase from 16.3 million in 1997 to more than 25 million by 2010. If the current accident rate is extrapolated over that traffic level, the number of accidents can be expected to increase to where there is a large jet aircraft accident every seven days to 10 days somewhere in the world. If the extrapolation is carried further out into the future, the interval between major accidents, of course, decreases even further. Within just the United States, the existing accident rate coupled with expected traffic growth would lead the number of catastrophic accidents to rise from the current total annual level of three to four to six to seven by 2010.

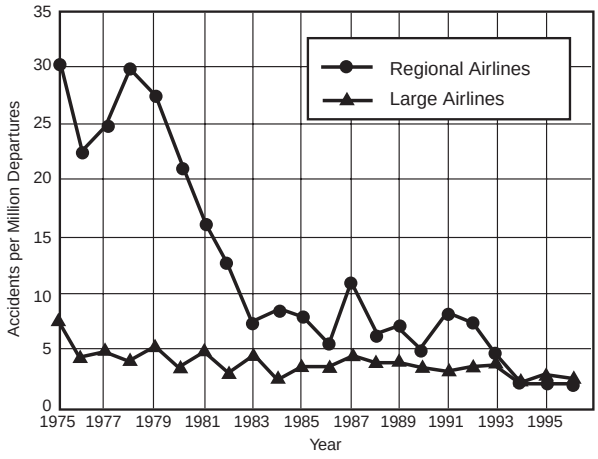
As mentioned above, the replacement of large piston-powered aircraft with more reliable jets in the 1960s and the first half

of the 1970s produced multifold reductions of the accident rate. It does not appear realistic to expect another introduction of a technology to produce a similarly dramatic reduction over a relatively short period of time. There is no "silver bullet," so to speak, for further safety improvements.

Accident Trends Have Fallen Among Regional Airlines, Air Taxis and General Aviation

Regarding regional air carriers, the accident rate also has fallen sharply. Between 1975 and 1996, the accident rate for regional air carriers fell from 33 per million departures to 3.47 per million departures. This remarkable improvement came about despite dramatic growth in the industry and fundamental changes in its character. In 1994, regional air carriers (defined through 1996 as scheduled flights in aircraft with 30 or fewer seats) carried 53 million passengers — twice the number carried just seven years earlier. By 1996, the number of passengers approached 58 million.

Airline deregulation has led to equity and contractual relationships between regional and larger air carriers and a subsequently sudden transformation in the U.S. regional fleet. Regional carriers are no longer characterized by small aircraft on short feeder flights; today's regional airline fleet consists primarily of sophisticated turboprop-powered aircraft. By 1996, the accident rate among the larger regional aircraft had become comparable to that of large air carriers (Figure 2). This trend should be reinforced by the recently implemented one-level-of-safety rule, in which both smaller aircraft and airports are required to adhere to equally or similarly stringent safety rules as larger aircraft and airports. Today, even more capable turboprops and new regional jets, along with corresponding training in advanced simulators, are about to revolutionize the industry again. These developments offer promise of still better safety performance in the industry.



Source: U.S. National Civil Aviation Review Commission

Figure 2

As with scheduled air carriers, the accident rates for on-demand air taxis have remained relatively steady over last 15 years. An air-taxi service is defined as an aircraft operator who conducts operations for hire or compensation on an on-demand basis and does not meet the "scheduled flight" qualifications of a regional carrier. On-demand air-taxi companies utilize a wide variety of aircraft, ranging from four-seat piston-powered aircraft to sophisticated 19-seat multi-engine turbine-powered jets. Although there have been fluctuations in the rate from year to year, since 1982 there have been about 4.4 air taxi accidents per 100,000 flight hours and about one fatal accident per 100,000 flight hours. (Note that the accident rates for air taxis and general aviation (GA) are discussed in terms of flight hours because data on the number of departures are not readily available.) Within the broad range of air-taxi operators, however, the accident rates vary. According to one industry analysis of government figures, the accident rate for turbine-powered aircraft operated as on-demand air taxis was extraordinarily low from 1993 to 1996 when compared with any other type of aviation activity.

Over the past few years, accident rates for GA aircraft have resumed their long-term improvements after a brief aberration in the early 1990s when there was a small upturn in the rates. GA captures many dissimilar types of aviation activity, ranging from high-performance corporate jets with professional crews to the recreational pilot. Note that accident rates within the GA community vary significantly, depending upon the type of activity. For example, over the last 10 years the accident rate for turboprop/jet aircraft has been about one-fourth of the rate for single-engine piston-powered aircraft.

In the aggregate, the fatal accident rate in GA reached a new low in 1996. Specifically, in the United States there were 1,908 GA accidents in 1996 with an accident rate of 8.11 per 100,000 flight hours. When compared to 1995, the figures for 1996 represented an 8 percent decline in the number of accidents and a 17 percent drop in the accident rate. According to the FAA, through August 1997, GA appears ready to achieve still another new low fatal-accident rate in 1997.

Large-jet Accident Rate Is Unacceptable

The Commission believes that an increasing frequency of large-jet accidents is unacceptable, and steps should either be initiated or carried out that will lead to a significant reduction in the accident rate. The Commission's views reflect a consensus that has developed among safety professionals in the pilot community, the manufacturing sector, the airlines industry and the government. The recent White House Commission on Aviation Safety and Security recommended the adoption of a goal of an 80 percent reduction in the fatal-accident rate within 10 years. The Commission believes that this is a reasonable target upon which to focus accident-

reduction policies. The Commission believes that steps taken in the near future can reduce the accident rate significantly over the next several years.

Resources Require Conscientious Application

The importance of adequate resources to meet the needs of aviation safety cannot be overstated. Nevertheless, the Commission recognizes that the aviation industry and the federal government must work within fiscal constraints even in the best of times. The demands of safety can be met (and in the past have been met) by a conscientious application of resources to crucial priorities. As to the recommendations and suggestions made by the Commission in this report, resources are a fundamental concern. The report of the Commission's Funding Task Force addressed the matter by recommending that the FAA's aviation safety programs be funded through the general fund of the U.S. Treasury. As explained in that report, the federal government must maintain a sufficient funding level for aviation safety, which is a broad-based public good. These financial resources can be effectively leveraged using the strategic priorities developed pursuant to recommendations in this report.

FAA and the Aviation Industry Need to Prioritize Their Safety Agenda and Implement a Strategic Plan

Over approximately the past three years, hundreds of specific and concrete recommendations and initiatives to improve aviation safety have been issued by previous commissions, industry-government working groups, task forces, committees, FAA analyses, U.S. General Accounting Office (GAO) reports, and congressional actions. The Commission strongly recommends that the FAA determine the priority of all these recommendations and develop a comprehensive, integrated strategic safety plan to implement them.

In establishing these priorities and a strategic plan for safety, the FAA needs to be in a partnership with all elements of the aviation industry. To the greatest extent possible, there should be a consensus on priorities with the industry. Where a consensus is not readily achievable, however, it is incumbent on the FAA to exercise leadership and make the proper choices. If the prioritization is based on an objective analysis of known data with a methodology that is well understood, the FAA will be able to move forward and justify its actions. It is important that this prioritization and plan be developed and publicly announced soon. The Commission believes that with all the previous analyses by industry and government agencies, the tools exist to do this now.

The FAA should function as a facilitator and catalyst for aviation safety improvement by gathering data and information from the best sources, assessing information with stakeholders, and then exercising its leadership role and responsibilities. In doing so, the agency must decide on those critical items that:

- Will provide a significant public benefit;
- Make the best use of limited resources;
- Can realistically be implemented in the commercial sector; and,
- Will benefit from government support or intervention.

This process should begin with analysis of previous and potential failures to meet safety expectations (i.e., accidents, incidents, insight from flight operational data and aviation system changes), proceed to identification of root causes and then transition to consideration of accident-prevention opportunities that have high leverage potential. As noted above, there has been an extensive amount of thought and analysis on these matters already, and full advantage should be taken of that work.

Accident-prevention plans should be evaluated based on the number of safety events that would be addressed, the severity of those events, the expected effectiveness of the plans and any possible unintended consequences. By taking this approach, accident prevention would become the highest strategic priority in safety. In essence, this would be the beginning of a safety risk management program at the national level.

The process must be conducted with the cooperation and full participation of aviation industry stakeholders. Industry has a wealth of data, expertise and experience that must be brought to bear to solve the complex problem of further reducing an already low accident rate. In this regard, the Commission believes that legislative and regulatory barriers should be eliminated to allow the protection of safety data, the free flow of ideas and innovative implementation of operational or design improvements.

Safety improvements are not likely to be broadly effective if traditional regulatory enforcement is the primary approach taken by the federal government. Legal, organizational and cultural barriers should be removed to the maximum extent possible to facilitate cooperative selection and implementation of safety improvements. By fully including stakeholders in a roundtable process, decision making can be more timely and effective.

The Commission believes that the FAA has the ultimate responsibility to make appropriate choices for U.S. government action to enhance aviation safety. The agency should facilitate and encourage, and in some cases mandate, complementary actions by industry. By cooperatively and selectively pursuing a few well-justified, data-driven, benefit-focused and highly leveraged actions, more lives are likely to be saved in the future than by attempting to "take a bite out of every item on the menu."

FAA Safety Programs Must Become Performance Oriented

The Commission is recommending that federal air traffic services be provided by a performance-based organization (PBO). Under the Commission's recommendations, FAA safety and regulatory programs are not placed under the formal PBO structure. Conceptually, the PBO is suited to an organization that is providing a service to customers or users. Safety regulation is policy making, regulatory enforcement and acting in the general public interest.

Having said that, the Commission strongly recommends that the FAA's safety programs become performance oriented, with measures of performance developed and used to hold the safety organization accountable. This is essential to improving the aviation accident rate. The first steps in accomplishing this would come in implementing the Commission recommendation that safety priorities be established and a strategic plan developed to implement programs based on those priorities. After that, measures and milestones should be developed to assess whether the safety goals of the organization are being achieved and are producing safety results.

Strengthen Government-industry Partnerships

The Commission believes that for much of the aviation industry, particularly with regard to manufacturing and most commercial operations, the relationship between the regulator and the regulated needs to change in some important respects to reflect the current industry "maturity" level on safety matters. Moreover, the Commission recommends that, in some critical areas, a move toward a government-industry partnership is essential to reducing the accident rate below the plateau that has existed for the last 30 years.

A strong consensus among aviation safety professionals has developed that making safety improvements based largely on accident data, and to some extent incident data, will result in improvements, but may not be sufficient to anticipate future problems. Robust data that would capture the precursors of incidents and accidents are also required.

One FAA-industry cooperative effort, in its infancy, is a program to collect, analyze and share data on actual flight operations. While this may appear to be a relatively straightforward matter, the sharing of this data between a regulatory authority and regulated entities has raised complex legal, enforcement and proprietary-information issues that must be resolved.

The best available source of this type of data is from digital flight data recorders (DFDRs), which are typically only analyzed after an accident to help determine its cause. But DFDRs can collect flight data on each flight and serve as an information base to spot developments or problems outside of the context of an accident, thereby enabling corrective steps to be taken before trouble occurs. The Commission believes quality assurance programs based on day-to-day operational data could be applied to other sectors of the aviation industry beyond the airlines.

As mentioned above, the traditional regulatory relationship between the agency and industry must be altered for this type of analysis to fully blossom. The Commission recommends that the FAA and industry take immediate steps to resolve the legal issues so that this real-world operational data can be effectively shared and analyzed in the effort to reduce significantly the accident rate. At the same time, the Commission believes that the FAA cannot forgo its enforcement role in the partnership, as it is an important tool that should be used when appropriate to protect the safety of the traveling public.

Expand FAA's International Safety Activities

There is significant variability in the accident rates among the regions of the world. Accident rates in Eastern Europe, Russia, Asia, Latin America and Africa are many times greater than the rates in the United States, Western Europe and Oceania. Any effort to significantly reduce an increasing number of accidents must involve the aviation authorities and aviation industries in all regions of the world.

The reasons for addressing safety on an international basis are the following:

- This is where the largest number of aviation fatalities are occurring;
- U.S. passengers and airlines fly frequently in these regions and need improved safety; and,
- International air transportation of people and cargo is a critical enabling factor for economic development, and benefits both the United States and world economies.

The FAA, in recent years, has taken the lead in working with non-U.S. aeronautical authorities to ensure that international standards are being met. The agency's efforts include assessments of non-U.S. governments' regulatory capabilities, entering into bilateral safety agreements and harmonizing regulatory standards.

The Commission recognizes that working with non-U.S. governments is a two-way street, and for these efforts to succeed, full cooperation with non-U.S. authorities is essential. As detailed in the section titled "Strengthen the FAA's Role in International Aviation Safety," the Commission recommends that the FAA review its international safety programs with an eye toward determining whether adequate U.S. resources are being devoted to this area. The Commission strongly believes that significant strides must be made at reducing the accident rate in regions of the world beyond the U.S., Europe and Oceania.

Recommendations Include Strategic Planning, Prioritization and Performance Measurement of Current and Future Initiatives

The Commission believes that aviation safety is achieved through the combined efforts of manufacturers, airlines, unions and the government. Promoting safety in an efficient aviation transportation system is, and must continue to be, the FAA's and industry's top priority. The FAA must take the lead in promoting safety through collaboration as well as compliance. The collaboration of aviation industry management, workers and the government to evaluate and prioritize safety initiatives should serve as the basic foundation for ensuring and improving safety.

The challenge for the FAA and the aviation industry is to collectively agree on a course of action to prioritize the many recommendations and initiatives the FAA has received over the past few years. For example, the FAA's associate administrator for regulation and certification has identified more than 350 proposed safety-related initiatives in flight standards alone. These initiatives and recommendations have come from numerous internal and external sources, such as the U.S. National Transportation Safety Board (NTSB), the GAO, the White House Commission on Safety and Security (the Gore Commission), a 1996 90-Day Safety Review, the 1995 Aviation Safety Summit and the Challenge 2000 report (which explores safety regulation in the 21st century), just to name a few.

