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Actions Needed To Reduce Risk With the Next Generation Air Transportation System

Statement of
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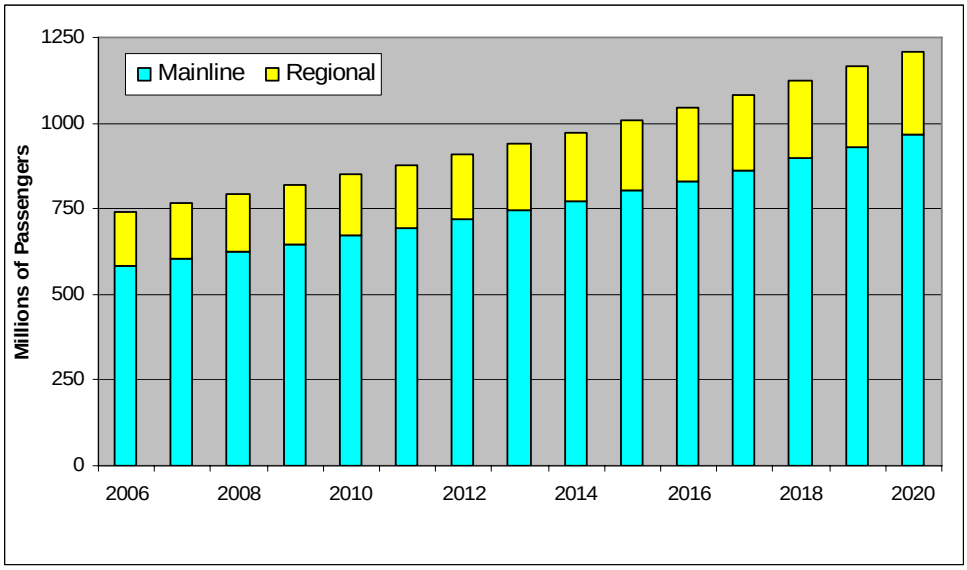
Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to testify on the Federal Aviation Administration's (FAA) efforts to develop and implement the Next Generation Air Transportation System (NextGen). FAA's Joint Planning and Development Office (JPDO) was established by law to begin advancing NextGen in the 2025 timeframe and coordinate diverse Federal research and development efforts.

As we have noted in previous reports and testimonies, there are compelling reasons for moving forward with NextGen. The current air traffic system (which operates largely on a ground-based infrastructure) has served the Nation well, but "business as usual" will not be sufficient to meet the anticipated demand for air travel or changes in the industry. Last year, U.S. airlines handled over 700 million passengers—this is forecasted to grow to over 1 billion by 2015 as illustrated in figure 1.

Figure 1. U.S. Commercial Air Carriers System Enplanements Fiscal Years 2006-2020



Source: FAA Forecast 2007-2020

With respect to delays, operational performance of the National Airspace System (NAS) slipped slightly in 2006 with one in four flights arriving late. This is the worst level since 2000 when aviation gridlock dominated the aviation agenda. We note that the average length of flight delays has increased from 51 minutes in 2000 to 53 minutes in 2006. Also, recent weather incidents that resulted in long, on-board delays have made the state of customer service a "front-and-center" issue once again; this was the subject of a hearing before this Subcommittee last month. It will be important for FAA and the JPDO to define solutions much sooner than 2025.

A driving force of FAA's reauthorization proposal is the financing of NextGen development. Much of the debate thus far has focused on the pros and cons of various financing mechanisms, such as user fees. This is understandable given the scope of the changes proposed by FAA. Nevertheless, FAA needs to focus greater attention on NextGen with respect to what capabilities will be delivered, when they will be delivered, and how the overall effort will be managed.

While there is considerable controversy about how best to finance FAA, there is general agreement on the need to modernize the NAS. FAA and the JPDO have established much needed goals to enhance capacity, reduce operating costs, and boost productivity. However, a multi-agency approach will be essential because FAA conducts very little long-term air traffic management research.

Our recent work shows that the development of and transition to NextGen are extraordinarily complex, high-risk efforts that will involve billion-dollar investments by both the Government and airspace users. Much work remains to establish requirements and align agency budgets to make the JPDO a truly effective multi-agency vehicle as set out by Vision 100.[1] Moreover, FAA is at a crossroads with respect to modernization; there are a wide range of actions that it must take to reduce risk and position the Agency to successfully deliver new capabilities.

