Office of Inspector General

Observations on Federal Aviation Administration's Research, Engineering, and Development Program

Report Number: AV-1999-064
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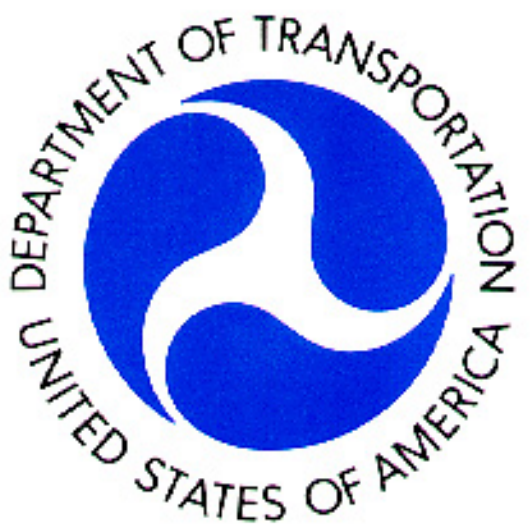

Memorandum

U.S. Department of Transportation
Office of the Secretary
Of Transportation
Office of Inspector General

Subject: INFORMATION: Observations on Federal Aviation Administration's Research, Engineering, and Development Program Report No. AV-1999-064

Date:

From: Kenneth M. Mead
Inspector General

Reply to Attn of:

To: Federal Aviation Administrator

At the request of the Chairwoman, Subcommittee on Technology, Committee on Science, we testified at the March 4, 1999 hearing on Federal Aviation Administration's (FAA) Research, Engineering, and Development (RE&D) budget request for Fiscal Year 2000. A copy of our statement is attached for your information.

As you know, research and development will be the key to improving aviation safety, providing increased capacity, and strengthening aviation security. Our statement discusses (1) changes in the way FAA finances its research and development efforts; (2) cooperation between FAA and the National Aeronautics and Space Administration (NASA) on aviation research; (3) the importance of human factors work in developing new capacity, safety, and security technology; and (4) recent changes to the Flight 2000 project, now called "Safe Flight 21."

We are encouraged by the actions FAA and NASA are taking to address recommendations in our October 8, 1998 Report (FAA/NASA Research and Development Coordination Efforts, Report Number AV-1999-008). Both agencies signed a new Memorandum of Understanding establishing a FAA/NASA Executive Committee to provide oversight of joint research efforts. In addition, FAA, NASA, and the Department of Defense are

preparing a national plan for aviation research that will be published later this year.

An important message of our statement is the need for FAA to take an active role in resolving human factors concerns in the development of new technology. Our recent work on the Standard Terminal Replacement System, Data Link, and the deployment of new explosives detection systems underscore the importance of human factors in developing and implementing new technology. Human factors work will become even more important as FAA and the aviation community transition to Free Flight and begin to use new collaborative decision-making tools.

We did not make recommendations in our statement and no reply is needed.

If I can answer any questions or be of any further assistance, please call me at (202) 366-1959 or Alexis Stefani, Deputy Assistant Inspector General for Aviation, at (202) 366-0500.

Attachment

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Before the Subcommittee on Technology,
Committee on Science,
U.S. House of Representatives

For Release on Delivery
Expected at
10:30 a.m. EST
Thursday
March 4, 1999
Report Number: AV-1999-064

Observations On FAA's Research, Engineering, and Development Program

Statement of
Alexis M. Stefani
Deputy Assistant Inspector General for Aviation
U.S. Department of Transportation

Madam Chair and Members of the Subcommittee:

We appreciate the opportunity to discuss FAA's Research, Engineering, and Development (RE&D) Program.

The RE&D Program plays an important part in developing new aviation safety, air traffic control, and security technologies. The RE&D Program has funded many new technologies, such as data link and satellite navigation, that are expected to play critical roles in improving the efficiency of the National Airspace System and transitioning to Free Flight.[1] FAA is requesting $173 million for RE&D funding in Fiscal Year 2000--an increase of about 15 percent from last year's level of $150 million.

Research and development will be key to improving aviation safety, providing increased capacity, and strengthening aviation security. FAA's new safety initiative--Safer Skies--should sharpen the focus of safety research by pointing out, through data analysis, the areas that need to be reviewed. Moreover, the transition to Free Flight will require continued research to ensure that new tools to facilitate collaborative decision-making between controllers and pilots can enhance capacity safely. Finally, while progress has been made in developing new explosives detection systems, emphasis needs to be focused on how these technologies can reach their full potential in the airport environment while keeping pace with changing threats to aviation.

