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AIR TRAFFIC CONTROL

Role of FAA's Modernization Program in Reducing Delays and Congestion

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Madam Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss the Federal Aviation Administration's (FAA) modernization of the nation's air traffic control (ATC) system and its relationship to the initiatives under way to address the escalating crisis of insufficient capacity facing the aviation industry. During the past two summers, major delays and congestion at our nation's airports have focused attention on the increasing gap between the demand for and the capacity of the national airspace system (NAS). The NAS includes the airports, other facilities, equipment, and people involved in providing air transportation services. The ATC system is the major component of the NAS and primarily refers to the equipment, technologies, and people responsible for keeping aircraft safely separated. Reducing delays and congestion in the NAS is a major challenge because the causes as well as the solutions are numerous and interconnected.

As policymakers assess potential options for increasing the capacity of the NAS, it is important to understand FAA's past efforts to modernize the ATC system and its ongoing initiatives to deploy new technologies. Our testimony today, based largely on work that we have done on FAA's modernization over the past decade, will highlight (1) the extent of the delay and congestion problems and the contribution of the ATC system to them, (2) the progress and problems encountered in FAA's ATC modernization program, and (3) the importance of a continued focus on delivering ATC equipment and on human capital issues as policymakers seek to address delays and congestion. In summary:

- The NAS is facing significant capacity problems. Last year, more than 1 out of every 4 flights nationwide was canceled, delayed, or diverted. These actions affected 163 million passengers, who, on average, were delayed almost an hour. Demand is still growing; FAA forecasts nearly a 59-percent increase in passenger enplanements from 1999 to 2011. Inefficiencies in the ATC system contribute to the delays and congestion. Other factors, such as an insufficient number of runways at some airports and bad weather, aggravate these problems. Modernizing equipment, along with other changes in the ATC system, is expected to help increase the capacity of

the NAS by between 5 and 15 percent. In addition to this effort, FAA and the aviation industry have over 50 initiatives in various stages of implementation to address delays and congestion.

- Twenty years ago, FAA anticipated significant increases in the nation's air traffic and embarked on an ambitious modernization program to help improve the efficiency of the ATC system and expand the capacity of our nation's airspace. Although air traffic has greatly increased, the improvements expected from this modernization program have fallen short. While FAA has installed new equipment to provide the necessary platform for fielding modern technologies to improve efficiency, this effort has experienced cost, schedule, and performance problems. As part of this program, FAA has begun to deploy new technologies to achieve free flight, which will enable pilots and controllers, under certain circumstances, to select optimal flight paths, thereby lowering costs and helping to accommodate more flights in our nation's airspace. However, FAA faces challenges in implementing these technologies. These include integrating the technologies with each other and other ATC systems to achieve the synergies anticipated, as well as determining the impact of using the free flight technologies on users, including controllers and technicians. Other major modernization projects being developed to help increase the capacity of the NAS are also experiencing cost, schedule, and performance problems.

- FAA and the aviation industry recognize the interdependence of the various components of the NAS—the people, equipment, and procedures—and the need for cooperation and coordination to effectively implement solutions. In the future, FAA's modernization program will continue to be an important part of the solution; therefore, FAA needs to avoid repeating the past mistakes that have plagued its program. Although FAA has taken steps to help ensure that it can deploy new equipment and technologies as planned, it has yet to fully institute a performance-oriented culture, which is essential to establishing a climate of accountability and coordination throughout the agency. The new chief operating officer, who will be responsible for improving the delivery of air traffic services, should greatly help the

agency establish this climate. FAA and the aviation industry will also need to address human capital issues related to the retirement, expected within the decade, of many aviation industry professionals, such as FAA controllers and airline mechanics.

Background

The National Airspace System (NAS) is a complex collection of systems, procedures, facilities, aircraft, and people. Because these components are interconnected and interdependent, they must work together as one system to ensure safe operations. The principal component of the NAS is the air traffic control (ATC) system—a vast network of radars; automated data processing, navigation, and communications equipment; and traffic control facilities.[1] Through this system, FAA provides such services as controlling takeoffs and landings and managing the flow of traffic between airports.