As requested by this Subcommittee, my statement today will focus on:

- FAA's progress and problems with ongoing modernization projects—this is important because existing projects form the basic platforms for NextGen initiatives.
- JPDO's progress to date in coordinating and aligning agency budgets and plans for NextGen—much work remains to achieve this and truly make the JPDO a multi-agency effort.
- FAA actions needed to help the JPDO shift from planning to implementation and reduce risk with NextGen—a complex, multibillion-dollar effort.

FAA's Progress and Problems With Ongoing Modernization Projects

Since the 1980s, FAA has spent $46 billion on various capital programs, including radars, air-to-ground communication systems, and facilities. A clear understanding of the status of existing programs is important because the transition to NextGen will build upon these programs.

For fiscal year (FY) 2008, FAA is requesting $2.46 billion in capital funds, the majority of which ($2.3 billion) is for Air Traffic Organization (ATO) efforts to

[1] Vision 100 – Century of Aviation Reauthorization Act, Pub. L. No. 108-176 (2003).

modernize the NAS. Since FY 2005, capital funding requests have leveled off, falling within the range of $2.4 billion to $2.5 billion, well below the levels authorized in the Vision 100 Act.

Over the last several years, increasing operating costs have crowded out funds for the capital account. Another trend has been FAA's decision to cancel, defer, and segment acquisitions while the capital budget stayed essentially flat. Further, only about 50 percent of FAA's capital budget goes to air traffic systems; the remainder goes to personnel, mission support, and facilities (i.e., sustainment). Although a large portion of FAA's capital funds will go toward sustainment, FAA is requesting funds for key technologies for NextGen. These include the following:

- **Automatic Dependent Surveillance-Broadcast (ADS-B)**[2] is a satellite-based technology that allows aircraft to broadcast their position to others. FAA requested $80 million in FY 2007 for this satellite-based technology. For FY 2008, it is requesting $85.7 million. FAA expects to award a contract for the installation and maintenance of the ADS-B ground infrastructure in 2007. However, a number of challenges must be addressed. These include conducting human factors work and determining how air and ground elements will be certified as safe. FAA may have to rely on a rulemaking initiative to help speed ADS-B airspace user equipage. The current cost estimate for ADS-B is approximately $1.2 billion, and FAA is planning to re-baseline the ADS-B costs this summer.

- **System Wide Information Management (SWIM)** is a new information architecture that will allow airspace users to securely and seamlessly access a wide range of information on the status of the National Airspace System and weather conditions. It is analogous to an internet system for all airspace users. FAA requested $24 million for this program in FY 2007. For FY 2008, it is requesting $21.3 million. The cost to fully implement SWIM is unknown, and we note that SWIM is scheduled to be reviewed by FAA's Joint Resources Council this June.

In FAA's FY 2008 budget submission, the Agency is requesting funds for new NextGen initiatives, such as NextGen Data Communication ($7.4 million), NextGen Network Enabled Weather ($7 million), and a new NAS Voice Switch ($3 million). FAA is also requesting $50 million for demonstration and infrastructure projects.

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[2] The first phase of ADS-B implementation, known as *ADS-B out*, is expected to replace many ground radars that currently provide aircraft surveillance with less costly ground-based transceivers. Aircraft would be equipped with ADS-B out, which broadcasts a signal to these transceivers. However, implementing ADS-B out is just the first step to achieving the larger benefits of ADS-B, which would be provided by *ADS-B in*. ADS-B in would allow aircraft to receive signals from ground-based transceivers or directly from other aircraft equipped with ADS-B. This could allow pilots to "see" nearby traffic and, consequently, transition some responsibility for maintaining safe separation from the air traffic controllers to the cockpit.

FAA Needs To Keep Its Major Acquisitions on Track

At the request of this Subcommittee, we are updating our work on FAA's progress and problems with its major acquisitions and its efforts to move toward NextGen. We are tracking 18 programs with a combined acquisition cost of $17 billion. Our analysis shows that several programs (with combined capital costs of $6 billion) will require significant attention and oversight because of their size, diminishing benefits, potential cost and schedule problems, or importance to the NextGen transition.

En Route Automation Modernization (ERAM): This program is intended to replace the "Host" computer network—the central nervous system for facilities that manage high-altitude traffic. FAA requested $375.7 million for ERAM in FY 2007. For FY 2008, it is requesting $368.8 million. The first ERAM system is scheduled to be fielded by December 2009. While providing some enhancements, ERAM is essentially a one-for-one replacement for the existing "Host" computer system. As currently structured, ERAM will have two follow-on software releases (releases 2 and 3) valued at $83 million; these are still undefined. ERAM is expected to provide the basic platform for NextGen's automated capabilities.