The recommendations run the gamut from the very broad (e.g., the establishment of a national goal to reduce the aviation fatal-accident rate by a factor of five within 10 years) to the very specific (e.g., the identification and elimination of contradictions in guidance material to inspectors on how to verify implementation of airline maintenance programs).

Merge Industry and FAA Prioritization Efforts

The FAA has identified and undertaken numerous safety initiatives. Further steps need to be undertaken, however, to prioritize all of these initiatives and recommendations so that government and industry resources are applied where the most safety improvement will be accomplished. To the greatest extent possible, there needs to be a coordinated, consolidated and agreed-upon FAA and industry safety strategy to ensure the maximum safety enhancement. A great deal of groundwork has been laid already to narrow the wide scope of existing safety recommendations by the development of the annually prepared Aviation Safety Plan, which was begun in 1995. The Commission strongly believes that it is time for the FAA and the industry to move further, beyond the identification stage and into the priority-setting stage.

The beginnings of priority setting have begun with the Integrated Safety Strategy Team (ISST). This group is composed of leaders from the FAA, the Air Transport Association of America, the Air Line Pilots Association, International, the Allied Pilots Association and airframe and engine manufacturers. The ISST was created to bring together these various organizations to coordinate, consolidate and agree upon safety strategies.

The Commission believes that the ISST's stated objective captures very well what needs to be done: "Develop an integrated safety strategy so that industry and the government can set safety-related goals and objectives focused on the right things, prioritized to result in the greatest improvement in commercial aviation safety." Simply stated, the objective should be to identify and reach consensus on those things that will bring about the biggest improvements in the safety of the aviation system, to prioritize them and to achieve a public awareness of what is to be accomplished.

Coordinate FAA, NTSB and Industry Priorities

The Commission is concerned that there is often at least the appearance that the NTSB and the FAA are at odds over what the safety priorities should be. Moreover, it appears that the relationship between the two principal agencies responsible for aviation safety has deteriorated. This is not helping to improve aviation safety or the public's perception of it.

In the development of the prioritization and strategic plan for safety, there should be full cooperation with the NTSB, just as there should be with all elements of the aviation industry, as mentioned in the preceding section.

The Commission recognizes the different statutory mandates of NTSB and the FAA. NTSB's safety recommendations are derived from accident investigations. The FAA, on the other hand, has ongoing safety responsibilities which are far broader and more extensive. In addition to responding to specific accident issues, the FAA must also develop and implement a long-term safety strategy and strengthen its long-term regulatory and inspection oversight. NTSB recommendations are indeed important (evidenced by the FAA implementing the vast majority of recommendations), but comprise only one segment of the FAA's safety priorities and programs.

The Commission recognizes that recommendations resulting from accident investigation by the NTSB will require immediate attention despite whatever priorities may be developed as part of an overall strategic approach to safety improvement. Therefore, it becomes increasingly important that the recommendations developed during an accident investigation process benefit from all of the expertise that is reasonably available to the NTSB. Accordingly, it appears to the Commission that the accident investigation process could be improved and given even greater credibility than it now has by using outside experts or "parties" to a greater extent in the analytical process of determining an accident's cause. This could be accomplished much in the same way that is spelled

out in international guidelines for accident investigation. The Commission believes that, in doing this, the NTSB should take steps to ensure that the independence and integrity of its decision making is preserved.

Furthermore, the Commission is concerned about the newly formalized NTSB role of assisting the families of accident victims, which is certainly a needed humanitarian function, and whether this responsibility, over time, might divert its focus and budget resources from its primary role to investigate accidents and make safety recommendations. The Commission was pleased to learn that NTSB recognizes this problem and has established procedures to separate accident investigation from family assistance. The Commission believes that this will need constant vigilance.

The NTSB's independence in the accident investigation process is essential and should not be jeopardized. The strength and credibility of the accident investigation process requires this independence, whether it be from other government agencies or the industry. In recognizing the critical need for independence in its accident investigation work and mission, the Commission believes that there is no conflict if the two agencies charged with improving aviation safety were to coordinate and agree upon what is important and should receive priority in an overall safety strategy.

The Commission recommends that there be a much-improved and better-coordinated process and relationship among the FAA, NTSB and the aviation industry over what the safety priorities should be. The Commission recommends that the agencies and industry take concrete steps to ensure that this occurs.

Coordinate Other Government Agencies' Policies with the FAA

With regard to the FAA's priorities for safety and the strategic plan to implement them, the Commission finds that it is critical that other government agencies be cognizant that their actions, regulations and policies can have unintended aviation safety consequences. There have been instances in which tax, environmental and other policy proposals or changes have raised aviation safety concerns. When other agencies are proposing a policy that they know will have an impact on the aviation industry, those agencies should be communicating with the FAA to learn if there might be any safety consequences in their actions. Furthermore, as the FAA becomes aware of actions or policies by other federal agencies that may influence aviation safety, the FAA should communicate its concerns to the relevant agencies so that nonaviation regulatory policies are not working against those aimed at improving safety.

FAA Must Utilize Available Data to Set Safety Priorities

The establishment of priorities and the implementation of the strategic plan must be driven by objective analysis of safety data. Both the FAA and the aviation industry have conducted extensive analyses as to the historical causes of accidents, so it does not appear that a fresh start is needed. Using those analyses, the Commission recommends that the hundreds of recommendations that presently exist should be evaluated to determine the initiatives that will result in the greatest safety benefits. The FAA and the industry must quantitatively determine, where feasible, which recommendations can be expected to reduce the most accidents, incidents and the precursors of those events in the short and long term.

This quantitative analysis must serve as the basis for setting aviation priorities in the future. The FAA and industry must be held accountable to complete the priority actions that will reduce the causes of aviation accidents and incidents. At the same time, the FAA must be afforded the support, in both resources and political will, to address these safety priorities.

Set Priorities and Establish Goals by Analysis of Data

As previously mentioned, there have been a significant number of distinct efforts by government and industry to identify and prioritize safety issues. These efforts, until very recently, have focused on cataloging and categorizing the myriad of recommendations.

Recently, the FAA and the industry, through the industry/government consortium described previously as the ISST, conducted analyses of what issues should be given priority. Through the ISST, it appears that a common understanding is emerging as to which issues, at a macro level, should receive priority attention. The reason for this emerging consensus is that the analyses are data-driven; that is, the priorities are grounded in the analysis of accident causes in the modern jet era. The Commission recommends that the priorities identified by this analysis serve as the basis for formulating the strategic safety plan called for in this report.

Increasingly, safety professionals are looking at safety improvements being accomplished through opportunities to intervene in an accident scenario before it runs its course. Accidents result when a series of events or occurrences come together in a unique way — the chain of events leading to the accident. Remove just one of the events or links from the others in the scenario, and the accident will not happen. With an eye toward this type of approach, both the FAA and industry have identified several critical "intervention opportunities." (Note that some of the following intervention opportunities may overlap or intersect with each other.)

Controlled-flight-into-terrain (CFIT) accidents. CFIT is an accident in which the aircraft is under control, but the pilots lose their sense of where the aircraft is in relation to the ground or other terrain features such as mountains, obstructions or water. In the past 10 years, approximately one-fourth of all commercial jet accidents worldwide (35 out of

a total of 136) have the common feature of the aircraft being otherwise under control, but literally flying into the ground. Such accidents are relatively less common in the United States, but they do account for approximately one in seven accidents during the same period. If not further addressed, historical statistics would point toward a CFIT accident every two years within the U.S.

The Commission recommends that the strategic plan for accident reduction contain specific action items to reduce the incidence of CFIT. Among these action items should be the implementation of requirements for enhanced ground-proximity warning systems (EGPWS). Such warning devices currently are required, but in some situations they do not provide enough warning time or a visual depiction of the terrain. The new enhanced systems provide a visual display of any hazardous terrain features in the vicinity of the aircraft Some U.S. airlines are already outfitting their aircraft with the new systems ahead of any requirement by the FAA to do so. In addition to these systems, both the FAA and the industry believe that there are training issues that need to be addressed to enhance pilot awareness of altitude and location relative to hazardous terrain — situational awareness.

Loss-of-control accidents. Loss-of-control accidents occur when the aircraft enters a situation, such as an unusual attitude or a mechanical malfunction, in which the pilot may have been able to recover control but did not. These accidents also account for approximately one-fourth of the worldwide accidents. Within the United States, they accounted for 11 out of 36 accidents in the past 10 years. If this 10-year trend continues, about one such accident can be expected each year.

The Commission recommends that the FAA and industry, as part of a strategic plan, develop new pilot-training programs that better enable pilots to recover from a loss of control of their aircraft. In the mid-1980s, the FAA and the industry embarked on developing better training for pilots to escape from hazardous wind-shear encounters utilizing improved technology, and the result has been dramatic. Within the past 10 years, there has been only one wind shear–related accident in the United States. A similarly focused effort on pilot training for loss-of-control situations should be a priority in the strategic plan.

Human-factor errors. An analysis by Boeing Commercial Airplane Group of all commercial jet accidents worldwide over the past 10 years found that approximately 72 percent of them had, as their primary cause, errors by the flight crew. Regarding U.S. accidents, the percentage has been approximately 65 percent. All other broad categories of primary accident causes pale by comparison as a percentage of the total.

Any strategy to bring about a dramatic reduction in the accident rate must include government and industry programs that strive to bring down the incidence of human error. Unfortunately, human error and its causes are much more difficult to fix than mechanical failures. It appears that virtually all the improvement in the short term will have to come through improved training and procedures.

The needed training in this area must be focused on improving the performance of the flight-deck crew as a whole rather than just improving individual flying skills and performance. Some airlines have instituted crew resource management programs in which pilots are trained to improve communication techniques among themselves and to coordinate tasks in particular situations. These kinds of programs should be expanded throughout the industry.

Analyses of accidents also indicate that at the onset of an accident, pilots sometimes deviate from standard operating procedures and make inappropriate responses to emergencies. Had they not done so in some cases, it is believed that the accident could have been averted. Again, improved training programs aimed at these human-factor problems should be a priority in the strategic safety plan.

Approach-and-landing accidents. In the typical flight, the percentage of time spent making the approach and landing is approximately 16 percent; however, this is the phase of flight in which 56 percent of all accidents occur. Analyses indicate that through pilot actions or air traffic control (ATC) procedures, a frequent ingredient in this type of accident is the failure to establish an early, stabilized approach. An additional element is the hesitancy by some pilots to "go around" when prudence would dictate aborting the landing and making another approach.

Again, this is an area that, in the short term, calls for improved training in following standard procedures and breaking down the perception that it is a "mistake" to call off a landing when something is not quite right.

Weather and turbulence-related accidents. Accidents attributed primarily to weather are a very small percentage of the total, approximately 3 percent over the past 10 years. Aircraft are designed to fly through most weather phenomena and do so safely. Nevertheless, in an accident situation, it is often weather that creates the nonroutine situation in which pilots do not follow standardized procedures or otherwise perform appropriately.

Improved weather training, as well as improved weather-detection and display technologies for aircraft and air traffic controllers, should be part of a strategic plan for safety improvement. The focus should be on better detection and avoidance of wind shear, ice and freezing conditions, wake turbulence generated by other aircraft and clear-air turbulence.

Runway incursions. Runway incursions (that is, aircraft, other vehicles or pedestrians incorrectly occupying a runway that is in use by another aircraft) are discussed in greater

detail later in this report. Accidents resulting from runway incursions are relatively rare. Nevertheless, reducing the incidence of them should be a priority because there are few, if any, human or technological redundancies in place at most airports to override a pilot or controller mistake that may precipitate a runway incursion. The results can be catastrophic. Also, the data indicate that the incidence of incursions is on the rise.

Technology that will enable controllers to anticipate potential conflicts on an airport's runway and taxiway system is now in the initial stages of deployment. The FAA and the industry are considering whether to deploy similar technology on a wider basis.

Including runway incursions as a priority in the strategic plan would keep a needed continual focus on this program. While runway incursions have been given a high priority from time to time in the FAA and the industry, the interest in this problem waxes and wanes. It appears that, although a runway incursion action plan has been developed, and elements of it have been implemented, it is time again to jump-start this program.

Uncontained engine failures. An uncontained engine failure occurs when the engine experiences an internal failure of a high-energy rotating component that cannot be contained within the engine casing. An engine stoppage or failure is typically not a significant safety issue because all aircraft are designed to fly on a remaining engine. However, when parts of the engine fail with enough force to damage the aircraft's structure or critical systems, the incident can have catastrophic consequences and result in injury or loss of life of passengers and crew.

The Commission believes that reducing the incidence of uncontained engine failures should be a priority in the strategic safety plan. Improvement of inspection techniques for critical engine components needs to be accomplished, as well as better damage mitigation from these failures.

Human errors in maintenance. Improper or poor aircraft maintenance has been cited as a primary causal factor in approximately 10 percent of all commercial jet accidents over the past 10 years. Just as with human errors in piloting, a reduction in these types of accidents will be achieved through improved training and standardized maintenance procedures. Standardized record keeping on performed maintenance would enable better maintenance quality assurance programs to be implemented.

The Commission believes that human performance analyses and improvement programs applied to the aircraft maintenance area would help reduce the accident rate and should be part of the strategic aviation safety plan to be developed.

Crash survivability. While it is not on the initial ISST list of priorities, the Commission believes that there needs to be continued attention given to improving the chances of passengers and crew surviving an aircraft accident. Since the mid-1980s, the FAA and the industry have devoted considerable attention to making improvements in crash survivability: improved flammability standards for materials used in the interiors of transport airplane cabins; improved access to emergency overwing exits; emergency floor-level lighting; hands-on training for flight attendants; and the location of passenger emergency exits.

During accident investigations, the NTSB has found that lives have been saved because of measures taken in these areas. The Commission recommends that as new aircraft are developed and existing ones refurbished, the FAA and the aviation industry keep accident survivability improvements a priority since most accidents can have survivors.

Further, testimony presented at the Commission's public hearing recommended that the federal requirements on airport firefighting training include aircraft familiarization so that firefighters know how to open aircraft doors from the outside. The Commission believes that such training should be in the training curricula for airport firefighters that are submitted for approval to the FAA.

Safety-data analysis. The ISST effort also identified safety-data analysis as an important means to reducing the accident rate in the future. The need to make safety-data analysis a high priority is discussed in detail in the next section of the report.