Today, I would like to discuss (1) changes in the way FAA finances its research and development efforts; (2) cooperation between FAA and the National Aeronautics and Space Administration (NASA) on aviation research; (3) the importance of human factors work in developing new capacity, safety and security technology; and (4) recent changes to the Flight 2000 project.

- First, some changes have occurred in how FAA finances its research and development efforts. Last year, the Congress shifted 12 projects totaling about $52.6 million from the RE&D account into the Facilities and Equipment account, which funds the acquisition of new air traffic control systems. The funds were placed in the portion of the Facilities and Equipment account called Engineering, Development, Test, and Evaluation.[2] FAA has been funding significant amounts of development efforts for air traffic control in its

[1] Free Flight is a concept of air traffic management that permits pilots and controllers to share information and work together to manage air traffic. With Free Flight, pilots will not have to fly routes structured around ground-based navigation systems.

[2] Engineering, Development, Test, and Evaluation budget activity includes programs that have migrated from the RE&D account or programs that are in the early stages of acquisition. For example, this activity funds work on mission needs analysis and alternative design analysis.

Facilities and Equipment account for several years. In addition to the $173 million requested for Fiscal Year 2000 for RE&D, FAA is also requesting $447 million for development work in the Facilities and Equipment account.

It is important to note that FAA is seeking to make greater use of prototyping efforts to take a more incremental approach to modernizing the National Airspace System. A central tenet of this approach is the "build a little, test a little" concept of technology development and deployment. Both Safe Flight 21 and Free Flight Phase 1 (a limited deployment of core capabilities for Free Flight) reflect this thinking.

- Second, joint FAA and NASA research has produced very valuable aviation technology. For example, windshear radar technology[3] has significantly enhanced safety by alerting flight crews of hazardous weather conditions.

  With plans to expend hundreds of millions of dollars annually on aviation safety and air traffic management research over the next several years, FAA and NASA need to closely align and coordinate their research efforts. In our October 1998 report,[4] we recommended steps FAA and NASA can take to ensure both agencies' resources are used in the most cost-effective manner. These steps include: (1) re-evaluating the structure and composition of the advisory committees; (2) increasing the number of common members participating on both advisory committees; (3) adopting a joint implementation plan for aviation safety research that includes a requirement for an integrated plan; (4) ensuring adequate cross representation of agency expertise; and (5) updating the coordinating committee agreement and requiring the committee to meet regularly to resolve issues regarding joint efforts.

  FAA and NASA are taking action to address our recommendations, including a new memorandum of understanding that establishes a NASA/FAA Executive Committee to provide oversight of joint efforts and the pending publication of a national plan for aviation research with the Department of Defense (DOD).

- Third, our work on the Standard Terminal Automation Replacement System (STARS), data link, and the deployment of new explosives detection systems underscores the need for FAA to take an early and active role in resolving human factors in the development of new technology. History has shown that

[3] Windshear is an abrupt change in wind direction and/or velocity that may occur in any type of weather. It is particularly dangerous to landing or departing aircraft. Windshear radar alerts flight crews of a windshear event up to 90 seconds before the aircraft flies into it, giving flight crews the time needed to prepare and avoid hazardous situations.

[4] Report on FAA/NASA Research and Development Coordination Efforts (OIG Report Number AV-1999-008, October 8, 1998).

inadequate attention to human factors early in the design of new technology can result in costly delays and design changes. It is clear that human factors will become even more important as FAA and the aviation community transition to Free Flight.

FAA must continue to implement a process that integrates a structured, scientific human factors discipline throughout the acquisition process. Once potential solutions have been identified, FAA must determine the impact on a program's cost and schedule. We recognize that the toughest decision is determining when "enough is enough". To help make these decisions, we recommended that FAA develop exit criteria and strategies that help to determine which solutions to implement and when.

- Finally, FAA has revised and renamed the Flight 2000 effort and changes in program content and test locations have taken place. The Flight 2000 project, as originally envisioned, was controversial, lacked industry support, and was estimated to cost $388 million. The new project, called "Safe Flight 21", is intended to test and validate technologies required for Free Flight. Safe Flight 21 focuses on 9 operational enhancements, such as display of terrain in the cockpit, that offer important safety benefits. As part of this initiative, FAA is working with cargo airlines to test a new surveillance technology in the Ohio Valley that is expected to provide more accurate aircraft position reports for use by controllers and pilots. FAA is requesting $16 million for Safe Flight 21 for Fiscal Year 2000.

