Is It Safe Up There?

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INTRODUCTION

The United States aviation industry is a valuable national asset. Nearly 625 million people were carried on our nation's airlines last year, for recreation and business. The Boeing Company builds 70 percent of the free world's transport airplanes and U.S. aviation exports are the largest single contributor to our balance of trade.

This paper deals with the issue of airline safety. While travel by com-

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mercial airplane is by far the safest mode of personal travel, averaging about 200 fatalities per year, an airplane accident is always a matter of great public interest and concern, frequently resulting in enormous media coverage, Congressional interest and calls for action.

I will briefly describe the national aviation system and explore the basics of safety itself. The safety of today's system will be discussed and finally, the prospects for a safe system in the future, in the face of accelerating demand for aviation services.

Today's National Aviation System

Today's national aviation system is a complex creature that has evolved over seven decades to the system we know today. It is composed of three major elements:

- ◊ *People*: those who operate and use the system—pilots, mechanics, regulators, instructors, technicians, air traffic controllers and passengers.
- ◊ *Equipment*: the aircraft that operate within the system—airplanes, hot air balloons, gliders, ultralights, agricultural aircraft.
- ◊ *Infrastructure*: the facilities and equipment used by the people—airports, air traffic control facilities, navigation aids, radar, communications, lighting aids, and the airspace itself.

The integrity of the commercial aviation system depends on the primary players—the airlines, regulatory agencies, and the manufacturers—meeting their well-defined responsibilities.

All components in the system—people, equipment and infrastructure—must meet specific, national standards and detailed certification criteria. Close quality control parallels exist throughout the system for each of the three elements. For example, an instrument landing system must be certified for use by a certified technician, just as a repaired airplane must be "signed off" by a licensed (certified) mechanic. All critical equipment and infrastructure has double, triple or quadruple redundancy designed and built into the systems and subsystems. Parallels again exist. Just as crucial ground navigation systems have power conditioning systems and auxiliary power sources, the modern airplane has redundancies in avionics, control systems, propulsion and even the pilots themselves.

The two types of flying activity are instrument flight rules and visual flight rules. Air traffic control provides services for all instrument flying and some visual operations. While the tools available to the controller (radar displays, communications and other aids) have advanced greatly, air traffic control for the most part, is done manually, just as it has always been.

How Safe is Safe?

Before addressing today's safety levels, I will start with a general discussion of safety itself. Safety, like beauty, is in the mind of the beholder. One person's comfort level may be totally unacceptable to another. Safety is not the absence of risk, it is the threshold of acceptable risk. Flight is inherently a risky venture, carried out in a hostile environment at great speeds. It requires professionalism, competence and knowledge for it to be done "safely." The only way to assure risk-free flight is to never allow the airplane to leave the gate.

The ultimate responsibility for assuring that the system is safe in the United States lies with the regulatory agency, the Federal Aviation Administration (FAA). Most of the day-to-day inspections, reviews and sign-offs are performed by the manufacturers, airlines and airports; the system depends on "self-inspections" and it is simply not possible for the FAA to make every inspection on every airplane in every location around the world. This "self-inspection," or "designee" concept is startling to many of the general public, but it has worked effectively for many decades. The airlines and the manufacturers have a great concern for the safety of their airplanes and operations; it is in their business interests to place a high priority on safety. To make this point, one only needs to look at the repercussions for Valujet Airlines following the tragic May 11, 1996, accident in the Everglades. The financial toll on the company was devastating. The spin-off effect of the accident on other "startup airlines" has also cost them dearly. This is a direct effect of the publicity surrounding the Valujet accident and the public's perception that the new airlines are not as safe as the established carriers.

If safety is the threshold of acceptable risk, then how much risk is acceptable? While 100 people may have 100 different answers to that question, our democratic system itself provides the answers. In my opinion, the Congress of the United States has the greatest influence on the level of safety, or acceptable risk under which we operate. Congress, of course, writes the laws that govern the operation and development of the national aviation system. Congress also controls the budget of the Department of Transportation and, in turn, the Federal Aviation Administration. The budget contains certain mandates in emphasis areas such as staffing, facility closures (or prohibitions against such), capital programs, travel funding and training. Through the committee system, they also exercise a great deal of oversight over the Federal Aviation Administration.