These broad priorities need further refinement and should continue to build on the safety prioritization process established in the industry-government 1997 Aviation Safety Plan. This safety plan, resulting from the January 1995 Aviation Safety Conference and subsequent workshops, identifies similar priorities and establishes a systematic tracking method. Both the ISST analysis and the Aviation Safety Plan process should be used as a basis for setting FAA and industry safety priorities.

Require FAA to Implement Strategic Plan

After the priorities for ongoing and future safety initiatives have been established, the Commission recommends that the FAA develop a comprehensive strategic implementation plan. The Commission finds that the FAA's safety agenda and the use of its scarce resources currently are too much determined by reacting or responding to the latest aviation accident. The Commission recognizes that when there is an accident, safety regulatory officials are obligated to respond to those events and determine if expedited or emergency actions are needed to address the causes of the accident. Nevertheless, in making such responses, it appears that the FAA's attention, particularly of its leaders, is easily diverted from other activities that may well have a larger safety benefit in the long run. If the FAA were to have a strategic prioritization of safety initiatives supported by quantifiable data, there would always be a sense of where the latest event fell on the yardstick of overall

priorities. More importantly, when implemented, the strategic plan would allocate resources and establish program milestones that could be measured.

When the FAA sets the priorities and develops a strategic plan for safety, it should be in cooperation with all elements of the aviation industry, as well as the NTSB, so that a strong consensus on top priorities can be achieved. With a prioritization based on objective analysis of known data and a methodology for making choices that is well understood, the FAA will be able to move forward. As discussed above, the Commission believes the recent accomplishments of the government-industry ISST and the annual Aviation Safety Plan are an excellent start. With all the previous analyses by industry and government agencies, the tools exist now to establish a firm set of priorities and a strategic plan to achieve successful results to improve safety.

This strategic plan should have a short-term as well as a long-term focus and should lay out where the industry and the agency should devote their resources. The plan should recognize the need for some resources to be allocated to investigate high-profile accidents. There must be a recognition that some ongoing safety initiatives may need to be deferred because they have a lower priority. Based on priorities, the plan should allocate resources to achieve goals and establish a means of measuring progress.

The plan should be detailed enough so that milestones for accomplishing specific tasks can be readily recognized by agency management and the industry, as well as the public. The FAA should periodically report on where initiatives stand, why any delays are occurring and whether and why changes are being made to the plan.

In short, the plan should serve as a road map for how government and industry are lowering the accident rate and as a location finder for where they are at any given point in time.

There should be a recognition that immediate issues will arise that will require short-term, unplanned analyses, responses and actions. When an accident happens, the FAA is obligated to provide the public information about the issues that arise from that accident. By having a strategic plan focused on specific issues and objectives with identified resources and milestones, the "fire" that springs up one day should not serve as an indefinite diversion from other ongoing programs.

While there should be staff and resources devoted to operating the "fire truck" on a day-in-and-day-out basis, they should be distinct from the people and resources focused on installing the "smoke detectors" so that future fires do not get out of control. There needs to be a group within the FAA and the industry whose sole mission is to carry out the strategic plan. The FAA and the industry cannot be put in the position of having to set the plan aside to confront the emergencies of the moment.

Establish Performance Measures for the FAA's Safety Organizations

In concert with developing priorities, performance goals and a strategic plan, the FAA must establish performance measures to focus resources and hold the FAA's safety management accountable to make improvements. For the operation and management of the service-oriented ATC segment of the FAA, the Commission has proposed establishing a PBO within the agency. A PBO is not appropriately suited, however, for the more traditional regulatory role of acting in the interest of public safety. But this does not mean that the performance of the FAA's safety and regulatory functions cannot be measured and assessed.

The Commission recommends that safety programs become performance-based, with specific goals, milestones and measures to assess whether safety goals are being achieved and producing a safer aviation system. The intervention opportunities established by the government-industry ISST are a sound basis for developing specific goals and measures. These goals, however, need to be further refined and broken down into specific actions to be taken by various safety organizations within the FAA. The Commission believes the FAA's performance measures should address the time required to issue new safety rules and regulations, or resolve other issues that may expedite safety improvements. Where appropriate, the FAA should measure performance towards safety goals for individual segments of the aviation industry (e.g., commercial transport, air taxi, general aviation or rotorcraft), because each may have its own risks and optimal mitigation strategies.

Of course, the resources to address safety risks across all aviation segments need to be identified and budgeted. The Commission recommends that the FAA merge performance data on safety initiatives with cost data to better understand the effectiveness of allocated safety resources. Although the FAA's existing performance measures are focused on safety outcomes, the resources required to achieve them have yet to be tracked or allocated. As the FAA institutes a cost-accounting system, the cost of achieving individual goals should be better understood. The combination of safety initiatives and their costs will help identify the most efficient use of resources. For future planning, however, FAA resource allocation plans should be able to incorporate any new breakthroughs that would significantly increase safety.

Institutionalize FAA's Safety Strategy

While the FAA takes many actions to enhance aviation safety, it is perceived as an agency that reacts to the "crisis of the day." An institutionalized methodology that establishes standards for prioritization, sets goals, allocates resources and measures performance will support the safety decisions the agency and industry make while also responding to the changing events that occur in this dynamic industry. Although the FAA must continually gather new information and reassess

priorities, the Commission strongly emphasizes the importance of a strategic approach based on established priorities.

The Commission recommends that the FAA form a joint industry-FAA safety council to periodically review safety priorities and the implementation of the strategic safety plan. The Commission also recommends that there be an annual public safety conference, with workshops addressing safety initiatives, based on the process established in the industry-government Aviation Safety Plan.

The Aviation Safety Plan established a process (formation of an oversight body and steering committee to monitor progress) to ensure that high-priority safety initiatives are tracked and receive appropriate attention. The Commission strongly recommends the continuation of a similar oversight body including senior government and industry officials. As with the Aviation Safety Plan, an assessment of progress should be provided to the FAA administrator and the U.S. secretary of transportation. The annual safety conference would review the progress of the action plan in a public forum. Such a conference would increase public awareness that safety is being addressed comprehensively.

In addition, although the Federal Aviation Reauthorization Act of 1996 specifically stated that the Federal Advisory Committee Act need not apply to aviation rule-making committees designated by the FAA administrator, it does not appear to have addressed the issue fully. For the FAA to take full advantage of the opportunities to work in cooperation with industry, the Commission recommends that representatives from the FAA, the DOT and the U.S. Congress continue to identify statutory or other impediments, such as elements of the Federal Advisory Committee Act and the Administrative Procedure Act.

Encourage the Improvement of Aviation-safety Programs in Industry and Government

The accident rate has leveled over the past three decades. If accident rates are to be lowered to meet the national goal of reducing the fatal accident rate fivefold within 10 years, fundamental change must take place in how safety is provided. The aviation community must look deeper than accidents and incidents to identify latent and emerging problems and fix them before a mishap occurs.

Today, technology, safety-reporting and risk-management concepts are emerging that could literally identify most aviation safety problems before they become accidents. If used in combination, safety could be dramatically improved. These concepts require the collection, analysis and sharing of types of data and information that are just now beginning to be routinely studied in the U.S. aviation industry. Among these are programs in which pilots, mechanics and other safety-related personnel are encouraged to report problems without penalty; safety self-audit and analysis programs within airlines; and programs that analyze digitally recorded operations data from actual flights.

Each of these approaches uses information and data in new and different ways as a means to take corrective actions before problems turn into accidents. These programs also require that the traditional FAA-industry regulatory relationship be changed so that the intended broad safety benefits (prevention of accidents) can be realized.

Regarding the analysis of flight operations data, an important means to improve safety risk management programs is now in its infancy in the United States. It involves utilizing digitally recorded flight operations data in a program known as flight operations quality assurance (FOQA). To bring FOQA and other self-reporting programs into full fruition and realize their potential safety benefits, impediments to the collection and analysis of flight, air traffic and other safety data need to be removed. There also needs to be a willingness in government and industry to invest in new ways of doing business.

Implement Safety-risk Management Programs Throughout Industry and Government

Historically, air carriers and unions have used reports from flight and maintenance crews as a means of identifying potential safety problems within companies. Within the past few years, the FAA has required each airline to have a senior safety executive and encouraged airline self-audit and self-disclosure programs. The FAA has also encouraged partnerships among unions, air carrier safety departments and the FAA itself to jointly identify safety problems and take constructive action, such as in the US Airways program that was created to address altitude deviations. [See *Flight Safety Digest*, December 1995.]

The American Airlines Airline Safety Action Partnership (ASAP) is a prime example of such efforts. ASAP consists of an agreement among pilots, their union, American Airlines and the FAA whereby pilots are encouraged to report safety problems and the other parties agree to work to address the problems in a way that is not threatening to the person who does the reporting. Each pilot report is submitted to the U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) to feed a national safety database for broader analysis and to guarantee immunity from FAA certificate action or civil penalties. A committee of all the parties then meets and works to resolve each safety issue as effectively and expeditiously as possible.

The Commission finds that an effective means to quickly reduce the accident rate is to implement a safety-risk management program in each company across the aviation community. The risk-management program should include a combination of a company self-audit and an ASAP-like self-disclosure program.

Such programs should include the analysis and sharing of reports from aviation professionals among industry members and between the industry and the FAA. A similar but more aggregated program should be administered at the national level to ensure that the government is focusing its aviation safety resources according to the results of such programs.

Whenever Possible, FOQA Should Become Part of Safety-risk Management Programs

Programs similar to the American Airlines ASAP program should be pursued across the aviation community as the foundation of any safety-risk management program. There is additional information now available which many companies may also use to improve their safety program. Aviation is one industry where almost every activity can be digitally recorded. It will be possible in the future to monitor, analyze, model and simulate the aviation system using digital flight and air traffic management data. This could become a new method for the aviation community (crew members, airlines, manufacturers, airport operators, maintenance facilities, air traffic services etc.) to identify and fix problems before they become accidents and for the FAA to oversee and improve the aviation system at a fraction of today's costs.

In the United States, DFDR data have been used in support of maintenance programs and for accident investigations. In other countries, however, these data are also beginning to be used to detect flight safety problems before accidents occur. FOQA programs have been providing critical safety information to non-U.S. airlines for over two decades. Flight Safety Foundation has described a FOQA system as "a program for obtaining and analyzing data recorded in flight to improve flight crew performance, air-carrier training programs and operating procedures, ATC procedures, airport maintenance and design, and aircraft operations and design." Currently, more than 25 non-U.S. airlines screen flight data for deviations from prescribed operations. Some airlines perform these analyses on data from all flights. While three U.S. airlines (United, Alaska and US Airways) have established flight data analysis programs, most U.S. airlines have not done so, largely because of concerns about data protection and the expense of conducting such programs. The Commission finds it regrettable that more airlines have not been able to institute these types of programs.

Today's FOQA concepts were derived from the flight-data efforts of non-U.S. air carriers, such as British Airways, Scandinavian Airlines System, KLM-Royal Dutch Airlines and TAP Air Portugal, over the past several decades. These systems share two common features. First, they are primarily concerned with identifying and counting unwanted events. These include, for example, approach speeds being too high at specified altitudes, vertical acceleration at landing being too high, an abandoned takeoff, a go-around etc. Second, the systems are as much, or more, concerned with detecting trends in the frequencies of these events as they are with individual event occurrences. The event detection and tracking systems developed by these airlines would, if implemented, provide valuable safety information to U.S. carriers.

FOQA programs basically involve converting digitally recorded flight data into useful safety information. Early aircraft flight data recorders (FDRs) had relatively few basic parameters, such as speed, time, altitude, pitch, compass heading and vertical acceleration. DFDRs in newer aircraft can record up to 200 parameters, several times per second. The Boeing 777 records up to 700 parameters every eighth of a second. Ongoing research by the FAA, NASA and the aviation industry, and the revolution in information technology, are now beginning to make it possible to use these data in ways not dreamed possible before. FOQA systems have the potential of becoming the basis for making aviation safety decisions at three levels: the company, the air crew and the air transport system as a whole.

At the company level, a FOQA program could be used to evaluate the safety and efficacy of flight operations within each airline. It could help identify operational problems specific to the airports served by that air carrier or to the aircraft fleets it employs. These data could be used to shape and evaluate air-carrier procedures and training. In this regard, FOQA could become an essential ingredient in streamlining air carrier training procedures, and serve as a performance-measurement tool for company risk-management programs and for assessing the effectiveness of training. Special-event identification and the statistical analysis of all flight data could be complementary and synergistic activities. Together, these analyses could provide a fuller picture of air-carrier operational performance.

At the air-crew level, FOQA data could be used for crew member self-assessment and training. Computer animation of flight data could allow flight crews to review their own performance, as well as that of other flights depicting both optimal and unacceptable performances. The ability to replay events is an important feedback element that could result in improved piloting and crew coordination skills and could also assist in understanding the context of an event.

At the air transport system level, bringing together FOQA information with pilot, dispatcher and mechanic reports across companies and with air traffic controller reports could assist in evaluating the overall safety and efficacy of the aviation system. For example, FOQA data could be used in models of air traffic operations to evaluate airspace allocation and to develop improved measures of practical traffic capacity, or to monitor the consequences of introducing new traffic control concepts. FOQA data could also be used to validate new training practices in ground-training devices and to provide operational data pertinent to ongoing research.

FOQA information at a national level could identify faults in system procedures, airport operations, airspace structures, aircraft certification and human-automation interface. Manufacturers, airlines, air crews and regulators are held

accountable by the flying public for the effective risk management of aviation operations. Most accidents stem from the interaction of the pilot, other crew members, the aircraft, the company flight operations center and the air traffic system. This suggests the need for a national, and perhaps international, systemwide FOQA program. But data to conduct FOQA programs are not being collected at the national level today, and most airlines are not prepared to implement FOQA programs, because of concerns about protection of the collected data.