BACKGROUND

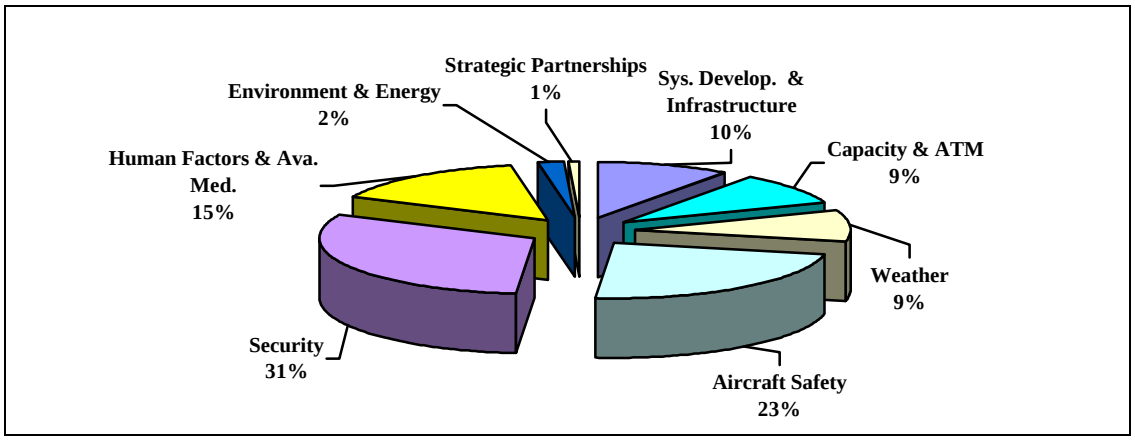
FAA's mission is to provide a safe, secure, and efficient aviation system that contributes to national security. FAA's RE&D Program develops and validates the technologies, systems, designs, and procedures required for the agency's full range of operational and regulatory activities. These activities include, but are not limited to, the acquisition of new technologies; air traffic services; certification of aircraft, airports, and personnel; civil aviation security; and development of environmental standards for civil aviation. FAA relies on other organizations, such as NASA and DOD to provide basic research, while it focuses on applications for civilian aviation.

FAA'S FISCAL YEAR 2000 REQUEST FOR RE&D

For Fiscal Year 2000, FAA is requesting $173 million for RE&D, an increase of about 15 percent over last year's spending level of about $150 million. About 27 percent of the funds are used in-house by FAA researchers, while the remaining money is spent on research efforts of FAA contractors and other Government

agencies. As we will discuss later, NASA also makes substantial investments in Aviation Safety (including weather research) and Air Traffic Management. Figure 1 shows FAA's RE&D financial plan for Fiscal Year 2000.

Figure 1: FAA's RE&D Budget Request for Fiscal Year 2000



Source: FAA's Fiscal Year 2000 Budget Submission

As Figure 1 shows, a little over half of FAA's RE&D budget request for Fiscal Year 2000 is for Aircraft Safety and Security. However, we note that of the 455 staff positions funded by RE&D,[5] 140 are for Aircraft Safety and 128 are for Human Factors and Aviation Medicine (58.9 percent combined). (Attachment I provides information on FAA's RE&D budget activities for Fiscal Years 1998 through 2000.)

The largest single aircraft safety effort continues to focus on aging aircraft ($15.9 million). FAA is developing, among other things, new systems to detect corrosion and small structural cracks in aircraft skins. FAA is also requesting $26 million for Human Factors and Aviation Medicine, $15.7 million for Weather projects, and $17.2 million for System Development and Infrastructure. FAA is requesting $16 million for one Capacity and Air Traffic Management project called Safe Flight 21.

Another important highlight of FAA's request is the continued investment in new security technology. FAA is requesting $53 million in Fiscal Year 2000 for research and development on System Security, which includes work on explosives and weapons detection. *This is in addition to $98 million in the agency's*

[5]RE&D staff estimates are based on Full Time Equivalents (FTE). Per Office of Management and Budget Circular A-11, an FTE is the total number of hours worked (or to be worked) divided by the number of compensable hours applicable to each fiscal year.