The State of Airline Safety in 1998

After a high number of fatalities in 1996, 1997 was a very good year for the U.S. airline industry. In 1997, eight fatalities from four accidents

were recorded, versus 356 fatalities from four accidents in 1996. Although 1997 worldwide totals were not available at the time this paper was written, nearly 1,200 passengers and crew died in 1996, an increase of 185 percent over the 1995 total of 420.

For the period from 1959 to 1995, over 70 percent of the most serious accidents—hull losses—were attributed to the flight crew, with airplane, maintenance, weather, airport/air traffic control system and other factors accounting for the balance.[1] This statistic should not suggest a simple solution for a problem much more complex than it may appear. An accident may be attributable to flight crew error, but the airplane, the airport environment and other factors presented to the flight crew may place the flight crew in a very difficult position. For instance, a landing approach accident might be avoided with improved airport approach lighting systems, better aircraft position information or wind shear detection systems.

Lest we put too much emphasis on the airplane and crew in the safety debate, we must also remember the other components of the national aviation system. The infrastructure plays a vital part in the safety equation. The tools given the pilot and air traffic controller—airports, air traffic control facilities, navigation aids, radar, communications, lighting aids, and the airspace itself—all affect the system's ability to move the traffic efficiently and safely. Unfortunately, the technological state of the nation's ground equipment is not the equal of that found in the modern cockpit.

Recognizing that providing quality surveillance, communications and navigation coverage over the 3.6 million square miles of the United States is a daunting and costly task, system modernization has been slow in coming. As an example, the enroute radar system that is the backbone of air traffic control, was built from the late 1950's to the mid-1960's, although improvements have been made to the existing system over the years. Radio coverage in some areas is lacking, weather sensors and reporting systems have been slow in coming on line, and delays in new system deliveries have been more the norm than the exception.

One point needs to be made before proceeding any further. Whenever critical components of the system fail, such as an instrument landing system in poor weather conditions, the system adjusts to the new configuration. In operating terms, this simply amounts to slowing the system down to the level at which it can be operated safely; to the user, this generally appears as delay.

Major upgrading of the air traffic control system began in the mid-

1. ABBOTT, KATHY H. "Interfaces Between Flight Crews and Modern Flight Deck Systems." Technology and The Flight Deck Symposium, August 5, 1997. Vancouver, B.C.

1980's. At that time, the FAA was the world's largest user of vacuum tubes. Since then, billions of dollars have been spent on major upgrades to the system, from solid state radios, to new en route traffic control computers and new terminal area radar systems. The traffic has grown dramatically in that same time period. Since the mid-1980's and until recent times, funding for system modernization has been adequate, enough to fund improvements at a reasonable pace. Over the past four to five years, however, FAA Program Managers have been scrambling to find the funds to keep already-committed programs going and to start only the highest priority programs. As an example, one major program had to delay commissioning new facilities because it lacked the funds to complete the communications hook-up needed to finish the project.

Airport improvements for such items as new runways, fire trucks, land acquisition, runway edge lighting, aircraft parking aprons, clear zones and airport terminal buildings have been heavily dependent on the federal Airport Improvement Program (AIP), particularly for medium and small airline-served airports. Capital projects for these airports are very costly relative to the airport's ability to create revenue. The medium and small airports are served by turbine powered airplanes, operating to the same standards as the large airlines. They require more land, wider safety areas and longer runways than needed by most general aviation aircraft. The airport operator must also provide airport security and crash/fire/rescue coverage. Unlike the large airports, the smaller facilities have no appreciable parking income, passenger facility charges, concession, lease, or landing fee revenues, explaining their dependence on the AIP. In recent years, the amount of AIP funding has dropped by about 30 percent, while costs and needs continue to escalate. Projects such as additional taxiways, runways and paved overrun areas that are delayed or canceled have safety implications because of congestion and the burden placed on existing facilities.