Safety Information Should Be Protected and Shared

FOQA and other safety-risk management programs are based on trust. Accident prevention depends on the ability to identify variance from normal operations, adverse trends and incidents that may be precursors to accidents. In each case, recorded data and incident reporting are essential to identifying these precursors. Keeping these data confidential is the key to acquiring the information. Military safety programs have effectively used confidential/privileged information for over 40 years to identify and correct safety problems that would not have been otherwise detected. Because companies only have information from their own operations, it is to their benefit to obtain information from other companies to put their operations into perspective and to have enough data when measuring rare events to ensure statistical validity. This is the objective of the FAA initiative to encourage data exchange: Global Analysis Information Network (GAIN). The FAA's GAIN proposal involves establishing a voluntary, privately owned and operated worldwide infrastructure to collect, analyze and disseminate aviation safety information (including FOQA data).

It appears that the only way to obtain in-depth safety information within a company, between companies or involving the FAA is for people who operate in the system (pilots, mechanics, controllers, dispatchers, airlines, manufacturers, airport operators, etc.) to agree to disclose this information and to allow it to be consolidated and analyzed for accident-prevention purposes. Individuals and companies will not agree to assemble or disclose safety data if the data will be used punitively, will be misinterpreted by nonexperts, will reveal trade secrets or will expose them to undue liability.

The central fear is that the data could be badly misunderstood by the press or public, or even be knowingly misrepresented. Safety-risk management programs must include assurances to protect aviation professionals and companies from punitive action as a result of sharing such data with each other or the FAA. Similarly, each carrier, pilot, mechanic, etc., must have assurances against the risk of public humiliation from either innocent or malevolent misrepresentation. The system must not be threatening in any way to the sources of the data or the insights from such disclosure will be lost. If the system is perceived to be punitive or threatening at any level, it will be doomed to fail.

Flight Safety Foundation has studied this issue and concluded that data protection over time is critical to building the trust necessary for people to reveal problems in the aviation system. The joint industry-labor-government Aviation Safety Plan cites data protection as a key to achieving "zero accidents."

Sharing of Safety Information Among the Aviation Community and the FAA Should Not Result in Punitive Actions

At the 1995 Aviation Safety Summit hosted by the U.S. Transportation Secretary, the FAA acknowledged the importance of sharing safety information and promised to initiate a rule-making to make it clear that the FAA will not take punitive action against individuals or companies who self-disclose information for safety improvement purposes. To date, the agency has failed to do so. In 1996, legislation was enacted permitting voluntarily submitted information given to the FAA and the NTSB to be exempt from the Freedom of Information Act (FOIA). The FAA must issue implementing regulations for the legislation to apply, but it has yet to do so.

There are several notable problems with the type of information sharing associated with safety-risk management programs. As already mentioned, information might be used for punitive or enforcement purposes by a company or the FAA. A pilot or other employee might be reluctant to report a problem or mistake if there is the possibility of punishment. An otherwise harmless mistake that goes unreported could be repeated by others enough times until the mistake becomes a link in a chain of events leading to an accident. The Commission notes that while company retaliation against employees who call attention to safety problems is rare, aviation safety would be advanced if there were "whistle-blower" protections for all aviation employees who report safety problems. Aviation employees should be afforded the same protection that exists for virtually all other safety-related occupations.

The FAA has determined that airline-operated FOQA programs have been demonstrated to provide significant potential for the enhancement of both safety and efficiency. It is in the public interest for the FAA to encourage voluntary implementation of such programs by ensuring that information obtained would not be used in punitive enforcement actions. An FAA rule-making process on this issue needs to move forward to ensure the protection of such information unless there is an indication of deliberate or willful [malevolent] action.

The question of whether self-disclosed information should be used for remedial enforcement action is a more difficult issue. The FAA has engaged in an internal debate over whether pilots or airlines can or should be given immunity if self-disclosed information reveals deficiencies in the fundamental qualifications of an individual or company. For example, if shared information reveals that a pilot is

unqualified from a certification standpoint, the FAA arguably should not allow that pilot to continue flying. Some argue that the FAA has an unwaivable legal duty to ground such a pilot regardless of how or where the information was obtained. Safety programs involving self-disclosure are designed to identify safety problems and to take action to correct them. FAA action would be required only if company-based programs fail to take action. The question then is whether it is better to accept the small risk of a problem not being addressed by the company in a timely way in exchange for the large volumes of valuable safety information that would otherwise not be available without the assurance of immunity. Furthermore, the FAA is expecting to receive deidentified and aggregate data from airlines with FOQA programs, so it would be very difficult for the agency to even have a basis upon which to take remedial enforcement.

In essence, there are two competing concerns at issue here. One is the duty of the FAA to ensure that only qualified individuals and companies and airworthy aircraft are being operated. The other is the duty to ensure that the overall aviation system is as safe as possible by preventing accidents before they occur. While both policies have the same ultimate goal of a safe system, they can come into conflict in the particular area of information sharing. Given the rather small chance that there are truly unqualified persons operating in the system and that information sharing would be the means of discovering such persons, the Commission believes that the FAA should favor the policy of protecting the information to bring down the overall accident rate.

As already mentioned, the FAA currently is working on two proposed regulations related to information sharing. One has to do with the withholding from public disclosure of voluntarily submitted information, and the other specifically addresses the agency's use of information provided through FOQA-type programs. Regarding the latter, the FAA has reportedly resolved its internal debate on the question of whether and how to use FOQA information for remedial enforcement action against unqualified certificate holders. Despite claims to making progress on development of both rules, the FAA must move these matters forward into the next phase of issuing Notices of Proposed Rule-making (NPRMs). Given the potential benefits of information and data sharing and increasing industry interest, the Commission believes that further delay is unacceptable. It appears from recent announcements by the FAA administrator that the FAA is prepared to take the necessary actions.

FAA Must Take Action on Safety-risk Management Initiatives

The Commission believes that the establishment of company safety-risk management programs, which include both the American Airlines ASAP-type self-disclosure program and company self-audit programs, are among the most important actions the aviation community can take to achieve a major reduction in accident rates. These types of programs should become routine and ubiquitous throughout the industry.

The ultimate success of these programs will depend on building trust, developing an experience base to understand the benefits and identifying the tools and technologies needed to efficiently and effectively share and analyze safety-related information. Therefore, the Commission recommends encouraging the aviation industry to move as rapidly as possible to incorporate FOQA-type programs into a comprehensive aviation risk-management program in each company in the aviation system. The Commission also believes FOQA-type programs could have applicability in improving the safety and performance of the ATC system. If each airline, airport, maintenance facility, manufacturer and en route center had such a program to assist them in identifying problems before they contributed to accidents, aviation safety management would be transformed.

Encourage Research and Development to Make Data Analysis Affordable and Effective for All Aviation Users

Apart from data protection, costs are a significant constraint to the implementation of FOQA programs. Today, data-analysis tools are available to implement such programs, but many are labor-intensive. Costs, especially for small operators, can discourage implementation. The FAA and NASA are collaborating with United Airlines and Alaska Airlines to develop tools that will make data analysis more affordable and effective. These tools are also important because they will make it possible both to document normal operations, in order to be able to determine variance from the norm, and to identify other unwanted events that are not apparent without such analysis. Without accurately knowing what is normal, it is impossible to take optimal action to prevent accidents or to validate that actions have the appropriate effect. The Commission applauds and encourages these research efforts.

Strengthen the FAA's Role in International Aviation Safety

With the rapid increase in the internationalization of air travel, it is critical that the FAA strengthen its role in international aviation safety. The FAA needs to be certain that it has deployed its resources to take into account that U.S. citizens fly all over the globe, U.S. carriers have increased their overseas presence as non-U.S. carriers seek to do the same here, and aircraft manufacturing is now a multinational business with facilities on all five continents.

When compared with the rest of the world, aircraft flying within U.S. airspace have an exemplary safety record (Table 1, page 15). After a passenger (or aircraft) leaves the U.S. aviation system, however, that passenger (or aircraft) faces a higher safety risk. According to a recent analysis by Boeing, the hull-loss accident rate in North America was more than

Table 1
Comparision of Accident Rates by World Region, 1987–1996

Region	Departures (millions)	Accidents	Accident Rates
Africa	3.1	41	13.0
Asia and Pacific Islands	8.0	30	3.8
China	2.3	6	2.6
Japan	5.0	3	0.6
Latin American and Caribbean	9.2	52	5.7
Middle East	2.2	5	2.3
Oceania	4.5	1	0.2
USA and Canada	69.8	38	0.5

Source: U.S. National Civil Aviation Review Commission

20 times lower than it was in Africa, and more than 10 times lower than in Latin America and the Caribbean. If overall aviation accident rates are to be reduced by any significant amount, greater emphasis must be placed on international aviation safety.

An analysis of worldwide accident rates for similar aircraft shows a significant difference in accident rates depending on the region of operation. The data suggest that there are significant factors other than airplane design itself that influence the worldwide accident rate, such as regulatory structure and oversight, flight operations and maintenance, air traffic management, and infrastructure.

Aviation is expected to continue its rapid growth throughout the world. Without a radical reduction in accident rates, this growth is forecast to result in one major aviation accident every seven days to 10 days, 10 years from now. More than 70 percent of those accidents can be expected to occur outside of North America and Western Europe. Clearly this is unacceptable to the flying public and aviation community, as U.S. lives and aircraft will be at stake.

The Commission believes that a significant reduction in international aviation accidents can be brought about by increasing the harmonization of regulations, standards and procedures with other countries; by providing training and technical assistance abroad; and by working with other countries and international organizations to improve safety, security and efficiency around the world. To fulfill this objective, the FAA has begun to undertake a number of initiatives designed to reduce international aviation accidents.

International Aviation Safety Assessment (IASA) Program. In August 1992, following a variety of safety problems, incidents and accidents involving non-U.S. air carriers flying to and from the United States, the FAA's International Aviation Safety Assessment (IASA) program was officially initiated. The program assesses the ability of a non-U.S. government to enforce compliance with the international standards and recommended practices for aircraft operations and maintenance established by the United Nations technical agency for aviation, the International Civil Aviation Organization (ICAO). IASA focuses on a country's ability to adhere to ICAO's international aviation safety standards, not on individual air carriers. At present, approximately 100 countries or regional country alliances have oversight responsibility for the close to 600 non-U.S. air carriers that fly to and from the United States.

Of the approximately 80 assessments performed to date, more than 30 of the countries assessed have been found not to be in compliance with ICAO standards.

For those countries that do not meet international safety standards, the FAA has placed restrictions on their air carriers operating to the United States. Until the agency is confident that ICAO can perform these assessments, the FAA will continue to monitor the more than 100 countries that either have, or have expressed interest in having, direct air service to the United States.

The identification of countries with difficulties in establishing effective aviation safety-compliance programs is only the first step. The Commission recommends that the FAA, in coordination with other U.S. government agencies and multilateral institutions, focus sufficient resources on helping such countries achieve ICAO-level compliance through training and other technical assistance.

Bilateral Aviation Safety Agreements (BASAs). Seeking to improve the safety level of the world's aviation system and to create greater regulatory efficiencies through more effective utilization of the agency's budget and personnel, the FAA has sought to build a network of regulatory cooperation with other competent civil aviation authorities.

This network is being based upon the negotiation of BASAs with appropriate countries. A BASA may cover any or all the following technical areas depending on the implementation procedures that are developed with the FAA's counterpart authority:

- Airworthiness approvals for civil aeronautical products;
- Environmental approval and environmental testing;
- Approval and monitoring of manufacturing and maintenance facilities as well as the alteration or modification of facilities;
- Approval and monitoring of manufacturing and maintenance personnel;

- Approval and monitoring of flight simulators; and,
- Approval and monitoring of flight operations.

Under these agreements, the FAA will be able to make maximum use of work performed by competent non-U.S. counterparts while retaining the authority to issue or withdraw airworthiness certificates and approvals as appropriate. As a result of such cooperation, the FAA anticipates greater regulatory efficiencies, enabling the FAA to shift scarce resources to focus on higher safety priorities. Additionally, industry should enjoy spin-off benefits of cost and time savings associated with reduced duplication of international certification work.

Together with the U.S. State Department, the FAA intends to negotiate BASAs with all countries with which the United States has a Bilateral Airworthiness Agreement, with all member states of the European Joint Aviation Authorities (JAA) and with any country that favorably concludes the technical assessment necessary to allow for such a bilateral agreement. Since the program's beginning in 1996, the United States has signed eight BASA executive agreements, but only one implementation procedure. With more than 40 countries either eligible or having requested BASAs, the Commission strongly urges the FAA to expend the resources necessary to complete technical assessments in developing implementation procedures to achieve a fully functioning and vital program.

Regulatory harmonization. The safety and cost advantages of a standard set of rules that would apply to all aeronautical products and operations around the world are obvious. The FAA and the JAA are working together to increase regulatory efficiency and to reduce certification redundancy by harmonizing regulations and standards. The FAA and JAA are concentrating on those rules and policies where the difference either results in a major discrepancy in the level of safety between the two regulations, or creates significant extra certification work to comply with both FAA and JAA regulations. To date, efforts have focused on aircraft and environmental certification, maintenance approvals, flight operations surveillance and simulator qualifications.

To further regulatory harmonization, ICAO has established minimum aviation safety standards and recommended practices for its individual signatory countries to use as a guide. However, these guidelines lack the degree of detail and comprehensiveness necessary to act as a country's stand-alone civil aviation regulations. In response, the FAA is developing a model set of aviation documents (aviation laws, safety regulations and implementation standards) that could be adopted by a country seeking to upgrade its safety oversight programs and increase the compatibility of its regulations with FAA, JAA and ICAO standards and suggested practices. These model regulations focus on maintenance, operations and airmen licensing requirements.

The Commission recommends that the FAA continue to harmonize its regulations with other countries' regulations so that the safety and cost-saving benefits of doing so can be fully realized. The FAA must ensure that the highest level of safety be retained when harmonizing two or more regulations.

International industry safety coordination. The Commission believes that programs to improve the accident rate in certain areas abroad need not be just government-to-government–type efforts. There is a large reservoir of expertise and willingness to lend assistance. Presentations to the Commission indicate that there are already formal and informal programs in place by international pilot organizations, as well as U.S. airlines that have ongoing contacts and relationships with non-U.S. aeronautical authorities, to bring non-U.S. aviation authorities and aviation companies up to higher standards. The Commission strongly believes those activities should be further encouraged.