With an acquisition cost of $2.1 billion and a monthly expenditure or "burn rate" of $31 million, this program continues to be one of the most expensive and complex acquisitions in FAA's modernization portfolio. While currently on track, considerable testing and integration work lies ahead. The next major milestone is completion of Factory Acceptance Testing,[3] which is planned for June 2007. Any ERAM cost increases or schedule slips will impact other capital programs and could directly affect the pace of the overall transition to NextGen.

Federal Aviation Administration Telecommunications Infrastructure (FTI): The FTI program is to replace seven FAA-owned and -leased telecommunications networks with a single network that will provide FAA with telecommunications services through 2017. FAA expects that FTI will significantly reduce its operating costs after the new network is completed. In FY 2007, FAA requested $28 million for the FTI program. For FY 2008, it is requesting $8.5 million. The vast majority of FTI, however, is funded out of the Operations Account as opposed to the Facilities and Equipment Account, which funds most acquisitions. For FY 2008, FAA estimates it will need $210 million to support FTI operations. Additionally, FAA is planning to request another $91 million to maintain legacy network operations until the FTI transition is complete.

[3] Factory Acceptance Testing is defined by FAA as formal testing conducted by the contractor to verify that the production item conforms to all contract specifications, is free from manufacturing defects, and meets all system requirements.

In April 2006, we reported[4] that FTI was a high-risk and schedule-driven effort that was unlikely to meet its December 2007 completion date. We found that FAA needed to improve management controls over FTI by developing a realistic master schedule and an effective transition plan. Since our report, the Agency has extended the FTI completion date to December 2008; this represents a 1-year schedule delay. In May 2006, we began a follow-up review of FTI. To its credit, FAA is making significant progress in delivering FTI services. As of March 31, 2007, 10,973 of about 21,820 services were operating on FTI.

As a result of the delay, FAA's Joint Resources Council approved a new cost baseline for FTI in August 2006. FAA increased its acquisition costs to develop the FTI network by an additional $8.6 million (from $310.2 to $318.8 million) and increased its overall operations costs to support FTI and legacy networks by about $100 million (from $3.0 to $3.1 billion).

We also continue to see an erosion of expected FTI cost savings. For example, in October 2005, the Program Office reported a reduction in the benefit estimate from $820 million to $672 million. By the end of FY 2006, we estimate that FTI cost savings decreased from $672 million to $442 million, including sunk costs. Moreover, since FAA has not yet validated the FTI cost and benefits estimates that were approved in August 2006—an action that we recommended and that FAA agreed to take—the true FTI costs and benefits remain unknown.

FAA continues to face challenges in making the transition to FTI. For instance, FAA currently has a large backlog of FTI services (averaging about 1,800 services over the last 3 months) that need to be addressed. The backlog includes transition failures, on-hold services, misconfigured [sic] equipment, and obsolete services. Additionally, transitioning digital services, such as critical radar and flight data, to FTI continues to be problematic. Some digital services were placed on "national hold" while engineering solutions could be developed.

In addition, FAA needs to ensure that it has an effective strategy to address FTI reliability and customer service problems. For example, many FTI services are not meeting reliability standards and are not being restored to service within contractual timeframes after outages. These problems led to unscheduled outages of both primary and back-up services, which led to flight delays. For example, on January 9, 2007, the Salt Lake City en route center experienced a 3-hour outage that caused 90 departure delays due to an FTI maintenance contractor trying to upgrade operational FTI equipment.

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[4] OIG Report Number AV-2006-047, "FAA Telecommunications Infrastructure Program: FAA Needs To Take Steps To Improve Management Controls and Reduce Schedule Risks," April 27, 2006. OIG reports and testimonies can be found on our website: www.oig.dot.gov.

Overall, key watch items for FTI include addressing the backlog of services, improving FTI reliability and customer service, stopping the erosion of expected cost benefits, and validating costs. Recently, FAA has completed negotiations with Verizon Business to extend LINCS[5] (FAA's largest and costliest existing network to be replaced by FTI), which expired in April 2007. FAA has agreed to a $92 million ceiling price to extend LINCS until April 2008. We will be reporting on the FTI program later in the year.

Airport Surface Detection Equipment-Model X (ASDE-X): ASDE-X is an important safety initiative planned to reduce the risks of accidents on runways. In FY 2007, FAA requested $63.6 million for the ASDE-X program. For FY 2008, it is requesting $37.9 million.