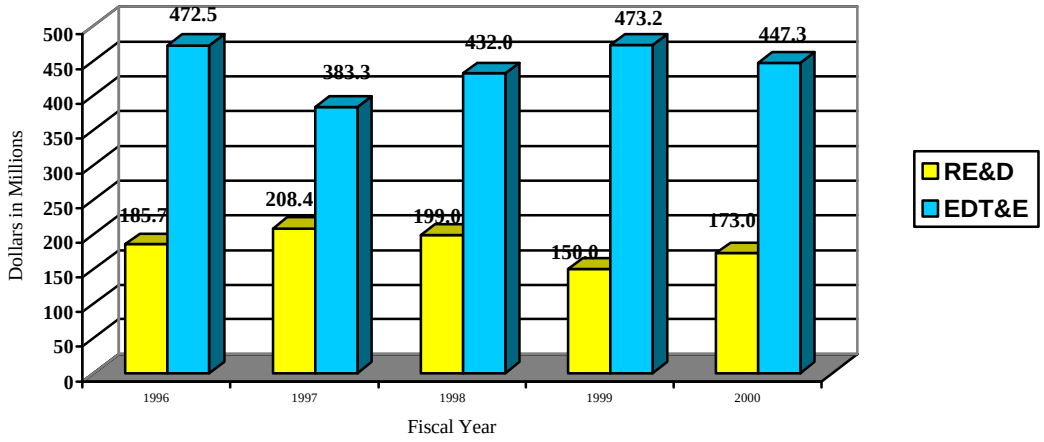
Facilities and Equipment request for the continued deployment of new explosives detection systems for screening passengers and bags at the Nation's airports.

Last year, Congress shifted 12 activities[6] totaling $52.6 million from the RE&D account to the Engineering, Development, Test, and Evaluation (EDT&E) category of the Facilities and Equipment account. Eleven of these activities are now called "Advanced Technology Development and Prototyping" activities in the Facilities and Equipment account. These include projects to develop and implement satellite-based navigation technology. Congress moved these activities because they fit more closely in the Facilities and Equipment account and management could be improved if they were funded together. [7]

FAA has historically conducted considerable research and development, totaling millions of dollars annually, through its Facilities and Equipment account for purchasing new air traffic control systems. In addition to the $173 million in RE&D requested for Fiscal Year 2000, FAA is requesting $447 million in its Facilities and Equipment account for EDT&E. FAA's Free Flight Phase 1 is funded through this account. Figure 2 illustrates the recent history of the relationship between the two accounts.

Figure 2: Budget Trends--RE&D and EDT&E

(Fiscal Years 1996 - 2000)



Source: OIG Analysis of FAA Data

[6]The 12 activities are Oceanic; Traffic Flow Management; Runway Incursion; System Capacity, Planning and Improvements; Cockpit Technology; General Aviation and Vertical Flight Technology; Operations Concept Validation; Software Engineering; Communications; Navigation; Surveillance; and Airport Technology.

[7] House of Representatives Report 105-648, dated July 24, 1998.

It is important to note that FAA is seeking to make greater use of *prototyping* efforts to take a more incremental approach to modernizing the National Airspace System. A central tenet of this approach is the "build a little, test a little" concept of technology development and deployment. This is intended to limit development efforts to a manageable scope, identify risks, and deploy technologies *before* they reach their full maturity. Both Safe Flight 21 and Free Flight Phase 1 reflect this thinking.

FAA also relies on the aviation-related research and development conducted by DOD, NASA, and National Oceanic and Atmospheric Administration.

FAA AND NASA CAN TAKE STEPS TO IMPROVE COORDINATION

FAA and NASA joint research efforts have a major impact on the future of aviation safety, and on airspace and airport capacity. These joint efforts include research in areas such as aircraft structures, human factors, simulation modeling of the air traffic control system, and weather. Both FAA and NASA support the national safety goal to reduce the fatal aviation accident rate by 80 percent in 10 years and goals to increase the capacity and efficiency of the National Airspace System.

In addition to FAA's research and development efforts, NASA plans to spend $608 million on aviation research over the next 4 years. We note that NASA expects to spend about $53 million for Weather Accident Prevention as part of its safety research. Table 1 summarizes planned NASA investments in Aviation Safety and Air Traffic Management research and development for Fiscal Years 1999 to 2002.