Faced with a rapidly growing volume of air traffic and aging equipment to control it, FAA initiated an ambitious program in 1981 to modernize its ATC system. Over the past two decades, FAA's modernization projects have experienced substantial cost overruns, lengthy delays, and significant performance shortfalls. Because of the size, complexity, cost, and problem-plagued past of FAA's modernization program, we have designated it a high-risk information technology investment since 1995.[2]

In 1998, in collaboration with the aviation industry, FAA revised its approach to NAS modernization to move from its traditional system of air traffic control, with heavy reliance on procedures, to a more collaborative system of air traffic management. FAA

[1]FAA uses three types of facilities to control traffic. Airport towers direct traffic on the ground, before landing, and after takeoff within 5 nautical miles from the airport and about 3,000 feet above the airport. Terminal radar approach control facilities sequence and separate aircraft as they approach and leave airports, beginning about 5 nautical miles and ending about 50 nautical miles from the airport and generally up to 10,000 feet above the ground. Air route traffic control centers, called en route centers, control planes in transit and during approaches to some airports. The airspace that most en route centers control extends above 18,000 feet for commercial aircraft.

[2]FAA's modernization program is one of four high-risk system development and modernization efforts. See *High-Risk Series: An Overview* (GAO/HR-95-1, Feb. 1995), *High-Risk Series: Information Management and Technology* (GAO/HR-97-9, Feb. 1997), *High-Risk Series: An Update* (GAO/HR-99-1, Jan. 1999), and *High-Risk Series: An Update* (GAO-01-253, Jan. 2001).

has begun testing some of the technologies—or tools--under this new environment, known as free flight, which are intended to help improve safety and increase the efficiency of the NAS. Despite some unresolved challenges, FAA has been moving aggressively to complete the initial deployment of these technologies by 2002.

Measuring the capacity of the NAS and achieving its most efficient use are both difficult challenges because they depend on a number of interrelated factors. The capacity of the NAS is affected by such factors as the number and type of aircraft seeking access, weather conditions, flight schedules, and airports' infrastructure. Achieving the most efficient use of the NAS is largely contingent on the procedures FAA uses to manage traffic, how well its equipment performs, and the proficiency of the controllers to efficiently use this equipment to manage traffic. Under the best of circumstances, capacity usually meets the demands for service. But, as we have experienced all too often, whenever any factors diminish capacity, congestion and delays result.

The National Airspace System Is Experiencing Significant Capacity Problems

The growing demand for air travel has fully taxed the capacity of the NAS, including the ATC system. Airline passengers are experiencing increasing flight delays and cancellations from the growing imbalance between their demands and the ability of the NAS to handle air traffic. Last year, more than 1 out of every 4 flights nationwide was canceled, delayed, or diverted. These actions affected 163 million passengers, who, on average, were delayed almost an hour. FAA reported that 1.9 million passengers moved through the system daily, and it forecasts a 59-percent increase in the number of enplanements between 1999 and 2011. Delays and cancellations are also increasing. In 2000, which was the worst year on record, FAA reported a 90-percent increase in delays and a 104-percent increase in cancellations compared with 5 years ago. The imbalance between demand and capacity is most pronounced during peak flying periods at the major airports through which major airlines route their flights, commonly referred to as hub airports.

Inefficiencies in the ATC system, along with the lack of adequate airport infrastructure, airline scheduling practices, and bad weather are among the many factors contributing to delays and congestion. Some in the aviation industry have also attributed delays to antiquated ATC equipment. They expect the use of modern equipment to vastly expand the capacity of the NAS.