ASDE-X is FAA's latest effort designed to provide controllers with positive identification of aircraft and vehicle positions on the airport surface. It is planned to improve airport safety by operating in all-weather and low-visibility conditions (e.g., fog, rain, and snow) when controllers cannot see surface movement on ramps, runways, and taxiways.

ASDE-X was initially designed to provide a low-cost alternative to FAA's ASDE-3 radar systems for small- to medium-sized airports but has evolved into a different program. FAA made a significant change to the scope of the program in September 2005 and now intends to upgrade ASDE-3 systems with ASDE-X capabilities at 25 large airports and install the system at 10 other airports that currently lack any surface surveillance technology. In September 2005, FAA increased ASDE-X costs from $505.2 million to $549.8 million and extended the completion date from 2007 to 2011.

We are concerned about further cost increases and schedule delays with this important program since the cost to acquire and install some ASDE-X activities has increased by $94 million since the 2005 re-baseline. To stay within the revised baseline, FAA offset this cost by decreasing planned expenditures for seven other program activities, such as construction for later deployment sites.

We are also concerned that the ASDE-X schedule is not realistic. As of March 2007, FAA had commissioned only 8 of the 35 ASDE-X sites. Of the seven sites planned for FY 2006, FAA only commissioned four. Further, it is uncertain when key safety features will be delivered. For example, FAA has yet to commission an ASDE-X system that can alert controllers of potential collisions on intersecting runways or converging taxiways. Because of these issues, the program is at risk of not meeting

[5] In March 2007, about 43 percent of LINCS A-nodes had been decommissioned.

its current cost and schedule plans to deliver all 35 ASDE-X systems by 2011. We are reviewing ASDE-X and will issue a report later this year.

Air Traffic Management (ATM): ATM includes the Traffic Flow Management–Modernization (TFM-M) program and the Collaborative Air Traffic Management Technologies (CATMT) program. TFM-M modernizes the TFM system, which is the Nation's single source for capturing and disseminating air traffic information to reduce delays and make maximum use of system capacity. CATMT provides new decision support tools to deliver additional user benefits and increase effective NAS capacity. At a cost of $450 million, these are two key efforts for coordinating air traffic across the NAS and managing the adverse impacts of bad weather. In FY 2007, FAA requested $79 million for ATM programs. For FY 2008, it is requesting $91 million.

Although the TFM-M effort has not experienced cost increases or schedule delays, we are concerned about risks and what will ultimately be delivered. Our concerns are based on the fact that FAA and the contractor significantly underestimated the size and complexity of TFM-M software development. FAA was pursuing TFM-M through a cost-reimbursable agreement, meaning that all risk for cost growth rested with the Government. FAA has modified the contract and adjusted the scope of work. The current risks for TFM-M focus on developing complex software, integrating TFM-M with other NAS systems, and stabilizing requirements.

Terminal Modernization and Replacement of Aging Controller Displays: FAA's FY 2008 budget request calls for $40 million for efforts aimed at modernizing controller displays and related automation systems at terminal facilities. FAA's budget states that three-fourths of the FY 2008 funds will be used for the Standard Terminal Automation Replacement System (STARS) "technology refresh" (i.e., replacing obsolete components) and software enhancements.

FAA's past modernization efforts have focused exclusively on STARS. In 2004, faced with cost growth in excess of $2 billion for STARS, FAA rethought its terminal modernization approach and shifted to a phased process. FAA committed STARS to just 50 sites at an estimated cost of $1.46 billion as opposed to the original plan to deploy STARS at 172 sites at a cost of $940 million.[6] FAA renamed this modernization effort the Terminal Automation Modernization-Replacement (TAMR) initiative.

In 2005, FAA approved modernizing five additional small sites with STARS and replacing the aging displays at four large, complex facilities at a cost of $57 million. This leaves over 100 sites that still need to be modernized. Although FAA has not

[6] OIG Report Number AV-2005-016, "Terminal Modernization: FAA Needs To Address Its Small, Medium, and Large Sites Based on Cost, Time, and Capability," November 23, 2004.

decided how it will modernize these 100 sites, its budget submission indicates that this effort could cost over $1 billion.

There is no current defined "end state" for terminal modernization, and past problems with developing and deploying STARS leave FAA in a difficult position to begin transitioning to NextGen capabilities. Future costs will be shaped by (1) NextGen requirements, (2) the extent of FAA's terminal facilities consolidation, and (3) the need to replace or sustain existing (or legacy) systems that have not yet been modernized.