The Commission has also been made aware of nonaviation multinational corporations wanting to provide assistance in this regard. As U.S. companies expand their business overseas, U.S. citizens are increasingly being required to travel to remote areas of the world. This travel has made aviation safety abroad a growing concern to U.S. multinational business executives. Many of these nonaviation companies have extensive flight operations experience that could be brought to bear on improving safety abroad. The Commission recommends that the FAA take the necessary steps to encourage the development of programs and activities in this regard through facilitating or initiating joint government-business round tables on this issue. This would be another avenue to encourage the utilization of government-industry partnerships to improve aviation safety and reduce the accident rate.

Report Raises Specific Safety Issues

Focus on Suspected Unapproved Parts (SUPs)

There has been a significant amount of public attention on the use of aircraft parts and components that do not meet FAA regulatory standards. The Commission was specifically charged with examining this issue and whether the FAA is adequately addressing it. Based on information and presentations made to the Commission, the Commission finds the following:

- The proportion of unapproved parts that are in the inventory of aircraft operators is minuscule compared to those that are approved;
- The vast majority of those relatively few unapproved parts are no different from approved parts except that the source of the parts is not, in a technical regulatory sense, supposed to supply them directly to aircraft operators; and,

- There is a very small but serious problem of some persons manufacturing and distributing counterfeit and substandard parts in a criminal manner, but to date there have been no commercial accidents in the U.S. attributable to these types of parts. This is because in commercial aviation there are ongoing systems in place at manufacturers and airlines to prevent such parts from finding their way into the inventory or onto an aircraft.

Regulation of approved and unapproved parts. A comprehensive network of federally prescribed controls governs the design and manufacture of aviation spare parts. Between the manufacture and the end use of an aeronautical part, checks and inspections occur by the personnel who purchase the part or select it from a stockroom for installation on an aircraft, aircraft engine, propeller or component. Nevertheless, whether by inadvertent action or deliberate action, parts that are not eligible for installation do circumvent these controls and sometimes make their way into inventories and onto aircraft.

An "approved part" is one that is eligible to be installed on an aircraft or other type-certificated product (only an aircraft, aircraft engine or propeller receives a type certification). In other words, an approved part has been designed, produced and maintained in accordance with U.S. Federal Aviation Regulations (FARs) and is in a condition for safe operation. This includes parts designed and produced under FAA approval as well as parts designed and manufactured under other systems that the regulations recognize as being acceptable.

An "unapproved part" does not meet these requirements. Examples of unapproved parts include:

- Counterfeit or fraudulently marked parts, components or materials;

- Parts shipped directly to users by a manufacturer, supplier or distributor who does not hold, or operate under, the authority to produce the part for sale directly to operators or repair facilities; and,

- Parts that have been maintained or repaired and returned to service by persons or facilities that are not authorized to do so.

According to the FAA, the DOT Inspector General's Office and industry presentations to the Commission, the vast majority of SUPs come from legitimate part manufacturers, distributors and others (such as airlines that may sell parts from their inventories) that either have not kept proper documentation or do not have the necessary authority to sell a part directly to another customer. While such practices are technically inconsistent with FAA rules and approvals, the direct shipment of these parts became a relatively standard activity against which the FAA did not routinely take enforcement action until recently.

Nevertheless, it is clear that the criminal element producing counterfeit parts has been attracted to this market due to the high prices of parts and high costs of adhering to regulations associated with aircraft parts.

The FAA's Suspected Unapproved Parts Program Office has actively promoted close cooperation with a number of law enforcement agencies, including the U.S. Federal Bureau of Investigation (FBI), the U.S. Defense Criminal Investigative Service, U.S. Customs and the DOT Inspector General's Office. From 1990 to the present, there have been 212 prosecuted SUP cases in which 95 percent involved persons who knowingly and willfully manufactured or sold SUPs. Law enforcement agencies have a 95 percent conviction/guilty plea rate in these cases. At present, there are approximately 300 investigations under way.

FAA actions. Until public concern raised by the press pushed this issue in the mid-1990s, the FAA did not consider SUPs a priority safety problem. To date, the FAA has been unable to document any commercial passenger flight accident in the United States that was primarily attributed to the use of an unapproved part. Furthermore, analysis of a recent 13-year period indicates that there have been only a handful of annual general aviation accidents and incidents attributable to unapproved parts. Nevertheless, investigations have revealed that unapproved parts have either entered the inventory of an air carrier or were installed on commercial aircraft.

In response to this public concern over SUPs in the aviation industry, the FAA created a task force to conduct a thorough review of the issue and to devise a comprehensive program to more aggressively address SUPs. The task force made 30 specific recommendations on combating the SUPs problem, including rule-making projects, a national SUPs training program and the establishment of a SUPs Program Office.

Since its inception in November 1995, the SUPs Program Office has been charged with the implementation and monitoring of the task force's recommendations as well as the coordination of working relationships with law enforcement agencies. To date, the SUPs Program has implemented the following key steps:

- Developed and implemented a national SUPs training program for both FAA and industry that has received high marks within both the FAA and the aviation community;

- Initiated several rule-making projects, including the mandatory reporting of SUPs, regulations on record-keeping and increasing civil penalties for persons other than airlines; and,

- Created a national database for use by FAA inspectors and law enforcement personnel to keep track of suspected unapproved parts.

Recommendations. To address some of the remaining concerns about SUPs in the aviation community, the Commission makes the following recommendations:

- The FAA should expedite its efforts to clear the regulatory issues surrounding proper documentation of parts that are technically unapproved by virtue of regulatory policy changes and new interpretations but would otherwise be legitimate;

- The DOT Inspector General and the FAA should continue to vigorously pursue those who manufacture and distribute counterfeit and substandard parts, so that the potential threat to aviation safety is eliminated;

- The penalties for criminal activity in this area should be increased. Convicted SUPs offenders have been returning to the industry after serving relatively short sentences. New legislation should prohibit convicted offenders from working in the industry. Also, law enforcement agencies should be given the authority to destroy confiscated unapproved parts; and,

- The FAA should continue to work with the industry to train aircraft maintenance personnel on the problems with and the identification of SUPs.

Allow Electronic Maintenance Record-keeping

The Commission urges the FAA to issue the NPRM critically needed for the industry to take advantage of the use of electronic maintenance record-keeping and the use of electronic signatures. The Commission believes that the technology developed for the use of electronic maintenance record-keeping could be utilized with great benefit in the effort to control the use of SUPs.

Since 1991, the FAA, through the Aviation Rule-making Advisory Committee (ARAC), has been debating the release of the NPRM, which would allow aircraft mechanics, repair stations and airlines to keep aircraft maintenance records in an electronic "format" and manner acceptable to the FAA administrator. The current FARs state that the maintenance records must be kept in a "form" acceptable to the administrator. Unfortunately, this equates to a cumbersome paper ("hard-copy") maintenance-record system. A change in the current regulations will open the door to future electronic technologies as well as current data-storage and retrieval systems.

Several advantages of electronic record-keeping were noted in testimony to the Commission during its recent public hearing on aviation safety. For example, a typical aircraft's maintenance logbook could be hundreds or even thousands of pages. It is not uncommon for the review of these logs to take three days to five days to determine the current maintenance status of an aircraft. Often the logbooks are illegible and present challenges when searching for specific items of information. One of the primary precursors to maintenance errors is human factors. The Commission believes that there is sufficient technology available that lends itself to application in a maintenance environment and would prove to be a great safety and efficiency benefit.

Increase FAA Safety Personnel and Training

In response to the legislative mandate for a review of the adequacy of the staffing and training resources of safety personnel within the FAA, the Commission examined the agency's hiring and training practices, interviewed members of management and the appropriate labor organizations, and reviewed agency plans for future requirements and hiring.

The Commission received information and statements from both management and labor indicating that there are currently no individuals (including safety inspectors, flight standards examiners, air traffic controllers and airway facilities technicians) who are not fully trained and certified to perform their functions.

After an agency review of staffing levels for all organizations within the FAA in light of budget restrictions, a general reduction in overall staffing began in fiscal year (FY) 1992. These reductions, which were largely driven by the guidelines from the National Performance Review, resulted in a decrease in the number of positions within each FAA organization. Subsequently, it was determined that these reductions had the potential of creating impacts on certain safety organizations, and staffing levels began to rise again. To meet the demand for services, staffing levels are projected to increase within each organization's safety-related work forces as the agency approaches the year 2000.

Beginning in 1994, the administration and the Congress increased agency hiring of safety personnel but did not provide sufficient funding for training, and that resulted in a backlog of training for some safety inspectors and flight-standards personnel. Similar mandates in the air-traffic service and airways-facilities organizations resulted in backlogs in the training pipeline that delayed certification of personnel. This approach to hiring without budgeting for training was shortsighted and wasteful of resources.

When personnel are hired in the future, the FAA, the administration and the Congress should ensure that training resources are available. The Commission finds that agency plans for future hiring do currently factor in the requirements for training, including modernization and enhancement of training programs and tools. The Commission strongly recommends that the FAA ensure that the appropriate training continue to be provided for all future hires as well as current employees.

Figure 3, which depicts training-budget resources, indicates the pattern described above and that the FAA, the administration and the Congress are now recognizing the need to have training resources available as staffing increases.

If the Commission's recommendations on safety risk management initiatives, such as self-reporting of problems, company safety audits and flight operator data analysis, become as widely adopted as this report suggests, new types of training will be required for inspectors and other FAA officials. Training will have to recognize the value of these voluntary programs with airline companies. The Commission recommends that training initiatives for FAA personnel be initiated to minimize the misunderstandings and maximize the safety benefits brought into fruition.

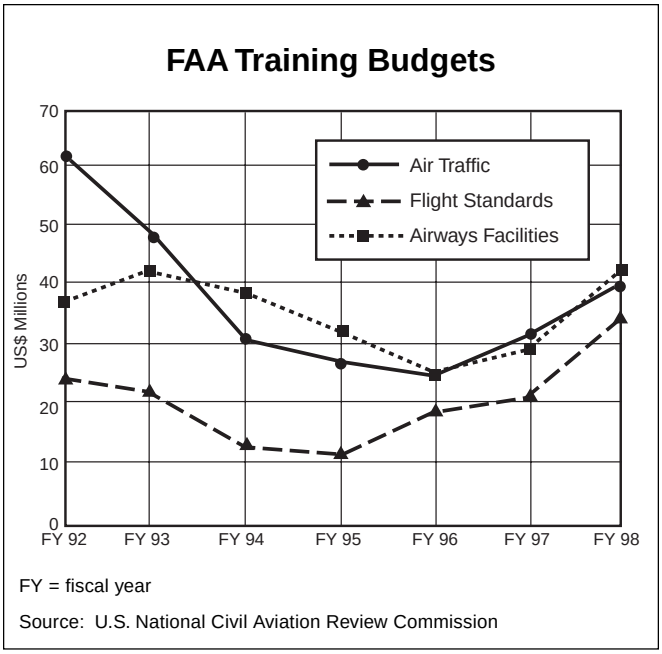
With respect to the controller (Figure 4) and inspector (Figure 5, page 20) work forces, the on-board level does roughly approximate the staffing standard, which is the level of staff needed to meet the work load. Nevertheless, with the airways maintenance staffing (Figure 6, page 20), the on-board level has historically been significantly below what the staffing standard seemingly requires.

The Commission has been advised by the FAA that this is because the agency has implemented many management and business-process re-engineering improvements to increase staffing efficiencies. Such improvements include remote maintenance monitoring and service management coverage, operations control centers (OCCs) and a reduction of organizational layers (e.g., improved employee-to-supervisor ratios). Nevertheless, these efficiencies are not completely reflected in the staffing-standard methodology used to determine and establish organizational-staffing requirements.

The Commission is concerned that the agency is not able to provide an accurate forecast of staffing requirements because outdated methodology is being used to determine those requirements. The FAA has initiated an effort to revalidate and modify staffing standards to reflect more accurately staffing requirements in light of the practices described above. The Commission strongly recommends that the agency accelerate this review so that any action that may be necessary to address staffing levels can be taken quickly.

Runway Incursions Show Upward Trend

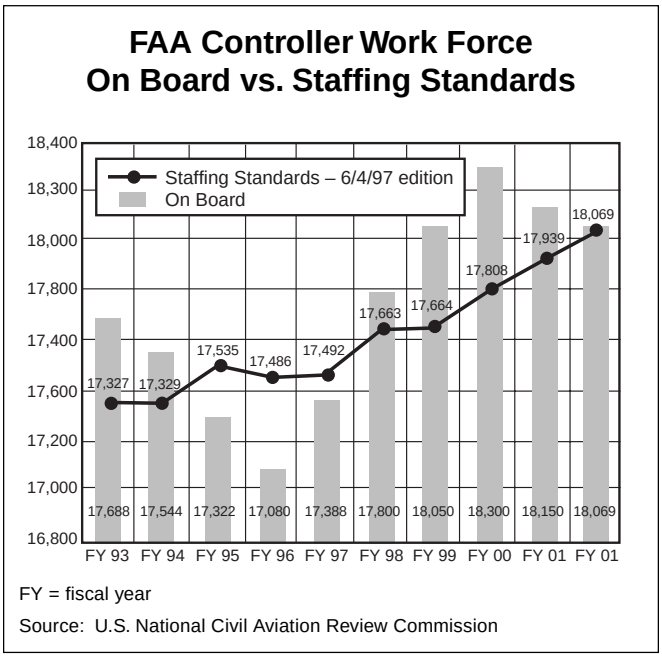
Because of the critical nature of runway incursions, the Commission has focused on this safety concern. Runway incursions are a very significant safety problem because there is little built-in redundancy to override a mistake by an air traffic controller or pilot. If an aircraft enters a runway without appropriate authorization in poor visibility conditions, the only hope of preventing a potential collision rests with the pilots seeing the conflict in time to take action.



FY = fiscal year

Source: U.S. National Civil Aviation Review Commission

Figure 3



FY = fiscal year

Source: U.S. National Civil Aviation Review Commission

Figure 4

Runway incursions are defined as "any occurrence at an airport involving an aircraft, vehicle, person or object on the ground that creates a collision hazard or results in loss of separation with an aircraft taking off, intending to take off, landing or intending to land." These events can be the result of ATC or pilot errors or pedestrian or vehicle deviations.