A significant portion of the funding for system modernization (and operation) and airport improvement grants comes from user taxes. However, regardless of the amount of user tax receipts in the Trust Fund, the FAA is dependent upon the Congress to appropriate funds on a year-to-year basis. The agency's budget request, part of the Department of Transportation package, is included in the President's January budget submittal for the following fiscal year. Before the agency's request is included in the Presidential submittal, it has already gone through review by the Department and the Office of Management and Budget.

After Presidential submittal, the agency's request is submitted to Congressional committee scrutiny through study, hearings, questions and responses, and finally to the full Senate and House for approval on a department-by-department basis. The FAA budget is considered in the

context of the entire budget and national priorities, placing the agency in the position of competing with social, space and defense programs. The recent balanced budget debate included the FAA along with all other agencies. Only after the budget process is complete, taking nearly two years from initial work to approval, can the agency start procurement or construction of facilities.

The obvious question at this point is, will the FAA be successful under the present process, in competing for airport improvement, system modernization and operating funds while facing the challenge of a near-doubling of airline passengers in the next 20 years? The FAA has estimated that the cost of providing present services 20 years from now will double, along with passenger growth.[2]

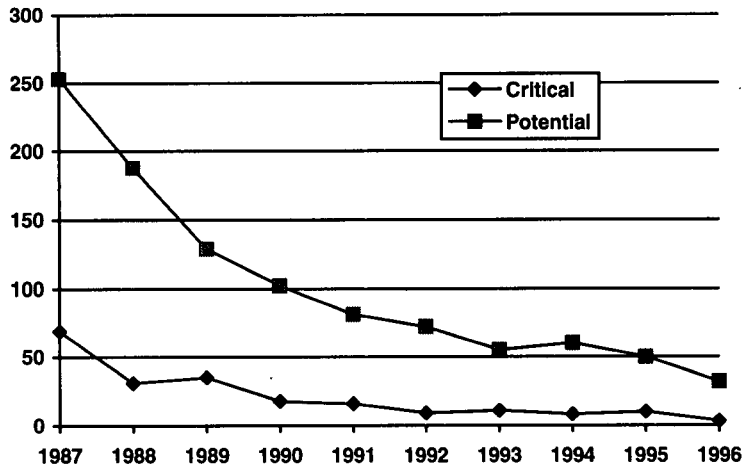
I will leave it to the reader to draw his or her own conclusions on the safety of today's system, but there is a body of evidence to show that today's system is much safer by several measures than the system of the past. In looking at the evidence, we need to remember that the system operated at a high activity level in 1997 as evidenced by the following statistics from the National Transportation Safety Board, for U.S. scheduled and non-scheduled airlines:

Flight Hours	15.3 million
Miles Flown	6,441 million
Departures	9.8 million

Near Midair Collision Reports are investigated and maintained by the FAA and are a rough measure of how well the system is working—traffic density; controller, equipment and pilot performance and adequacy of procedures. By their nature, they are subjective, but important. In the chart below, "critical" means a situation in which collision avoidance was due to chance—less than 100 feet of aircraft separation. "Potential" means an incident which would have resulted in a collision if no action had been taken by either pilot—a proximity of less than 500 feet.

2. Hinson, David, FAA Administrator. Speech to *Aero Club of Washington*. January 23, 1996.

Reported Near Midair Collisions



The data points above are absolute numbers, not rates or percentages. They are even more impressive in the message they carry, when one considers the growth in traffic over the ten-year period. From 1987 through 1996, potential near mid air collisions decreased from 253 to 32, a decrease of 87 percent, and critical near mid air collisions decreased from 69 to 3, a 96 percent decrease.