Without question, the most urgent concern facing terminal modernization is how quickly FAA can replace aging displays at the four large sites that are particularly critical to the NAS—Chicago, Illinois; Denver, Colorado; St. Louis, Missouri; and Minneapolis, Minnesota. FAA chose not to compete this work based on a joint proposal from two contractors and instead decided to modify the current STARS contract to include the work. Although this was expected to expedite replacement of the aging displays, the time spent revising the contract to establish cost, schedule, and design parameters caused FAA to lose the time advantage from foregoing competition. As a result, the aging displays will not be replaced until 2008. We recommended action on this matter over 2 years ago in November 2004.

Advanced Technology and Oceanic Procedures (ATOP): FAA requested $31.4 million in FY 2007. For FY 2008, it is requesting $53.1 million. ATOP is FAA's $548 million effort to modernize how controllers manage oceanic flights. FAA now has ATOP in use at Oakland, California; New York, New York; and Anchorage, Alaska.

Since September 2005, FAA controllers have experienced recurring failures (loss of data-link communication with aircraft and aircraft position jumps) with the new ATOP system at the Oakland site. These problems directly limit the potential capacity and productivity benefits from the new automation system. This could impact FAA's plans for using ATOP to demonstrate NextGen capabilities.

According to controllers, these incidents represent potentially hazardous safety conditions that need to be resolved. The larger separation distances required between aircraft over the oceans than for those in domestic airspace have allowed controllers to manage these problems. However, benefits from the new automation system, such as reduced separation, have not been fully realized. Problems persist in ATOP as evidenced by two operations bulletins (on aircraft altitude changes and detecting conflicts between aircraft) issued by the Oakland facility in April. FAA needs to resolve the problems that it has identified with communication service providers and aircraft avionics and adjust ATOP software as needed to realize expected benefits.

Perspectives on FAA's Metrics for Measuring Progress With Major Acquisitions

FAA reports in its FY 2007 Flight Plan and the most recent Performance and Accountability Report that 100 percent of its critical acquisitions were within 10 percent of budget estimates and 97 percent were on schedule for 2006. FAA is currently tracking about 29 acquisitions, such as the acquisition of new radars.

FAA's cost and schedule metrics are worthwhile tools for Agency management and oversight of major acquisitions—a step we called for a number of years ago. However, these metrics have limitations that need to be understood by decision makers in order to properly assess the overall status of FAA's acquisition portfolio.

First, FAA's cost and schedule metrics are *snapshots* in time. They are not designed to address changes in requirements, reductions in procured units, or shortfalls in performance that occur over time. Second, FAA's budget metrics involve comparisons of cost estimates taken during the fiscal year. These estimates involve the updated, "re-baselined" cost figures—not estimates from the original baseline. This explains why the Wide Area Augmentation System (a satellite-based navigation system) is considered "on budget" even though costs have grown from $892 million to over $3 billion since 1998.

"Re-baselining" a project is important to get realistic cost and schedule parameters and is consistent with Office of Management and Budget (OMB) guidance and the Agency's own Acquisition Management System. The revised baselines are used for justifying budgets and making investment decisions, i.e., ensuring that major acquisitions are still cost beneficial. We note that OMB allows FAA to measure deviations from the new baselines once they have been approved. Nevertheless, such comparisons of revised program baselines—absent additional information—fail to provide an accurate picture of a program's true cost parameters.

Finally, FAA's schedule metrics used for assessing progress with several programs in 2006 were generally reasonable but focused on interim steps or the completion of tasks instead of whether systems met operational performance goals. For example, ASDE-X metrics focused on delivery of two systems. This metric does not relate to whether systems entered service or met operational performance expectations. We note that there are no written criteria for selecting or reporting the milestones. The table below provides information on some of the metrics used for measuring progress with acquisitions in FY 2006.

Table. Metrics Used To Measure Programs in 2006

Program	Metric	Planned Date	Actual Date
Airport Surface Detection Equipment Model-X	Deliver two systems	Feb. 2006	Feb. 2006
Standard Terminal Automation Replacement System	Deliver to one site	Feb. 2006	Jan. 2006
Air Traffic Management	Conduct detailed design review	August 2006	March 2006
Precision Runway Monitor	Complete factory acceptance testing for Atlanta	April 2006	April 2006
Wide Area Augmentation System	Complete initial installation of two reference stations	September 2006	May 2006

Source: FAA ATO-F Capital Expenditures Program Office

As FAA's former chief operating officer stated, measuring cost and schedule may not be sufficient in evaluating NextGen initiatives. We agree and believe it will be important to focus on the promised capability and benefits of new initiatives, particularly those associated with the goals of enhancing capacity, boosting productivity, and reducing Agency operating costs. Therefore, FAA should explore a wider range of metrics to measure—and report on—progress with NextGen efforts.