The Commission is disturbed that the overall number of runway incursions has risen in the last two FYs when compared with the preceding three years, especially in the area of events caused by pilot error and vehicle and pedestrian deviations

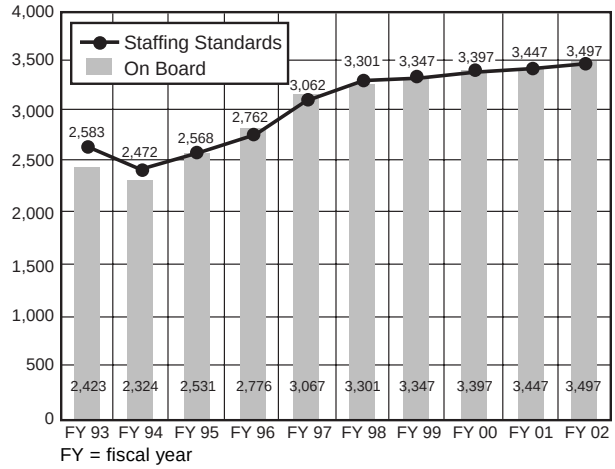


Figure 5

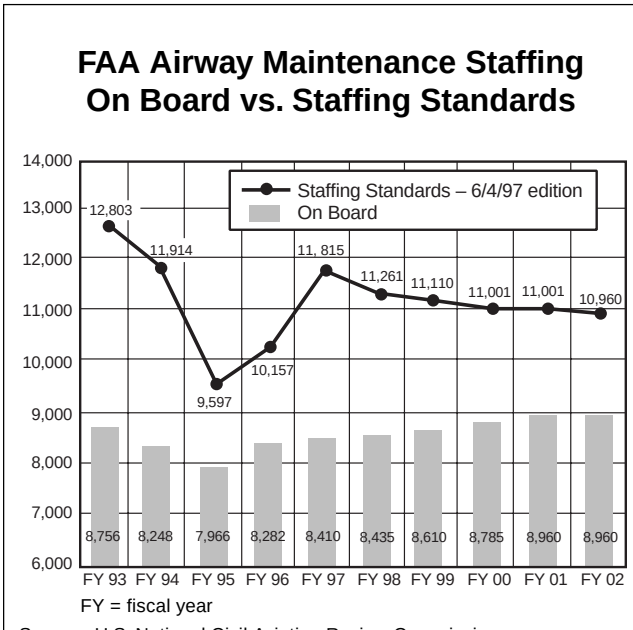


Figure 6

(Figure 7, page 21). The number of incursions that were the result of ATC errors has steadily declined since FY 1993.

The Commission believes that the existing FAA runway incursion program should continue to assist in the implementation of automation improvements designed to reduce incursions and maintain an agency focus on required actions to eliminate these events. The Commission is encouraged by the agency's actions regarding the installation of Airport Movement Area Safety System (AMASS) at 38 sites by the third quarter of FY 2000. AMASS is a computer technology utilizing radar information to alert controllers to potential conflicts on the airfield.

Because several airports slated to receive AMASS are "dual-site" locations that will receive two AMASS systems because of the geographical size of the airport, there will be a total of 34 airports that receive this system. Although the agency does not believe AMASS will completely eliminate the possibility of runway incursions, it is optimistic that AMASS will greatly reduce the risk of surface accidents by providing an early warning to the controller. Currently, there is one noncommissioned prototype AMASS unit undergoing operational testing at San Francisco (California, U.S.) International Airport.

Since there are over 400 airports receiving commercial service, the Commission believes this technology should be further deployed to expand this safety net at other locations. Implementing AMASS as developed, however, costs almost US$8 million per site. The Commission is encouraged by the initial agency plans to study the feasibility of deploying a less costly AMASS-type of coverage at another 100 airports. In addition, NASA and FAA research has developed cockpit and ATC displays which present moving-map and virtual head-up presentations of airport taxi routes and traffic during low visibility. This technology offers great promise for the future.

The Commission is concerned, however, by the rise in pilot-error incursions, especially as it relates to the number of general aviation pilots who are involved in these events. A review of data indicates that although the number of runway incursions caused by airline or air-taxi pilots has remained relatively stable, the number of incidents involving general aviation has increased dramatically. Upon investigation, it appears that these pilots are not following ATC instructions, have an inadequate knowledge of ATC procedures or become disoriented during low-visibility taxiing.

Beginning in FY 1998, the FAA will have available new training aids and programs designed specifically to address the issue of runway incursions. Although these actions are encouraging, the Commission is concerned about the overall upward trend in spite of past FAA efforts. The FAA needs a plan to address this issue. The Commission also recommends that the FAA develop guidance and encourage a runway incursion program at certificated airports based on the concepts of the ASAP. Under such a program, pilots would feel free to report and discuss runway incursion problems with local air-traffic and airport officials. This program would address runway incursion problems for all aviation segments, including general aviation, and should be centered at airports so that these and other safety issues can be raised and solved locally without fear of punitive action. For issues that exceed the ability of local operators, airport personnel and ATC officials to solve, there should be procedures to raise these issues to regional or national levels as appropriate.

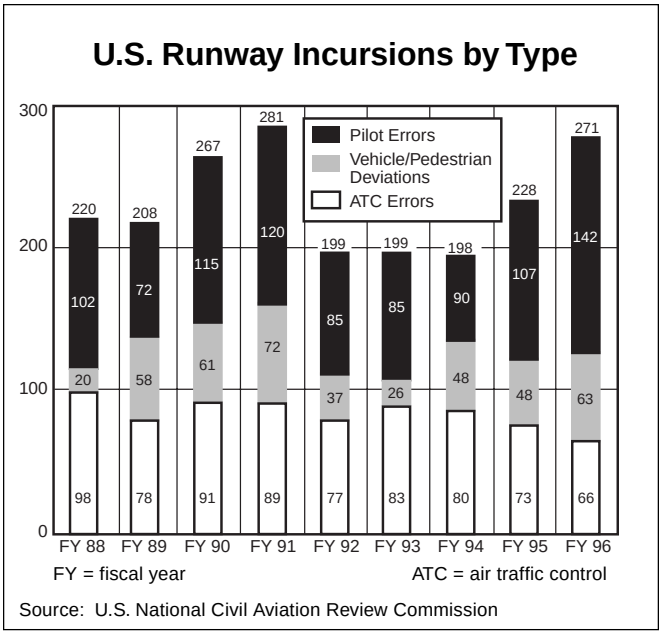


Figure 7

Expand Parameter Recording of DFDRs

Expanding the parameters on FDRs is one of the NTSB's "most-wanted" transportation safety improvements. FDRs and cockpit voice recorders (CVRs) are the "black boxes" that record key parameters of an aircraft's flight. FDRs can help determine the cause of accidents and incidents and provide valuable data for developing mitigation strategies for preventing future safety problems.

Recently, the FAA issued a regulation requiring that certain airplanes be equipped to accommodate additional DFDR parameters. This regulation was developed in response to the NTSB's recommendation. The regulation requires additional information to be collected on certain aircraft to ensure more thorough accident or incident investigations and to enable industry to predict certain trends and make necessary modifications before an incident or accident occurs.

The Commission urges the aviation industry to aggressively expedite continued upgrading of flight data sensing and recording equipment with the standards established in the regulation. This would not only help to improve accident investigations, but would also facilitate FOQA programs.

FAA Oversight in the Future

While this report places a strong emphasis on improving aviation safety through a variety of cooperative and collaborative programs between government and industry, it must be strongly emphasized that the FAA's oversight and inspection role continues. The FAA has taken steps to ensure that its inspection resources are directed where they are most needed.

The FAA has a long-standing policy to direct increased surveillance toward airlines in the throes of financial difficulty or undergoing a merger or acquisition. More recently, the FAA has indicated that rapid expansion of an airline's operation will precipitate increased FAA attention to that airline. While financial problems or rapid growth do not necessarily pose safety problems, the FAA must be aware of how the dynamics at a particular airline fit with the management style and safety philosophy of an airline undergoing those changes.

The FAA needs to be constantly vigilant and aware that the dynamics of an economically deregulated airline industry will continually raise issues of capital financing, ownership of aircraft, innovative management approaches, performance of maintenance and training, and operational control. Industry responses to the competitive business environment will require corresponding safety inspection policy and resource adjustments by the FAA to reflect ever-changing airline practices in the economically competitive environment that exists.

Conclusion

After approximately 30 years of a commercial aviation accident rate that has been low overall but has not been improving, a consensus has developed in the aviation industry and the federal government that steps need to be taken to reduce the accident rate in a very significant way.

The anticipated growth in aviation between now and the first quarter of the next century will almost certainly lead to an occurrence of aviation accidents with a frequency that will be wholly unacceptable to the public. The White House Commission on Safety and Security, chaired by U.S. Vice President Gore, recommended earlier this year that a goal of an 80 percent reduction in the accident rate over the next 10 years should be established. This Commission concurs in that goal.

From a safety standpoint, aviation is one of the most regulated activities in existence. This should continue. The relationship between government and the aviation industry over the past several decades, which has produced the safest means of commercial transportation, is a remarkable success story. But the time has come to embark on a concerted effort to improve the safety of the aviation system even further.

Accomplishing the goal of a dramatic reduction in the accident rate will require a strategic plan with identified priorities, resources and milestones for action. At present, there is not one. Without a plan, the FAA and industry safety agenda will naturally reside with fixing the problem that caused the last accident.

Fixing the problems that led to the last accident is important, but that last accident may have only a small relevance to the effort to reduce the overall accident rate dramatically. An ongoing

public strategy is required to ensure that the right issues are receiving the attention and resources needed over the long term.

To accomplish the goal of a significant reduction in the accident rate, government and industry must also take some fundamentally different approaches in their relationship to each other. This will require a breaking of the traditional regulatory and enforcement pattern.

Government enforcement of safety rules must continue, but there needs to be a recognition in the future that working for safety improvements from only a traditional enforcement-of-the-rules perspective will not produce the results that are needed. There will need to be a much stronger emphasis placed on cooperative interaction, information sharing and collaborative development of solutions to safety issues.

A number of methods are in their infancy and should be expanded throughout the industry. Examples include programs in which airlines and pilots self-report safety issues with no risk of punitive action, airline internal safety-audit programs and programs to use digitally recorded flight data to analyze real-world operations.

For these programs to become widespread tools in the effort to reduce the accident rate, the data from these programs needs to be shared and protected from inappropriate uses or punitive actions. The FAA and the industry very much need to cut through the thicket of legal and bureaucratic tangles that are preventing these important safety and accident-prevention programs from being implemented.

It is also clear that safety must be addressed globally. Aviation has become very internationalized as trade expands. Reducing the accident rate is going to be far more difficult in some places than in others. The FAA has embarked on a course of action to work with other countries' regulatory authorities to ensure that standards are being met, that regulations are harmonized to the greatest extent possible, and that there are cooperative agreements to improve safety. This must continue and expand if the accident rate is to be reduced.

A consensus has developed to take these actions to improve aviation safety. The Commission believes that it is time for industry and government to take the steps outlined in this report so that safety is not just regulated, but is promoted.♦

U.S. Aviation Runway-incursion Rates and Near-midair Collision Rates Show Upward Trend

The rate of runway incursions at U.S. airports has increased steadily since 1993.

FSF Editorial Staff

According to recent U.S. Federal Aviation Administration (FAA) data, near-midair collision (NMAC) rates and runway incursion rates were higher in 1997 compared with 1996.

The rates were reported in the FAA document *Aviation System Indicators: 1996 Annual Report*, supplemented by 1997 data from the FAA Internet World Wide Web site.

An NMAC is defined as "an incident associated with the operation of an aircraft in which a possibility of collision occurs as a result of proximity of less than [153 meters] 500 feet to another aircraft, or a report is received from a pilot or flight crew member stating that a collision hazard existed between two or more aircraft."

The NMAC indicator is a ratio that compares the number of NMACs to the number of air-carrier flight hours and is expressed as NMACs per 100,000 flight hours. An air carrier is defined as any carrier operating under U.S. Federal Aviation Regulations (FARs) Parts 121, 127, 129 or 135.

As shown in Table 1 and Figure 1 (page 24), NMAC rates have remained below 1.00 per 100,000 flight hours since 1991, and, except for 1994, have trended lower on an annual basis. But the rate of 0.69 per 100,000 flight hours for 1997 reversed the trend.

The annual report noted an important caveat: Because they depend on pilot judgment and voluntary reporting, the results shown in the table and graph are considered subjective.

A runway incursion is defined as "any occurrence at an airport involving an aircraft, vehicle, person or object on the ground that creates a collision hazard or results in loss of separation with an aircraft taking off, intending to take off or intending to land."

Runway incursions can be caused by:

- Surface operational errors, which are "occurrences attributable to the air traffic control (ATC) system that [result] in less than applicable separation minima between two or more aircraft, or between an aircraft and terrain or obstacles and obstructions ... ";
- A surface pilot deviation, which is defined as "a pilot action that results in violation of a FAR or North American Aerospace Defense Command (NORAD) Air Defense Identification Zone tolerance"; or,
- Vehicle/pedestrian deviations, which comprise movements unauthorized by ATC of vehicle operators

or pedestrians on an airport, including aircraft operated buy a nonpilot.

The runway-incursion rate compares the number of runway incursions to the number of operations at the airport. (Airport operations comprise arrivals and departures from the airport at which the ATC tower is located.)

Table 2 and Figure 2 (page 25) show the rate of runway incursions since 1990. After dipping to a low in 1993, the rate of runway incursions has climbed steadily and for 1997 was at 0.50 per 100,000 airport operations, its highest point in the past seven years.