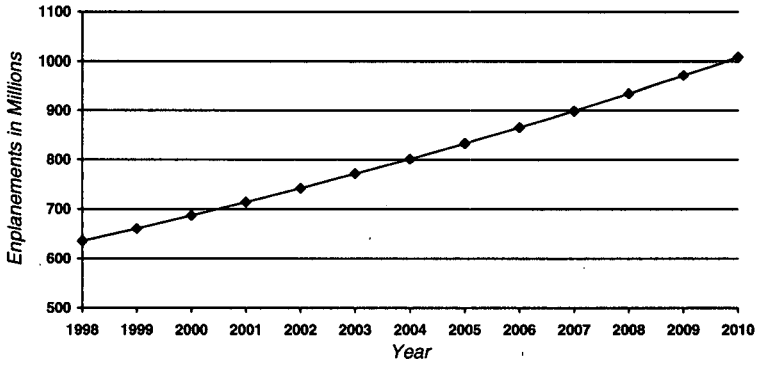
Nearly 625 million passengers were carried safely to their destinations last year, with a fatality rate of 1:128,000,000 passenger enplanements. If the 1960 U.S. accident rate were overlaid on 1997 activity, there would have been *270* accidents last year or more than one every working day (Hinson, August, 1997); the 1997 total number of accidents for scheduled and non-scheduled carriers, including non-fatal accidents was *49*. In the *entire* history of U.S. aviation, the *total* fatalities are just over 13,000, or approximately the average four month death rate on our nation's highways.

Future Challenges

Aviation has had a profound effect on our way of life. Early in its history, flying was only for the businessperson, the wealthy and privileged. Today people of modest means visit relatives and take vacations via the airplane. Developing countries are seeing dramatic growth in their aviation industry, particularly in Asia. And as long as goods and people have to be moved for economic and business reasons, aviation will serve a vital role.

The FAA develops the Terminal Area Forecasts every year. Their latest projections show the following for U.S. scheduled airlines. An enplanement is the initial boarding of a passenger embarking on a trip, not connecting passengers.

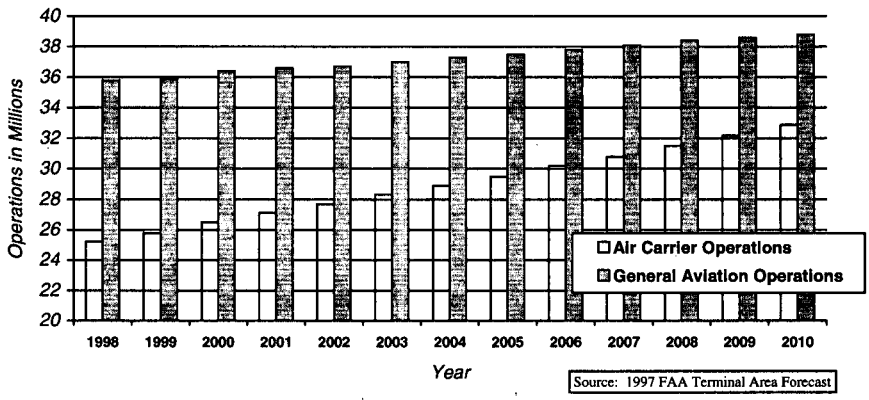
Forecasted U.S. Air Carrier Enplanements



Source: 1997 FAA Terminal Area Forecast

From 1998 to 2010, enplanements on our U.S. carriers are expected to grow by nearly 60 percent. As shown below, airline operations (a landing or takeoff) will increase by more than 30 percent over the same time period and general aviation operations by 11 percent.

Forecasted Annual Operations



Source: 1997 FAA Terminal Area Forecast

This growth translates into more demand on the system—more controller workload, more pressure on airports, runways, terminal

buildings, parking lots and the airspace itself. The Boeing Company has projected a worldwide transport fleet of 23,000 airplanes from 11,000 today, by the year 2015. They have also reported that if the 1996 worldwide accident rate were held constant at the level of about one per million departures, there could be a serious accident somewhere in the world every one or two weeks in the year 2015!

Given that today's accident rate is unacceptable to some at least, what have we to look forward to, given the constant increase in activity in the same, finite blocks of airspace and real estate?

First, we can take heart in the progress to date. According to The Boeing Company, the accident rate for the newer generation of airplanes, such as the B757, B767 and the A310 is considerably better than earlier designs. With no hull losses to date, it is reasonable to expect that the current new crop of airplanes such as the B777, A330 and A340, will be safer yet, as a result of more sophisticated design and applied technology.