TABLE 1: NASA FUNDING FOR AVIATION RESEARCH

(Dollars in millions)

	Appropriation	Budget Projections		
Fiscal Year	**1999**	**2000**	**2001**	**2002**
Aviation Safety Technology	$ 70.3	$ 90.6	$ 99.5	$ 96.6
Aviation Systems Capacity (Air Traffic Management)	$ 53.9	$ 60.0	$ 59.2	$ 77.6
Totals	$124.2	$150.6	$158.7	$174.2

Source: NASA Office of Aeronautics and Space Transportation Technology

While FAA and NASA share a common mission and some aviation safety and air traffic management goals, the two agencies have different research roles. FAA's research is generally short-term to refine existing technology, systems, designs, and procedures that directly support its operational and regulatory responsibilities. NASA, on the other hand, conducts primarily basic scientific research that provides long-term research and development in aeronautics and related technologies.

In other words, NASA investigates and demonstrates concept feasibility and possible application of the technology for civil aviation. FAA then carries the project forward from pre-production prototype development to full-scale development and deployment in the National Airspace System.

We recognize that FAA and NASA have different and evolving roles, and separate approaches to achieving shared goals. This makes it critical that the two agencies have a clear agreement on how the research undertaken can meet the demands of a growing air transportation system and improve the margin of safety.

Last year, we conducted a review with NASA's Inspector General to examine the effectiveness of FAA and NASA efforts and how well work was coordinated. NASA and FAA coordinate research through memorandums of understanding/agreement and through a series of committees. We identified five areas where FAA and NASA can take action to enhance efforts and help ensure agency research resources are used in the most cost-effective manner. We recommended that FAA and NASA:

- Re-evaluate the advisory committee structure and modify, where appropriate, the number and composition of the committees and subcommittees.

- Increase the number of common members participating on both advisory committees.

- Adopt a joint implementation plan and a formal agreement for aviation safety research that includes a requirement for an integrated plan.

- Ensure adequate cross representation of agency expertise at each agency's headquarters, key research facilities, and task force activities.

- Update the coordinating committee agreement and require the committee to meet regularly to resolve, in a timely manner, issues regarding FAA and NASA joint research efforts.

FAA and NASA are taking steps to address our recommendations and ways to implement them. In October 1998, FAA and NASA signed a new memorandum of understanding that establishes a joint NASA/FAA Executive Committee to provide executive direction and oversight of joint efforts. In addition, FAA, NASA, and DOD are working on a national plan for aviation research, which is expected to be complete in April 1999. The plan includes roadmaps for integrating research to achieve national aviation goals.

FAA and NASA plan to enter into a formal agreement for aviation safety this spring and the agencies are on track for having an integrated aviation safety research plan in Fiscal Year 2000. Also, NASA has filled a position at FAA Headquarters, now participates on RTCA[8] subcommittees addressing Free Flight, and is a member of the FAA/EUROCONTROL Research and Development Committee.

HUMAN FACTORS ARE CRITICAL

Human factors play a critical role in developing new technology. Our work on STARS, data link, and new explosives detection equipment underscores the need for an effective process to identify and resolve human factors concerns.

STARS

Our work on STARS has shown the need for FAA to incorporate human factors work in all acquisitions. STARS is a critical modernization project that will replace displays, software, and computers at over 170 terminal air traffic control facilities at a cost of $940 million. STARS was designed to provide the platform necessary to support future software and hardware enhancements, such as data link.

Overall, STARS has experienced considerable cost growth and schedule delays. In September 1998, FAA informed the Congress that an additional $293 million could be needed to complete the program. This amount includes over $190 million for changes to the system's computer-human interface. The STARS schedule continues to be impacted by the software development needed to resolve human factors concerns. FAA will not meet its schedule for initial operation of the Early Display Configuration[9] of STARS at Ronald Reagan Washington National Airport as originally planned.

[8] RTCA is a not-for-profit corporation that functions as a Federal Advisory Committee and develops consensus-based recommendations on contemporary aviation issues.

[9] Early Display Configuration of STARS consists of new controller displays and maintenance workstations using the existing Automated Radar Terminal System's computer processors and software.