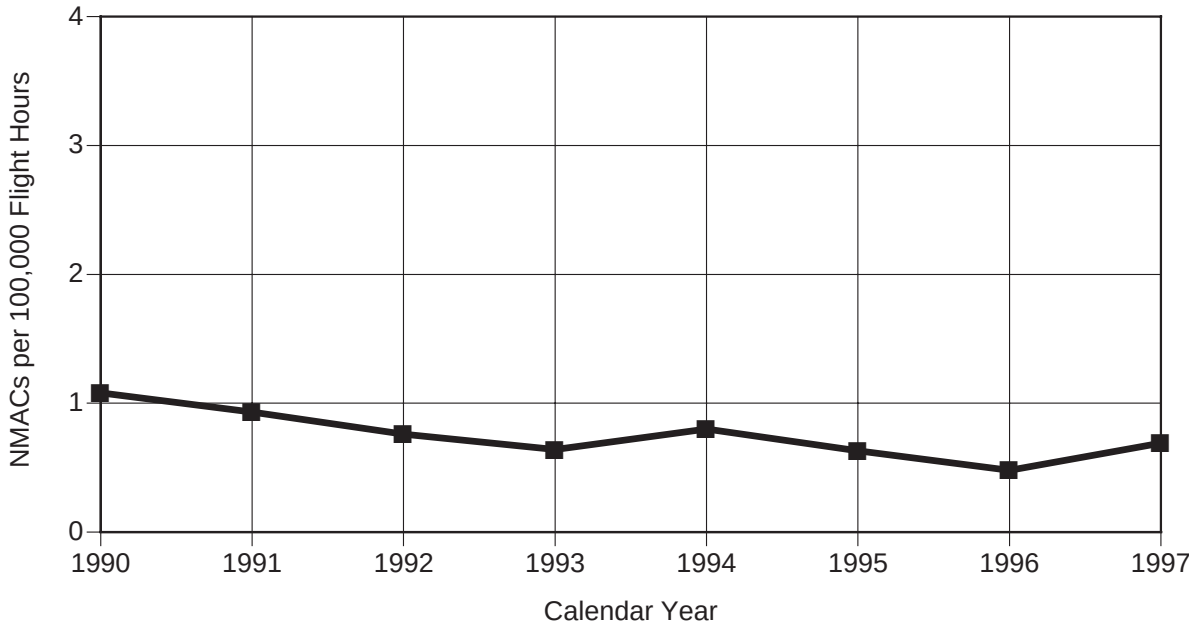
It is misleading to treat any one indicator as a measure of the status of the overall aviation system. Aviation safety is the sum of all indicators. Nevertheless, a change in one indicator can help the aviation community focus its resources, investigate the underlying factors and take the steps necessary to correct any adverse trend.

Table 1
Air-carrier Near-midair Collision (NMAC) Data

Calendar Year	Number of Near-midair Collisions	Number of Flight Hours	Near-midair Collision Rate (per 100,000 flight hours)
1990	181	16,740,876	1.08
1991	152	16,313,303	0.93
1992	127	16,695,064	0.76
1993	109	17,044,553	0.64
1994	142	17,808,444	0.80
1995	112	17,875,395	0.63
1996	88	18,503,756	0.48
1997	127	18,390,000	0.69

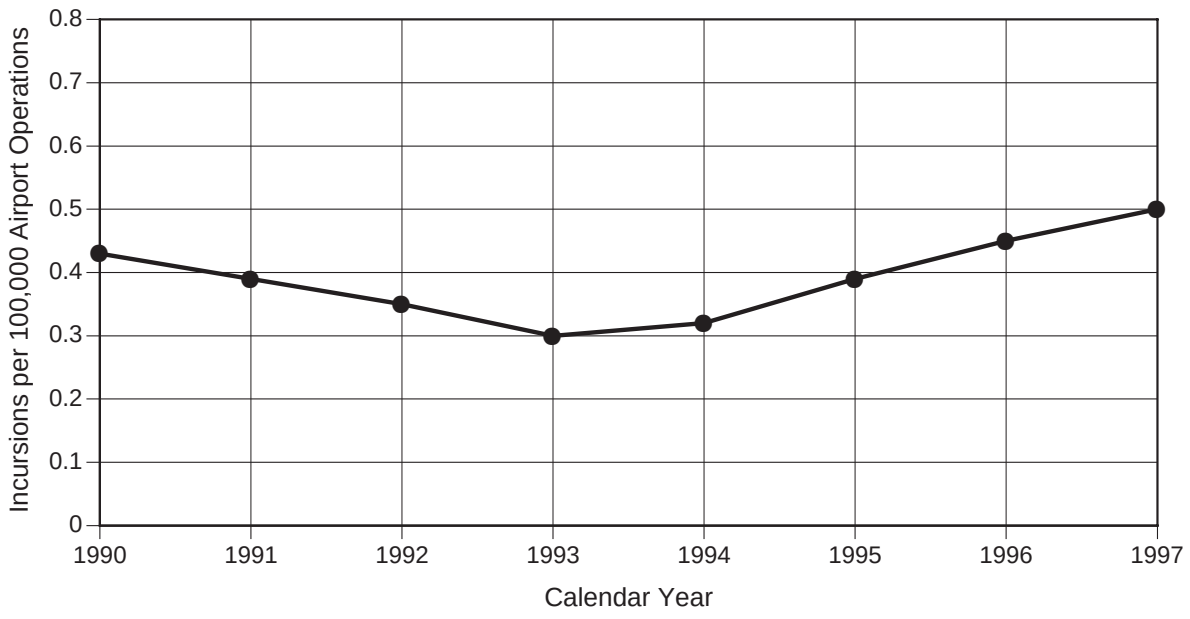
Source: U.S. Federal Aviation Administration

Air-carrier Near-midair Collision (NMAC) Data



Source: U.S. Federal Aviation Administration

Figure 1



Source: U.S. Federal Aviation Administration

Figure 2

Table 2
Runway-incursion Data

Calendar Year	Number of Runway Incursions	Number of Airport Operations	Runway Incursion Rate (per 100,000 airport operations)
1990	281	65,476,538	0.43
1991	242	62,387,597	0.39
1992	219	63,017,350	0.35
1993	186	61,980,424	0.30
1994	200	62,445,120	0.32
1995	240	61,796,714	0.39
1996	277	61,250,183	0.45
1997	319	63,475,695	0.50

Source: U.S. Federal Aviation Administration

Publications Received at FSF Jerry Lederer Aviation Safety Library

Study Reviews Air Traffic Controller Selection from International Perspective

Most pilots satisfied with FAA safety seminars, evaluation finds.

FSF Editorial and Library Staffs

Advisory Circulars (ACs)

Design Dive Speed. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 25.355-1. Oct. 20, 1997. 2 pp. Available through GPO.*

This AC presents an acceptable, although not the only, means of demonstrating compliance with the provisions of Part 25 of the U.S. Federal Aviation Regulations (FARs) related to the minimum speed margin between design cruise speed and design dive speed for transport-category airplanes. As with all ACs, it is not regulatory but provides guidance for applicants in demonstrating compliance with the objective safety standards set forth in the rule. [Adapted from AC.]

English Language Skill Standards Required by 14 CFR Parts 61, 63 and 65. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 60-28. Sept. 23, 1997. 2 pp. Available through GPO.*

This AC provides guidance for airman applicants, training organizations, designated examiners and aviation safety inspectors in determining English-language skills required for airman certification under U.S. Federal Aviation Regulations (FARs) Parts 61, 63 and 65. All contain distinct regulatory English-language requirements: Part 61 for pilots, flight instructors and ground instructors; Part 63 for flight navigators and flight engineers; and Part 65, for dispatchers, mechanics, repairmen and parachute riggers. [Adapted from AC.]

Issuance of Type Certificate: Restricted Category Agricultural Airplanes. U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 25.25-1. Dec. 1, 1997. 6 pp. Available through GPO.*

This AC provides information and guidance for obtaining a type certificate in the restricted category under U.S. Federal Aviation Regulations (FARs) Part 21, paragraph 21.25, for small single-engine piston- and turboprop-driven airplanes used for agricultural special-purpose operations. An acceptable means is presented for meeting the requirements of Part 21 for the issuance of a type certificate in the restricted category. Incorporated in this procedure are the appropriate normal-category airworthiness standards of FARs Part 23, Airworthiness Standards: Normal, Utility, Acrobatic and Commuter Category Airplanes.

Includes Appendix 1: Typical Normal Category Requirements Found to Be Inappropriate for Single-engine Agricultural Restricted Category Airplanes. [Adapted from AC.]

Reports

Review of Air Traffic Controller Selection: An International Perspective. Broach, Kana; Manning, Carol A. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/15. July 1997. 27 pp. Tables, figures, references. Available through NTIS.**

Keywords:
1. Air Traffic Controllers
2. Performance
3. Personnel
4. Tests
5. Selection
6. Validation

How an organization selects air traffic control system operators is an important element in aircraft safety and efficient airport and airway management. The research presented in this report examines how air traffic controllers are selected in the United States, Germany, the United Kingdom and Sweden.

Described first is the development and validation of the multiple-hurdle selection process used by the FAA between 1976 and 1992, followed by a description of the computerized test battery, which replaced the second-stage screening used by the FAA, in June 1992.

Second is a description of the four-step selection process for controllers in Germany by the Department of Aviation and Space Psychology in the German Aerospace Research Establishment for the Air Navigation Services, the counterpart of the U.S. FAA. Job analysis, test-battery development, personality test and validity research for air traffic control applicants in the United Kingdom are presented.

Finally, the report describes air traffic controller selection and research in Sweden. Topics examined include validity of existing tests, job analysis and future research and development in Sweden.

The report concludes with a discussion of air traffic controller job-performance measurements, including alternative approaches such as simulations and operational-data replay and analysis, and the future directions of the increasingly interconnected, global air traffic control system. [Adapted from Report.]

An Evaluation of Safety Seminars. Hunter, David R. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/16. July 1997. 41 pp. Tables, figure, references, appendixes. Available through NTIS.**

Keywords:
1. Aircraft Pilots
2. Aviation Safety
3. Training

Aviation safety seminars are the FAA's primary means of providing continuing education to pilots on safety and other aviation issues. These seminars are intended for private and commercial pilots who do not otherwise receive training from their employers or other sources. FAA aviation safety-program managers (SPMs) located at each of the 78 flight-standards district offices (FSDOs) conduct many of the seminars. Aviation-safety counselors (ASCs), who are volunteers with aviation expertise, also conduct many seminars.

The SPMs had not previously collected detailed information on the majority of attendees. In crafting their product of aviation-safety information, the SPMs need to know their customers so they can accommodate their requirements. The present study collected detailed information on the characteristics of seminar attendees, including demographic data. Evaluation forms were distributed at FAA safety seminars to measure such items as satisfaction with seminars, frequency of attendance, seminar content, and training and maintenance activities.

Among the findings, most pilots (99 percent) were satisfied with FAA safety seminars and would recommend them to other pilots. Results also suggested that participants frequently took part in activities expected to enhance their skills or proficiency. High levels of both computer and videocassette-player use and ownership suggest that alternative forms of training and information distribution may be possible.

The challenge remains, however, to attract a greater percentage of pilots while maintaining the current high satisfaction levels. The report contains five appendices: Safety Seminar Evaluation Seminar Leader's Form; Seminar Evaluation Form — Common Page; and four versions of the seminar evaluation form. [Adapted from Introduction and Discussion and Conclusions.]

Stereochemical Determination of Selegiline Metabolites in Postmortem Biological Specimens. Kupiec, Thomas C.; Chaturvedi, Arvind K. U.S. Federal Aviation Administration (FAA) Office of Aviation Medicine. Report No. DOT/FAA/AM-97/14. July 1997. 13 pp. Tables, figures, references. Available through NTIS.**

Keywords:
1. Selegiline Metabolites
2. Methamphetamine
3. Amphetamine
4. Enantiomers
5. Diastereomers
6. Parkinson's Disease
7. Aircraft Accident Investigation

During an aircraft accident investigation, the FAA Toxicology and Accident Research Laboratory evaluates biological samples collected from aircraft accident victims in coordination with the FAA Office of Accident Investigation. The biological samples are analyzed for prescription, nonprescription and illicit drugs, along with volatiles and primary-combustion gases.

This report concerns analytical findings related to a unique general-aviation aircraft accident involving a 68-year-old pilot

who received fatal injuries. Two types of tablets were found at the crash site. The tablets were found to be levodopa and selegiline, a combination of drugs routinely prescribed for treating Parkinson's disease, of which the pilot had a history.

The stereospecific analysis described in this study was able to determine during the toxicological evaluation that the victim had been taking a prescribed medication to treat his Parkinson's disease, and not an illicit or controlled form of the drug. This analysis was able to differentiate between *levoratatory* isomers (indicating the prescribed medication), and *dextrorotatory* isomers (indicating an illicit or controlled substance).

This report concludes that it is essential to conduct a thorough analysis of drugs in biological samples to facilitate accident investigations. Findings must indicate whether the victim was taking an illicit drug or a prescribed/nonprescribed medication in compliance with a physician's orders. [Adapted from Introduction and Discussion.]

International Aviation: Competition Issues in the U.S.-U.K. Market. Statement of John H. Anderson Jr., director, Transportation Issues, Resources, Community and Economic Development Division, U.S. General Accounting Office (GAO), before the Subcommittee on Aviation, Committee on Commerce, Science and Transportation, U.S. Senate, June 4, 1997. Report No. GAO/T-RCED-97-103. 16 pp. Figures. Available through GAO.***

Air travelers in both the United States and the United Kingdom have more limited options and probably pay higher airfares because of the current bilateral agreement between the United States and the United Kingdom to limit competition. Because of this agreement, only two U.S. airlines are allowed to serve Heathrow Airport in London, England, but British Airways, as a result of previous negotiations, has extensive access to the U.S. market.

Barriers at Heathrow Airport that prevent access by U.S. airlines include limited takeoff and landing slots and scarce facilities and available gates. The U.S. Department of Transportation has had little success in securing greater access for U.S. airlines at Heathrow.

This report draws on previous reports issued over the past several years on international aviation issues and discusses the (1) current status of airline competition in the U.S.-U.K. market and of negotiations between the two countries, (2) potential competitive impacts of the proposed alliance between American Airlines and British Airways and (3) obstacles that might prevent U.S. airlines from having adequate access to Heathrow Airport. [Adapted from Introduction.]