JPDO's Progress to Date in Coordinating and Aligning Research—Much Work Remains To Truly Make the JPDO a Multi-Agency Effort

FAA's JPDO was specifically mandated by Congress in the Vision 100 Act to develop a vision for NextGen and coordinate diverse agency research efforts. The office was established within FAA to coordinate research efforts underway at the National Aeronautics and Space Administration (NASA), Department of Commerce, Department of Defense (DOD), and Department of Homeland Security (DHS). The JPDO's mission is critical because FAA conducts very little long-term air traffic management research. FAA requested $18 million in FY 2007 for the JPDO. For FY 2008, it is requesting $14 million.[7]

The majority of the JPDO's work is done through eight integrated product teams (IPT) that focus on specific strategies, such as how to use weather information to improve the performance of the National Airspace System. The teams are composed of personnel from FAA, other Federal agencies, and the private sector.

[7] The JPDO is funded through FAA's Research, Engineering, and Development account. In FY 2008, JPDO officials expect to also rely on $3.5 million from the capital account for risk reduction activities.

In our February 2007 report,[8] we found that much remains to be done for the JPDO to truly become a multi-agency organization as set out in Vision 100. Specifically, we found that there was considerable coordination among JPDO participating agencies but little or no alignment of research and development plans—this is still the case today. Further, individual IPT leaders had no authority to commit their parent agencies' resources, and we concluded that a more product-driven approach would be a step forward.

The JPDO has announced a number of changes, including the formation of a council to examine regulatory issues. We also understand that the JPDO will refocus the IPTs as "working groups." The most notable changes are the dissolution of the Agile Air Traffic System IPT and the establishment of two new working groups for aircraft and air navigation services. The IPT restructuring plan has been approved by FAA management but is still in the process of being implemented. Therefore, we have no opinion on whether the changes will have the desired affect of shifting JPDO planned efforts toward implementation.

Progress in Developing Mechanisms for Alignment

It is still not clear to what extent FAA can leverage the wide range of research and development being conducted at other Federal agencies to help reduce NextGen costs. The JPDO is developing an inventory of other Federal agencies' research, and its preliminary analysis suggests that about $300 million in FY 2008 research dollars could benefit NextGen. We note that the JPDO's research inventory is still a work in progress. JPDO is planning to have a more detailed assessment for the FY 2009 budget cycle.

To help decision makers address whether FAA is leveraging the right research, we recommended that the JPDO include information on specific research projects it is leveraging in progress reports to Congress and how that research supports NextGen. FAA concurred with our recommendation.

Central to the JPDO mission—and to making it an effective multi-agency vehicle—is the alignment of agency resources. This is a complex task, and the law provides no authority for the JPDO to redirect agency resources. To its credit, the JPDO has released a concept of operations for NextGen, but considerable work remains to effectively align Federal research dollars for NextGen. There are four key efforts in process for aligning agency resources.

- **NextGen Enterprise Architecture:** The JPDO's efforts to develop an enterprise architecture (or overall blueprint for the next generation system) will help in setting goals, supporting decisions, adjusting plans, and tracking agency

[8] OIG Report Number AV-2007-031, "Joint Planning and Development Office: Actions Needed To Reduce Risks With the Next Generation Air Transportation System," February 12, 2007.

commitments. It will also show requirements from FAA, DOD, and DHS and where various agency efforts fit in NextGen. Moreover, it will help resolve difficult policy decisions in the future, such as which agencies pay for what. However, considerable work remains to link current systems with future capabilities and develop technical requirements, particularly for new automation concepts. The architecture documents we have reviewed to date are essentially templates that lack sufficient detail to support capital investment decisions. The JPDO expects to complete another version this month.

- **NextGen R&D Plan:** The JPDO does not yet have a Research and Development (R&D) plan that can guide various agency research efforts over the next several years. This is important because the JPDO concept of operations has identified over 70 research or policy question areas that need attention. Coordinated and integrated research planning will be a critical element in the development of NextGen, and it is difficult to fathom how the JPDO has functioned without an R&D plan thus far. The JPDO is in the process of developing an R&D plan that will document NextGen research needs and the organizations that will perform the work and expects to publish this plan in August.