An important lesson from the STARS program is that FAA must develop a process to integrate a structured, scientific human factors discipline throughout the acquisition process. Human factors evaluations must be performed early and throughout the entire acquisition process. As the National Research Council notes:

> "…good human factors is a 'pay now or pay more later' proposition. By the time the system reaches late stages of development or testing, major design commitments have been made, resources have been spent, and there is reduced motivation to discover design flaws that threaten deployment schedules."[10]

To avoid 11th hour rework, controllers and maintenance technicians need to be involved early and throughout the design and development of new air traffic control systems. Once potential solutions have been identified for human factors concerns, FAA must determine the impact on a program's cost and schedule and make the tough decisions on when to implement solutions. We recognize that the toughest decision is determining when "enough is enough". To help make these decisions, we recommended that FAA develop exit criteria and strategies to make informed decisions.

The need for human factors evaluations will become more critical as FAA begins to add the collaborative decision-making systems needed for Free Flight. Under Free Flight, the controller's role could significantly change from a decision-making and communications role to a collaborative and monitoring role.

The design of collaborative decision-making systems that controllers will use in this new role must be carefully evaluated for human factors in order for these systems to be safe and effective. FAA recognizes that much research needs to be conducted with respect to Free Flight, and intends to focus on, among other things, guidelines to support collaborative decision making for all airspace users.

Data Link

The human factors issues with data link communications for controllers and pilots have important safety implications, and represent one of the biggest challenges facing the implementation of the technology.[11] Because voice communications play such a large role in current controller and pilot interactions, experts agree that

[10]National Research Council, The Future of Air Traffic Control: Human Operators and Automation, Washington, D.C., National Academy Press, 1998.

[11] For additional details on Data Link, see FAA's Progress and Plans for Implementing Data Link for Controllers and Pilots (OIG Report Number AV-1999-057, Feb. 24, 1999).

data link, which is analogous to electronic mail, will fundamentally change the way controllers and pilots communicate with each other.

An important workload related issue is how controllers and pilots will use two distinct communications systems (voice and data link) to share important information. Controllers will be expected to handle both data link and non-data link equipped aircraft in the same airspace. Similarly, pilots will fly in and out of airspace where data link is not universally used. This also has implications for the controller workforce and will likely require close coordination between labor and management.

The amount of "*head down*" time required of pilots and controllers to compose and send, or read and respond to data link messages is a concern. "Head down" refers to the time a controller's or pilot's attention is diverted from primary tasks. For the pilot, there is concern that responding to data link messages will impact time spent on primary flight duties and monitoring the instrument panel.

Another concern is the loss of *"party line"* for pilots. With the existing voice communication system, pilots can tune to a particular frequency to hear air traffic control instructions to, and pilot responses from, other aircraft. For example, a pilot can benefit from hearing that an aircraft ahead encountered turbulence or was placed into a holding pattern. Since data link messages are delivered to individual aircraft, there is concern that data link will deprive pilots of important information pertaining to surrounding airspace.

Early and continued involvement by pilots and controllers in these human factors efforts is essential. We recommended that FAA focus attention and resources on (1) new air traffic control procedures for using data link, (2) controller and pilot training programs, and (3) the design of new data link equipment for displaying and sending messages. FAA's joint research and development work with NASA (Cockpit Automation) and DOD (Team Performance and Decision Making) can help FAA and industry efforts to implement data link.

New Explosives Detection Equipment

FAA and the industry continue to deploy significant numbers of new explosives detection equipment at airports for screening passenger bags. This is the first large-scale deployment of sophisticated explosives detection equipment at the Nation's airports. Congress provided $144 million for this effort in Fiscal Year 1997, $13.6 million in Fiscal Year 1998, and $100 million in Fiscal Year 1999. FAA is requesting an additional $98 million for Fiscal Year 2000.

Last year, we reported on progress and problems experienced with deploying new explosives detection systems.[12] FAA and industry have found that integrating new explosives detection systems with day-to-day operations is more complex than first imagined.

The human factors issues associated with the new equipment cannot be underestimated. FAA believes--and we agree--that screeners (operators of the new equipment) are absolutely critical in improving security. FAA test results indicate that the equipment can correctly identify a potential threat but an operator can make a wrong decision and "clear" the bag. Technology is not a panacea--effective security rests on a careful blend of procedures, technology, and well-trained security personnel. Continued human factors work, particularly on the selection and training of security personnel (who operate new devices) and data collection and analysis of operator performance, is needed to ensure that new security technology can meet current and future threats.