Aviation Insurance: Issues Related to the Reauthorization of FAA's Aviation Insurance Program. Statement of Gerald L. Dillingham, associate director, Transportation Issues, Resources, Community and Economic Development Division, U.S. General Accounting Office (GAO), before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives, May 1, 1997. Report No. GAO/T-RCED-97-115. 12 pp. Appendix. Available through GAO.***

The U.S. Federal Aviation Administration (FAA) aviation insurance program established in 1951 provides insurance coverage for aircraft operations considered essential to the foreign-policy interests of the United States when commercial insurance is unavailable on reasonable terms. This program is designed to help maintain the financial security of U.S. airlines and to support U.S. foreign-policy interests, because the government often enlists the aid of commercial airlines to move troops and supplies.

Various commercial airlines have relied on the program, as have the U.S. Department of Defense (DOD) and the Department of State. The statement contained in this report reviews changes made to the aviation insurance program since 1994, when it was reported that insufficient funds were available to pay potential claims.

The Defense Authorization Act for fiscal year 1997 made funds available to the program for losses incurred under DOD-sponsored flights, which are the majority of flights insured. But two concerns raised in the 1994 report remain unresolved: (1) the program's ability to pay claims for nondefense flights, which could deplete the available funds and leave a large portion of the claim unpaid; and (2) ambiguity in the statutory language and FAA's current implementing regulations concerning whether the president determines that a flight is in the foreign policy interest of the United States before insurance is issued.

Contains one appendix: A Summary of the Major Attributes of the Aviation Insurance Program. [Adapted from Introduction.]

Books

Air Travel: How Safe Is It? Second Edition. Taylor, Laurie. Osney Mead, Oxford, England: Blackwell Science, 1997. 287 pp.

The author of this analysis has been a pilot for more than three decades, first with the Royal Air Force (RAF), then with British Airways. She also has experience with the British Air Line Pilots' Association and the International Civil Aviation Organization and she brings a wide perspective to her subject.

A great deal of progress has been made in the design, construction and operation of civil aircraft, not to mention the environment in which they operate, including air traffic control,

airports, navigation and weather forecasting. Pilot training has also improved, as has our understanding of the factors that cause aircraft accidents. At the same time, the author notes concern about the level of satisfaction with the current condition of air safety by some organizations within the air transport industry.

This book serves as a comprehensive reference manual about airline safety. Sections cover a broad range of issues, including the role of international organizations, human factors, the natural environment, flight operations, the accident record and advanced technology. *Air Travel: How Safe Is It?* concludes with a speculative look at future safety challenges and suggested areas for improvement. Contains an index. [Adapted from Introduction.]

Applied Aviation Psychology: Achievement, Change and Challenge: Proceedings of The Third Australian Aviation Psychology Symposium. Hayward, Brent J.; Lowe, Andrew T., eds. Brookfield, Vermont, United States: Ashgate Publishing Company, 1996. 484 pp.

The Third Australian Aviation Psychology Symposium was held at Manly, Sydney, in November 1995. The proceedings will be of particular interest to anyone concerned with the application of aviation psychology to improvement of aviation safety.

The volume's first seven parts discuss subjects of continuing importance in the increasingly complex world of aviation, including aviation safety, crew resource management, pilot training, air traffic control, human resources, maintenance and situational awareness. The eighth and final section contains reports from the developmental workshops held during the symposium, on the topics of human-factors training, situational awareness, cabin-safety management, air traffic control — implications of new technology, human factors in aircraft maintenance and aviation safety.

Includes an index. [Adapted from Introduction and Preface.]♦

Sources

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

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

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

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

Advisory Circulars (ACs)

AC No.	Date	Title
150/5220-10B	10/20/97	*Guide Specification for Water/Foam Aircraft Rescue and Firefighting Vehicles.* (Cancels AC150/5220-10A, *Guide Specification for Water/Foam Aircraft Rescue and Firefighting Vehicles,* dated July 3, 1991.)

FAA Orders

Order No.	Date	Title
7210.3P	02/26/98	*Facility Operation and Administration.* (Cancels FAA Order 7210.3M, *Facility Operation and Administration,* dated Feb. 2, 1996. FAA Order 7210.3N was canceled by GENOT, N1700.21, dated July 4, 1997.)
7110.10M	02/26/98	*Flight Services.* (Cancels FAA Order 7110.10L, *Flight Services,* dated July 1, 1996.)
7110.65L	02/26/98	*Air Traffic Control.* (Cancels FAA Order 7110.65J and all changes to it, dated July 20, 1995. FAA Order 7110.65K, *Air Traffic Control,* dated July 17, 1997, was canceled by GENOT, N7100.21, dated July 4, 1997.)

Incorrect Altimeter Setting Puts Aircraft on Approach at 74 Meters above Field Elevation While Eight Kilometers from Runway

Emergency helicopter strikes power line, killing pilot, nurses and accident victim who was being transported to trauma center.

FSF Editorial Staff

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

Incorrect Altimeter Setting Discovered before Takeoff

Type of aircraft unknown. No damage. No injuries.

The flight was being vectored at night to an instrument landing system (ILS) approach to Runway 10R at a U.S. airport. The air-route traffic-control center (ARTCC) had provided an altimeter setting of 1,032 hectopascals (30.48 inches of mercury) and had issued a clearance for the aircraft to descend. At an altitude of 1,300 meters (4,200 feet) and 10 kilometers (six miles) from touchdown, the crew received an ILS glideslope warning.

Several seconds later, over the final approach fix, the glideslope indicator was still showing a full-scale "aircraft-low" condition. The captain aborted the approach and flew the aircraft to 1,500 meters (5,000 feet).

During communication with ATC, the captain asked for confirmation of the altimeter setting and was told that the setting was 998 hectopascals (29.48 inches of mercury); the aircraft had been 305 meters (1,000 feet) lower than the indicated pressure altitude.

The lowest the aircraft had flown above ground level (AGL) on its approach was 945 meters (3,100 feet). Because the field elevation was 788 meters (2,858 feet), the aircraft had been only 74 meters (242 feet) above field elevation while still eight kilometers (five miles) from the runway. The altimeter setting was corrected, and the second approach was uneventful.

Observant Flight Attendant Averts Possible Incident

Boeing 767-300. No damage. No injuries.

The B-767 was parked in South America on an unlighted ramp at night in drizzling rain. While the first officer was doing a walkaround inspection, a flight attendant standing in the entry door saw white paper protruding from the aircraft's pitot tubes. The ground crew told the pilot that paper had been stuffed into the pitot tubes to prevent insects from entering the tubes. The paper was removed and the departure was made without further incident.

Nose Gear Fails to Extend Fully, Collapses on Landing

McDonnell Douglas DC-9-31. Minor damage. No injuries.

During a daylight approach to a South American airport, the crew could not confirm that the nose gear was fully extended. The captain discontinued the approach and flew the aircraft past the airport control tower for a visual check. The crew in the tower reported that the nose gear appeared to be down.

An emergency landing was made, during which the nosewheel was held off the runway for as long as possible. When the nose wheel finally touched down, the nose gear collapsed, causing minor damage to the aircraft.

Fog and Freezing Rain Hamper Rescue Efforts

Embraer 110. Aircraft destroyed. Four fatalities.

The commuter aircraft was making a daylight approach in fog and freezing rain. There was a crew of two and 15 passengers aboard. The flight's destination was an isolated North American community about (322 kilometers) 200 miles northeast of the nearest major city. The aircraft struck the ground about (100 meters) 328 feet short of the runway, killing four persons.

Rescue efforts were hampered by the poor weather and the remote location that made it accessible only by snowmobile. An armed-forces transport aircraft carrying rescue technicians and medical personnel was unable to land at the site until the next morning when the injured were evacuated.

Instrument Approach in Fog Ends in Fatal Accident

Unidentified aircraft. Aircraft destroyed. Two fatal injuries, one serious injury.

The twin-engine aircraft was on an instrument approach to a western U.S. airport in fog and early-morning darkness when the aircraft disappeared from the radar scope.

There were three persons aboard the aircraft. They included the pilot and two mechanics who had been sent to work on an airline jet aircraft that had been grounded for repairs at the airport where the accident aircraft was to land. The pilot and one of the mechanics were killed in the accident. The second mechanic was injured seriously.

Failure to Communicate Costs Aircraft

Beechcraft Super King Air 200. Aircraft destroyed. No injuries.

The aircraft was taking off from a snow-patched runway in darkness and poor weather (blowing snow and [183-meter] 600-foot visibility) with a crew of two and 10 passengers. There was a crosswind of (37 kilometers per hour [kph]) 20 knots, gusting to (56 kph) 30 knots, from the right. As the aircraft accelerated through (167 kph) 90 knots (V_1 was [185 kph] 100 knots), it began to veer to the left.

The copilot, who was the pilot flying, applied right rudder in an attempt to straighten the aircraft's track; but the drift continued to the left. To avoid impacting a snow bank on the left side of the runway, the copilot elected to rotate early.

The captain, believing that the takeoff was to be aborted, reduced engine power. The aircraft became airborne momentarily, cleared the snow bank at the edge of the runway, settled back into deep snow, ground-looped and came to rest about (15 meters) 50 feet from the side of the runway.

Aircraft on Go-around Strikes Airport Antenna

Cessna Citation 500. Aircraft destroyed. One serious injury.

Unable to stop after landing in heavy fog at an eastern U.S. airport, the pilot tried get the aircraft airborne again. The aircraft struck the top of an antenna array at the end of the runway and flipped onto trailers at a trailer park just off the end of the runway; a fire erupted.

Three persons were aboard the aircraft. The copilot was seriously injured. Three trailers were damaged, but no other injuries were reported on the ground.

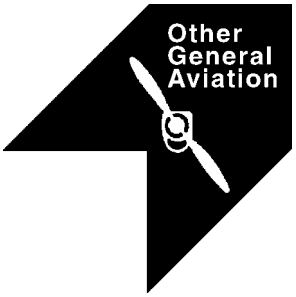
Runway Overrun Leads to Multiple Collisions

Learjet 35. Damage undetermined. No injuries.

Following an instrument approach in darkness to Runway 03, the aircraft landed long and overran the end of the runway.

Beyond the end of the runway, the Learjet collided with a parked Cessna 152, a parked Piper PA-28 and a hangar before coming to rest.

Weather at the time comprised a ceiling of (31 meters) 100 feet and visibility of (1.2 kilometers) 0.75 mile in rain. Runway 03 is (1,541 meters) 5,052 feet long and has a grooved asphalt surface.



Low Approach Results in Death of Student Pilot

Piper Cherokee. Aircraft destroyed. One fatality.

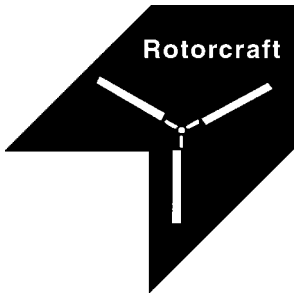
The 20-year-old student pilot was making a night approach when the aircraft landing gear clipped the roof of a semi-trailer truck on an interstate highway near the airport.

The single-engine aircraft struck the ground nose-first, short of the runway. The pilot, the only person aboard the aircraft, was taken by helicopter to the area hospital, but died as a result of trauma sustained in the crash.

Midair Collision Ends Two Approaches

Two Cessnas. Both aircraft destroyed. Four fatalities.

The two single-engine aircraft were trying to land in low clouds and light snow at a small airport. According to one observer, a pilot, the aircraft were approaching the same runway at the same time, and one aircraft was directly above the other. At an altitude of about (76 meters) 250 feet, the two aircraft collided and fell to the ground. All four persons aboard the two aircraft were killed on impact.



Medevac Helicopter Strikes Power Line When Leaving Accident Site

Type unknown. Aircraft destroyed. Four fatalities.

The chain of events began with a four-car highway accident in a construction zone that killed one person and injured nine. A medical evacuation helicopter responded. When leaving the accident site, the helicopter struck a power line and fell to the ground, killing the pilot, two nurses and an injured accident victim who was being transported to a nearby trauma center. As a result of the helicopter accident, an estimated 15,000 homes and businesses in the area were without electric power for a short time.

Helicopter Rolls onto Passenger

Bell 206B. Aircraft destroyed. One fatality.

The helicopter had landed to offload two surveyors and their equipment. After landing, the pilot lowered the collective and moved the cyclic control to confirm that the helicopter was firmly down. It was parked, engine running, on an uneven two- to three-degree downslope that ran from front to back and from right to left.

As a result, the forward half of the skids were on the ground, but the rear sections were not seated firmly. In addition, there was a (28–kilometers per hour) 15-knot wind from 30 degrees to the right of the aircraft's nose.

The rear-seat passenger disembarked from the left (downhill) side, unloaded his equipment and moved away from the helicopter. The front-seat passenger also disembarked from the left side, unloaded his equipment and then stepped onto the skid, as if to pass a message to the pilot.

At that moment, the helicopter was struck by a strong gust of wind and the aircraft rocked back on its skids and began to roll to the left. The pilot attempted to counter the roll and pitch, first by moving the cyclic control and then by trying to lift off. Neither effort was successful.

As the weight came off the skids, the helicopter than began to slide backwards down the slope. The aircraft hit a partially buried tree stump and rolled over. The pilot was unable to recover control before the rotor blades made contact with the front-seat passenger and the ground. The passenger was struck by the rotor blade and killed.✦

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Disaster Response Planning Workshop for Business Aviation

June 18–19, 1998
Atlanta Airport Hilton and Towers
Atlanta, Georgia, U.S.

Who Should Attend?

- Department managers (flight, maintenance, scheduling and administration);
- Flight safety managers;
- Corporate safety/disaster response managers;
- Corporate security managers;
- Human resource/personnel managers;
- Public relations/communications managers;
- Risk/insurance and financial managers; and,
- Administrative managers.

Why Should You Attend?

- Develop your own disaster response plan—now!;
- Update your current disaster response plan (at least every other year);
- Increase the number of people in your department with skills and expertise in disaster response (one or two aren't enough);
- Improve corporate managers' understanding of the unique issues involved in an aviation-related disaster (you'll want all the help you can get); and,
- Help your department's staff after a nonaviation disaster (automobile accident, fire or act of violence).

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