While acknowledging inefficiencies in the ATC system, particularly in moving traffic in and out of the congested airspace around airports, FAA disagrees with the assertion that aging equipment is to blame for delays. The agency maintains that in recent years, it has replaced the majority of the equipment at many of its air traffic control facilities. While it is true that much of the equipment, especially in the en route centers is modern, this equipment was expected to be in place much earlier. As for the expectation that ATC modernization will bring major gains in capacity, FAA estimates that new equipment, coupled with changes in design and operating procedures for the airspace, will increase the number of flights nationwide that can be handled safely between 5 and 15 percent. FAA estimates that the biggest gain in capacity—between 50 and 55 percent—will come from adding new runways. While gains attributable to modernization are not as great as some may have expected, the agency nevertheless acknowledges that they are important and that it must take action to achieve them.

In this regard, in April 2001, FAA announced a set of initiatives in its *Operational Evolution Plan*, which is designed to increase capacity in the NAS. The agency, in cooperation with the aviation industry, is planning improvements in designing airspace and aircraft routes and deploying new technologies, among other actions, to permit more efficient movements and eventually allow more aircraft to move safely in the NAS. This plan complements the April 2001 benchmarks of capacity for the nation's 31 busiest airports. Since over 70 percent of the passengers move through these airports, the benchmarks allow policymakers to target short- and long-term solutions at these airports, thereby achieving the biggest increases in capacity. The aviation industry has also taken steps to address the capacity crisis. For example, a few of the major airlines have individually adjusted their flight schedules to even out peaks and have adjusted

flight times throughout their system to more accurately reflect gate-to-gate departure and arrival times. Collectively, FAA and the aviation industry have over 50 initiatives to help improve the capacity of the NAS in various stages of implementation. We are reviewing the status of these initiatives and expect to report on them in the fall of 2001.

FAA Has Fielded Some New Equipment and Technologies, but Several Key Efforts Still Face Problems

Over the past two decades, FAA has encountered numerous problems in its ambitious ATC modernization program to acquire new facilities, replace old equipment, and introduce new technologies. Although FAA replaced the hardware for the HOST computer system[3] as scheduled in 1999 to preclude potential Year 2000 problems, many major modernization projects are years behind schedule and cost more than anticipated. Others have met with eventual success after FAA restructured them and modified their requirements. More recently, FAA has taken a number of steps to overcome past problems with its modernization efforts.

ATC Modernization Is an Ambitious Undertaking

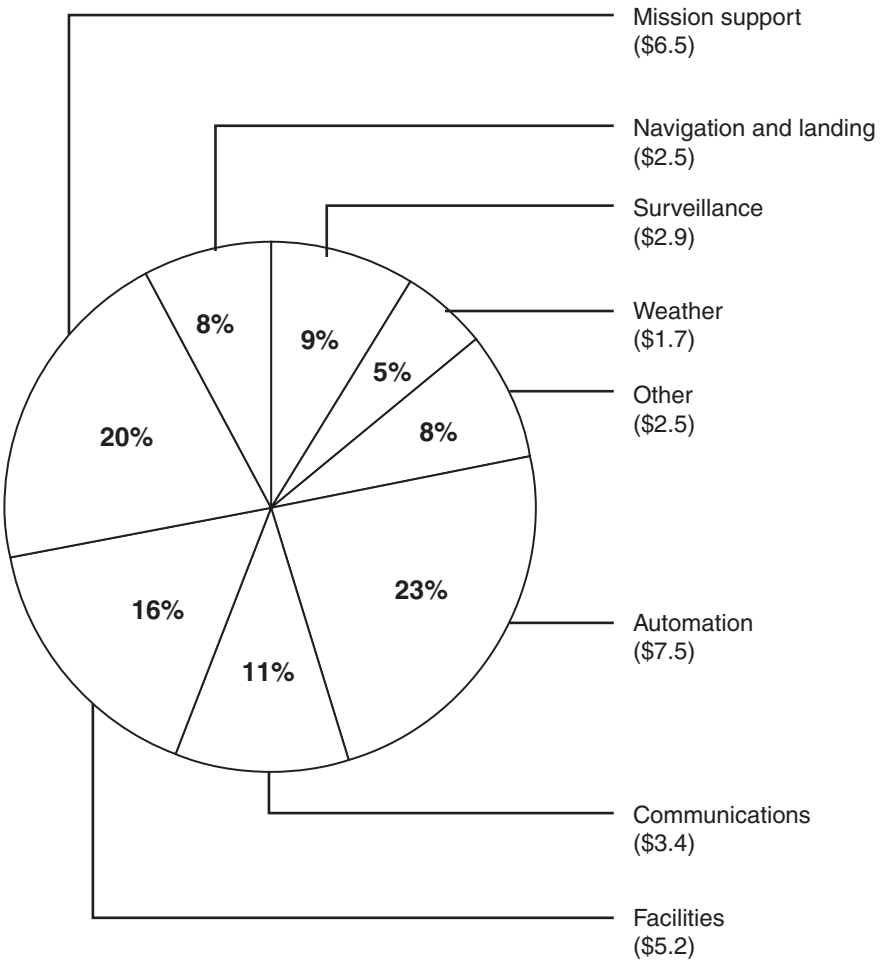
ATC modernization, which was announced in 1981 as a 10-year, $12 billion program, has expanded and is now expected to cost more than $44 billion through fiscal year 2005.[4] Of this amount, the Congress appropriated over $32 billion for fiscal years 1982 through 2001. The agency expects that approximately $12 billion will be provided for fiscal years 2002 through 2005. See figure 1 for an illustration of how FAA's appropriation was divided among seven functional areas.