RECENT CHANGES TO THE FLIGHT 2000 PROGRAM

Over the past year, FAA has revised the scope and direction of the Flight 2000 Program. In February 1997, FAA announced an initiative called Flight 2000 to test and validate technologies required to support Free Flight, including new satellite-based technologies for communications, navigation, and surveillance. Tests were planned for Alaska and Hawaii. The Flight 2000 program, as originally conceived, was controversial and did not enjoy wide industry support. FAA estimated that Flight 2000 would cost $388 million. Industry voiced concern about the scope of the project and questioned whether lessons learned in Alaska and Hawaii would transfer well to operations in the continental United States. Because of industry concerns, Congress prohibited FAA from spending funds on Flight 2000 in Fiscal Year 1998.

To address these concerns, FAA undertook a collaborative effort with stakeholders through RTCA--an advisory body to FAA--to restructure the program. This effort resulted in a revised program with a new name--Safe Flight 21. The demonstration program will now take place in the Ohio Valley and Alaska and focus on nine operational enhancements. FAA and industry will test new communications, navigation, and surveillance technologies as well as their integration with pilot and controller information displays.

[12] Aviation Security: Federal Aviation Administration (OIG Report Number AV-1998-134, May 27, 1998).

In the Ohio Valley, FAA is working with cargo airlines to use ADS-B[13] to improve terminal operations in low visibility conditions, principally at night. This technology is expected, among other things, to help flight crews identify and judge the distance and speed of aircraft they are following. Federal Express, United Parcel Service, and Airborne Express intend to equip 12 of their aircraft with ADS-B at a cost of about $80,000 per aircraft. Because a disproportionately high number of cargo flights occur at night, FAA believes that ideal test situations could exist where the impact of equipping sufficient numbers of aircraft at a hub airport can be assessed. FAA plans to equip four aircraft from the FAA Technical Center to take part in the Ohio Valley demonstration.

In Alaska, FAA intends to equip up to 200 General Aviation aircraft with new avionics for communications, navigation, and surveillance. This part of Safe Flight 21 is also referred to as the "Capstone" initiative. FAA officials expect to spend about $18,000 per aircraft for new avionics. In addition to serving as a demonstration for new avionics, FAA is hoping that tests in Alaska will provide immediate safety benefits by filling gaps in radar coverage through the additional surveillance offered by ADS-B. FAA also intends to use satellite navigation technology to increase the pilot's situational awareness by providing a terrain database and display in the cockpit.

FAA hopes to have all avionics installed by the end of 1999 so that testing in Alaska can begin in January 2000. Testing is planned to begin this year in the Ohio Valley. We caution that milestones for Alaska are aggressive. Most avionics will not be installed in Alaska until October 1999, and some ground stations will not be in place until June 2000.

Safe Flight 21 is now estimated to cost about $51 million in RE&D dollars over 3 years. However, FAA estimates that additional funds totaling $245 million may be needed in the future to complete efforts in Alaska and the Ohio Valley. FAA recognizes that additional planning remains to be done. According to FAA, key questions focus on the number of aircraft that will ultimately be equipped in Alaska and the timing of ground support system deployment in the Ohio Valley.

Safe Flight 21 should be carefully planned as it moves over the next year from the installation phase to the actual testing and evaluation of the avionics. *FAA needs to focus attention on how it intends to manage the effort, with particular emphasis on human factors concerns for both controllers and pilots.*

[13]ADS-B is a surveillance technology on an aircraft that is expected to provide more accurate position reports for use by controllers and pilots by periodically broadcasting the aircraft's location, heading, and other information. ADS-B relies on satellite-based navigation and permits controllers to see traffic in places previously outside of radar coverage.

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Madam Chair, that concludes my statement. I would be happy to respond to questions that you or other members may have.

Attachment 1

Summary of FAA RE&D Budget Activities Fiscal Years 1998 to 2000
(Dollars in Millions)

Research Activity	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Request	FY 1999-2000 Change
System Development & Infrastructure	$14.65	$15.78	$17.27	$+1.49
Capacity & Air Traffic Management Technology	21.26	0	16.00	+16.00
Communication, Navigation, & Surveillance	18.10	0	0	0
Weather	15.30	18.68	15.76	-2.92
Airport Technology	5.00	0	0	0
Aircraft Safety Technology	49.20	34.89	39.64	+4.75
System Security Technology	44.23	51.69	53.22	+1.53
Human Factors & Aviation Medicine	26.55	25.07	26.21	+1.14
Environment & Energy	2.89	2.89	3.48	+.59
Strategic Partnerships	2.00	1.00	1.42	+.42
Total	$199.18	$150.00	$173.00	+$23.00

Source: OIG Analysis of FAA Data