New technology will be available to the flight crews and controllers as well:

Better *weather detection systems* will provide information to airline dispatchers and pilots, allowing more efficient and safe flight around weather systems, both enroute and near the airport.

- *Global Positioning Systems (GPS)* are being used now, but will become the primary source for navigation and surveillance information, replacing ground based, line-of-sight-limited VOR navigation facilities and radar facilities. GPS will also be the primary means of guidance for precision landings and departures at our nation's airports.
- Improved *air traffic control tools* are already being installed in FAA facilities, to give the controller more reliable and efficient means to see and communicate with the airplanes under his/her control.
- *Data link* will allow clearances, weather and traffic information to be provided in the cockpit in a fast, error-free, digital form. One of the big advantages of data link will be the elimination of "read back" errors between the pilot and controller.
- *Improved collision avoidance* systems on board the airplanes will reduce the number of collision scenarios.
- *Flight decks* will continue to improve with added redundancy and integrated avionics, giving the pilot more options and flexibility.
- *Training* of flight crews will become more sophisticated. Flight data recorder information from "safe to destination" flights will be used by the airlines to improve training. The information, to the extent it is generic, will be shared among the airlines, regulatory agencies and manufacturers for improvements in many areas from operations to design.
- *Human factors* will be a major consideration from the onset of airplane design, to assure that the airplane can be operated and maintained easily within human limits.

I submit that most aviation experts would say there is, or will be, ample technology to drive today's accident rate down to very low numbers, even with added activity. To exploit available technology and new equipment, however, there must be the financial wherewithal and the will to make it happen. The manufacturers and airlines must have the resources to equip the airplane as desired. The FAA, as the provider of the air traffic control system, faces a rocky road ahead, given the budget process, Departmental and Congressional control described earlier in this paper.

The FAA cannot continue operating and modernizing the air traffic control system as it has in the past, if this country is to meet its air transportation needs in the future. The service provider must be responsive to the customer's needs, and fast on its feet, to take full advantage of new technology, support the economic vitality of our nation, and win the global competition. It has been said that the FAA is the only agency in government that controls the production of the companies with which it does business.

NAV CANADA is the new privatized air traffic control corporation recently established by our northern neighbors. They have already shown the ability to raise significant capital, and what better investment than in a monopoly with an viable, long term future? Other countries with smaller air traffic control systems have shown that a non-government controlled system can operate more efficiently and more responsively than their governmental predecessors. Given the proximity of Canada to this nation, cultural similarities, overlapping airspace and identical system architecture, we may see the Canadian system eventually emulated in this country.

Medium and small airports face an uncertain future with the high cost of capital development and limited means to raise money. The federal trust and general fund support that has filled the gap between cost and revenues is drying up. As important components of the national aviation system, a new source of dependable revenue for capital projects must be found or federal support must be reinstated.

SUMMARY

Our national aviation system has evolved over the past seven decades to serve a vital role in the economy and our way of life. The system is complex, built on national standards with rigid quality control in all areas from the cockpit to the maintenance hangar to the air traffic control facility.

Safety is the threshold of acceptable risk. The Congress, by its authority and actions, has the greatest influence on determining our opera-

tional safety levels. Most serious accidents are attributed to flight crew error, but many factors affect the crew's ability to make the right decisions and take the right actions. Near Midair Collision Reports and a decline in accident rates for the period up to and including 1997 suggest safety has improved greatly in recent years.

FAA forecasts show continuing growth in enplaned passengers and operations in the years to come. We must continue to take advantage of available technology and human factor considerations to reduce the accident rate even further. There is a serious question that modernization of air traffic control systems can keep up with the demands of the flying public, due to the federal budget process.

Medium and small airline-served airports are having difficulty making capital improvements as a result of funding cuts in the Airport Improvement Program. New financing means must be found or a restoration of federal funding is needed to meet the demands of the future.

References

Hinson, David, FAA Administrator. Speech to *Technology and The Flight Deck Symposium*, August 5, 1997. Vancouver, B.C.