[3]HOST is the en route centers' system for processing flight and radar data that is displayed on the controllers' workstations.

[4]The total cost of modernization includes appropriations for all actual and projected facilities and equipment from fiscal year 1982 through fiscal year 2005 for projects in FAA's financial plan.

Figure 1: Air Traffic Control Modernization: Funding by Functional Areas, Fiscal Years 1982-2001

Dollars in billions



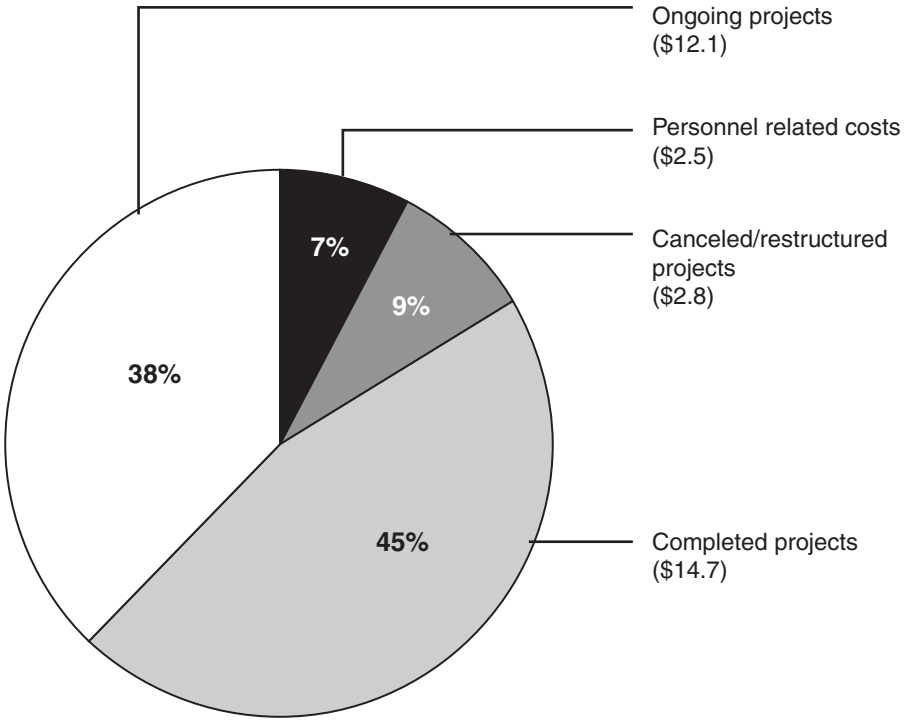
Source: FAA.