- **NextGen Memorandum of Understanding (MOU) for JPDO efforts:** For more than a year, the JPDO has been working to reach agreement on an MOU with the participating agencies. The MOU will not guarantee coordination and alignment but can be helpful in setting expectations, roles, and responsibilities. To date, this agreement has not been signed by all participating agencies. According to JPDO officials, DHS and DOD have not yet signed but are expected to do so soon.

- **NextGen Integrated Budget document:** The JPDO is developing an integrated budget document that provides a single business case in a document similar, but not identical, to the Office of Management and Budget "Exhibit 300." As we noted last year, this will help ensure that various agency efforts are indeed aligned. The JPDO has been working with OMB and is targeting to submit an OMB Exhibit 300 by September 2007, which will be in time for the FY 2009 budget submission.

The Role of NASA

A key, short-term cost driver for NextGen is the role that NASA will play. Historically, FAA's R&D efforts have focused on short-term research, with NASA conducting the majority of long-term air traffic management research, including automated controller tools and human factors work. NASA requested $529 million in FY 2007 for aeronautical R&D and is requesting $554 million for FY 2008.[9] Not all

[9] NASA has changed the way it reports and presents its budget. This makes doing year-to-year comparisons difficult. The numbers presented in our testimony are from NASA's FY 2008 budget request and represent NASA's full-cost simplification method, which reallocates overhead costs.

of NASA's Aeronautics budget is directly linked to NextGen. Of particular interest to NextGen automation efforts is NASA's investment in "airspace systems," which is funded at about $100 million annually. The JPDO is looking to NASA to develop automated aircraft metering and sequencing and dynamic airspace reconfiguration—key elements of NextGen.

NASA is planning to spend less on aeronautical research than it has in the past and is restructuring its aeronautical research portfolio. In discussing progress with the JPDO, NASA's Associate Administrator for Aeronautics told us that NASA no longer plans to develop prototypes and that research would be restricted to "fundamental research"[10] and proof of concept experiments. This is in sharp contrast to the support it gave FAA with the Free Flight Phase 1 program (a previous modernization effort that introduced, among other things, new automated controller tools at select locations).

FAA's Research, Engineering, and Development Advisory Committee (REDAC)[11] has raised concerns about NASA's efforts to restructure its aeronautics program and its potential impact on NextGen.[12] The REDAC is concerned that changes to NASA's aeronautical research efforts will place uncertainty on the ability of NASA to deliver development efforts at the same level of technological maturity that it has in the past. As a result, FAA would have to assume a larger burden and the associated costs to complete development and bring new systems to fruition. To accommodate changes in NASA investments and to address this gap, the REDAC estimated that approximately $100 million would be needed annually.

As we noted in our February 2007 report, it will be important for FAA and NASA to come to a clear understanding of the level of technical maturity that NASA projects will have. This has cost and schedule implications for NextGen, particularly new automated systems for controllers. If NASA is unable to provide projects at a level that FAA can transition to prototypes, the JPDO and FAA will have to determine how this R&D will be completed, managed, and paid for.

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[10] NASA officials define "fundamental research" as continued long-term, scientific study in areas such as physics, chemistry, materials, experimental techniques, and computational techniques that lead to a furthering of understanding of underlying principles that form the foundation of the core aeronautics disciplines as well as research that integrates the knowledge gained in these core areas to significantly enhance capabilities, tools, and technologies at the disciplinary (e.g., aerodynamics, combustion, and trajectory prediction uncertainty) and multidisciplinary (e.g., airframe design, engine design, and airspace modeling and simulation) levels.

[11] FAA's Research, Engineering and Development Advisory Committee, established in 1989, advises the Administrator on research and development issues and coordinates the FAA's research activities with industry and other Government agencies.

[12] Federal Aviation Administration Research, Engineering, and Development Advisory Committee draft report, "Financing the Next Generation Air Transportation System," August 22, 2005.

The Role of the Department of Defense

An active role by DOD in the development of NextGen would be beneficial because it is both a provider and a consumer of air traffic services and has national security missions that require it to utilize the NAS. As we noted in previous reports and testimonies, DOD's experiences and lessons learned in sharing data (from air and ground systems) in actual operations will prove invaluable in reducing cost and technical risk with NextGen.

To date, DOD has participated in several IPTs, most notably the Weather IPT, and it had a leadership role in the Shared Situational Awareness IPT, which was coordinating work on a net-centric system to share data. However, the position of the Director of Shared Situational Awareness IPT—a DOD official—has been vacant since June 2006. This has limited DOD's influence and presence at the JPDO strategic planning level.