Figure 2 illustrates how FAA's appropriation was divided by project status—completed projects, ongoing projects, canceled or restructured projects, and personnel-related costs.

Figure 2: Air Traffic Control Modernization: Funding by Project Status, Fiscal Years 1982-2001

Dollars in billions

(Percentages may not add due to rounding.)



Source: FAA.

FAA Has Had Mixed Success in Deploying Key Automation Projects Essential to Free Flight

A key part of FAA's modernization program is replacing old equipment that processes radar and other data and displays this information on controllers' workstations. This

new equipment forms a platform that is essential for FAA to deploy the new technologies that automate many of the controllers' functions. Eventually, the synergies of these technologies will enable FAA to transition from air traffic control to air traffic management, which will allow more aircraft to safely use the NAS. The agency estimates that this new equipment and related technologies will help achieve an increase of between 5 and 15 percent nationwide in the number of flights that can be safely handled when coupled with changes in the design and operating procedures for the NAS.

After restructuring the Advanced Automation System—the centerpiece of its original modernization program—and modifying its requirements, FAA deployed the Display System Replacement (DSR) project to all 20 en route centers in 2000.[5] However, another project from the restructured centerpiece that will deploy similar equipment in terminal facilities has encountered major cost, schedule, and performance problems. As a result, while FAA has not established a new schedule to deploy this equipment—the Standard Terminal Automation Replacement System (STARS)—it has indicated that the project's development cost will increase by nearly $500 million over its original 1994 estimate of $940 million.

To help mitigate problems with the modernization program, in 1998, FAA began a phased approach, known as free flight and has begun to deploy some new technologies. FAA has been demonstrating and measuring the operational effectiveness of five technologies in phase 1 of free flight.[6] To date, the surface movement advisor and collaborative decision making tools have been successfully completed. With regard to the remaining three, demonstrations have shown that two of these—URET and TMA—have the potential to provide benefits despite some technical challenges. Because the third tool—

[5]The Advance Automation System was designed to provide, among other things, new workstations for controllers and related hardware and software. In 1994, FAA restructured the project after the estimated cost had tripled, capabilities were shown to be significantly less than promised, and delays were expected to run nearly a decade. DSR is the en route workstation that graphically displays, on the controller's screen, the flight plan and radar data processed by the HOST computer.

[6]The five tools being demonstrated in phase 1 (1998-2002) are collaborative decision making, surface movement advisor, passive final approach spacing tool (pFAST), traffic management advisor (TMA), and user request evaluation tool (URET). Under phase 2 (2003-2005), FAA will deploy certain tools to other locations.

pFast—has encountered significant technical challenges and FAA is still developing STARS—the infrastructure that provides the platform for this tool—the agency decided not to extend deployment of this tool to additional facilities in phase 2.

In 1998, as FAA and industry were planning for the deployment of free flight technologies, we found that FAA faced many challenges in implementing them.[7] Among these challenges were the need for FAA to address outstanding issues related to technology development and deployment, such as addressing the impact of modernization on users, principally controllers, and integrating various technologies that will be used under free flight operations with one another as well as with other ATC systems. Our preliminary findings and those of others indicate that FAA still has not fully addressed these and other challenges.

With respect to determining the impact of free flight tools on controllers, FAA has not established a clear plan for conducting these assessments. We agree with FAA, NASA, and air traffic controllers that using free flight tools will change the roles and responsibilities of controllers—necessitating a major cultural change. For example, using the TMA tool will require controllers to move from a common method of separating traffic according to distance, which relies more on controllers' judgment, to a method using time, which is more dependent on automated technology. The traditional method results in less efficient use of the airspace because controllers often add distance between planes to increase the margin of safety. Under the newer method of separating traffic, computers will help controllers balance the arrival flow into terminal airspace by assigning a certain time for an aircraft to reach a predetermined point. FAA acknowledges that transitioning to the new method will take time, but has yet to develop a strategy, including detailed training, to help ensure its success.

To allow FAA and users to fully exploit the capabilities of free flight technologies and achieve expected improvements in safety, capacity, and efficiency, FAA needs to

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[7]See *National Airspace System: FAA Has Implemented Some Free Flight Initiatives, but Challenges Remain* (GAO/RCED-98-246, Sept. 28, 1998).

integrate the technologies with one another and with other major ATC systems. Free flight technologies are expected to improve the efficiency of operations at high altitudes, close to the terminal, and on the ground. While these technologies are generally designed to operate independently of one another during phase 1, FAA plans to begin integrating them during phase 2 to achieve their collective synergies. However, FAA still needs to integrate URET with other major ATC systems, including FAA's HOST, DSR, and local communications networks. This integration is key to fully realizing increases in controllers' productivity. Compounding the complexity of integration, FAA has been simultaneously upgrading the HOST and DSR software to increase their capabilities. How well URET will work with these systems is unknown because FAA has yet to fully test this tool with them. FAA has developed some of the software needed for integration and has begun testing the URET software. By the end of August 2001, FAA expects to complete full testing of URET software in conjunction with major ATC systems. Testing may uncover the need for additional software modifications, which could increase costs and could cause the agency to defer planned capabilities.

FAA Has Also Had Problems in Deploying Other Equipment and Technologies

FAA recognizes the importance of projects in three other functional areas—communications, navigation and landing, and weather—to increase the capacity of the NAS without compromising safety. After major delays, the agency has deployed equipment in these areas. For example, FAA has replaced the voice system used by controllers in the en route centers to communicate with other controllers and with pilots. The agency has also installed a weather radar that alerts aircraft in the terminal area of hazardous weather conditions, such as microbursts, gust fronts, and precipitation. However, projects in these three areas, which have been under development since the 1980s, have continued to experience numerous technical problems.

In communications, FAA has been developing a way to transition from voice to data link communications to keep pace with the demand for ATC services, improve controllers'

productivity, and reduce errors in voice communications. The agency has not finalized the cost for the data link project but estimates that it will be at least 2003 before it will provide limited capability in this area. To improve navigation, FAA has been developing a way to transition from a ground-based to a satellite-based navigation system using the Department of Defense's Global Positioning System. Originally, FAA intended to have the initial system operational by 1997; now FAA estimates that this system will be available by 2003, but with less capability. To reduce en route air traffic delays caused by severe weather, FAA has been developing a system to consolidate weather data from several sources and provide this information at a single, integrated workstation. Although FAA had planned to complete a similar project by 1991, FAA now estimates that it will complete the initial deployment of this project by the end of 2002.

Because of the critical link of the projects noted above to current and planned efforts to safely expand the capacity of the NAS, future delays could have a negative impact on these efforts. For example the Automatic Dependent Surveillance Broadcast, a technology that is intended to provide pilots with precise information about the location of other aircraft in the NAS, depends on FAA's satellite-based navigation system to assure them that the position information they receive from satellites is accurate. This satellite-based system also has the potential to help pilots and controllers prevent accidents on the ground at airports. Continued delays in FAA's satellite navigation program could place deployment of important features of this new surveillance technology in jeopardy.

A Continued Focus on ATC Modernization and Human Capital Issues Is Important for the Aviation Community to Expand NAS Capacity

Because of the interconnection and interdependence of key components of the NAS, assessing solutions to the capacity problem is complex. FAA and aviation industry leaders recognize that most proposed solutions cannot be implemented in isolation and therefore must be carefully coordinated to help ensure successful implementation as well as mitigate the risks of potential unintended consequences. While not the sole

solution to the delay and congestion problem, FAA's modernization program is nonetheless an important part of the solution. Its success affects future projects and the deployment of new technologies to expand the capacity of the NAS. Furthermore, as policymakers assess options, it is important to consider whether human capital needs, such as succession planning, are being adequately addressed.

FAA Has Taken Steps to Address Modernization Problems, but Must Hold Individuals Accountable and Ensure That They Coordinate Their Actions

Despite efforts to address its modernization problems, FAA still faces problems in instituting an organizational culture that is accountable for outcomes and encourages individuals to work together as coordinated teams to achieve them. Over the past couple of years, FAA's increased collaboration with the aviation industry and its phased approach to modernization have been positive developments and have allowed FAA and the industry to target specific problems and together develop initiatives to solve them. However, according to our work and that of others, FAA has not fully instituted the performance-oriented culture that is a key to the success of modernization and other agencywide efforts.

The Congress and the aviation community have noted that FAA lacks accountability for delivering key modernization projects. Recently, the FAA Administrator has taken steps to assign specific accountability to individuals who head major offices and to develop agreements to link these individuals' performance to outcomes. Most likely, the accountability and expectations for achieving outcomes will be pushed to managers at lower levels within FAA to increase the likelihood that these employees will collaborate as teams to achieve outcomes. Such action would be in contrast to the current situation where major offices still tend to function in stovepipes that inhibit an integrated team approach to developing and delivering systems. FAA has identified this integrated team approach as key to the agency's efforts to deploy systems that meet performance goals.

To increase accountability for delivering air traffic services, in 2000, the Congress created the position of chief operating officer.[8] This individual will be responsible for ATC modernization as well as other agencywide activities and services related to air traffic. Subsequently, in December 2000, the administration directed FAA to establish a performance-based organization that would encompass all of FAA's functions related to air traffic. FAA is in the process of establishing this organization, to be headed by the chief operating officer. This increased attention to accountability, coupled with changes under way in the performance management system to link pay to performance, are very positive signs for FAA and should go a long way toward establishing a climate in which individuals throughout the agency are held accountable for specific outcomes.

FAA and the Aviation Industry Will Need to Take Steps to Ensure an Adequate Supply of Well-Trained Aviation Professionals

If steps are not taken now to plan for succession, the retirement of critical personnel responsible for the safe and efficient operation of the NAS in the coming decade could negatively affect the ability of FAA and others to meet future demands for air service. Many of the controllers hired after the 1981 strike are approaching retirement eligibility. While estimates of retirements vary, it is generally agreed that by 2010, at least 40 percent of the current controller workforce will be eligible to retire. The retirement of large numbers of controllers in a relatively short time frame raises a number of issues. For example, FAA will need to determine (1) how many controllers will be needed in the future to control traffic, given increased demand and improved equipment; (2) how many controllers will be leaving and when; and (3) the source to supply new controllers. Addressing these issues cannot be deferred because hiring and training new controllers to be fully proficient with the latest procedures and technologies takes a significant amount of time. For example, at some of the busiest air traffic control facilities, it takes up to 5 years for a new controller to go through the training process and become "fully certified." Therefore, to ensure that it maintains an adequately staffed, well-trained controller workforce, FAA must plan well in advance for these retirements.

[8]Wendell H. Ford Aviation Investment and Reform Act for the 21st Century – P.L. 106-181, sec. 303.

Likewise, FAA and the airlines face similar challenges with maintenance technicians and aircraft mechanics, respectively, who maintain equipment used throughout the NAS. Given the critical responsibilities that these professionals fulfill, it is vital that FAA and the industry address these challenges. GAO has reviews under way to address the human capital issues surrounding succession planning for these aviation professionals.

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FAA's management of the key initiatives that it has underway, supported by industry input, will be critical to safely expanding the capacity of the NAS. Continued congressional oversight is also important to ensure that FAA meets the challenges presented by the increasing demand for air travel.

Madam Chairman, this concludes my statement. We will be happy to answer any questions from you or any Member of the Subcommittee.

Contacts and Acknowledgments

For future contacts regarding this testimony, please contact Gerald L. Dillingham at (202) 512-2834. Individuals making key contributions to this testimony include Jeanine Brady, Pete Maristch, Belva Martin, and John Noto.

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