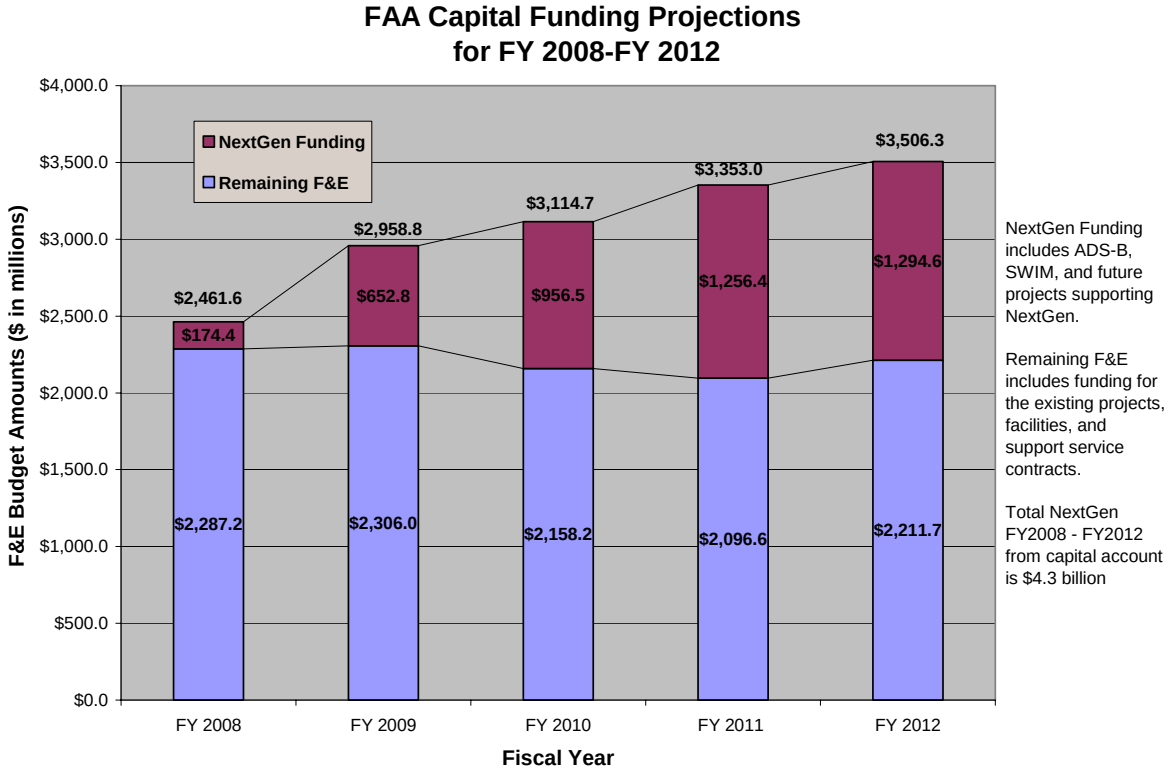
We understand that DOD is planning to designate the Secretary of the Air Force as the Department's executive agent for NextGen. There is also discussion about establishing an office within the Air Force (under the Electronics Systems Center at Hanscomb Air Force Base) to specifically interface with JPDO. This would enable the JPDO and DOD to approach NextGen in a more coordinated way—something that has been missing. It would also establish formal lines of funding for DOD's engagement in NextGen efforts and facilitate technology transfer. These plans need to be finalized; if implemented, they will help the JPDO become a more effective, multi-agency effort.

FAA Actions Needed To Help the JPDO Shift From Planning to Implementation and Reduce Risk With NextGen

The transition to NextGen is an extraordinarily complex, high-risk effort involving billion-dollar investments by the Government and airspace users. We have made a series of recommendations specifically aimed at reducing risk and facilitating the shift from planning to implementation.

FAA needs to develop realistic NextGen cost estimates, quantify expected benefits, and establish a road map for industry to follow. A central question in the current debate on financing FAA is what the costs associated with developing and implementing NextGen will be. Figure 2 illustrates FAA's most recent cost estimates.

Figure 2. FAA Capital Funding Projections for FY 2008 to FY 2012



Source: FAA National Airspace System Capital Investment Plan FY 2008 – FY 2012

FAA estimates suggest that the Agency will require $15.4 billion for capital projects from FY 2008 to FY 2012. This includes $4.6 billion for NextGen initiatives ($4.3 billion from the capital account and $300 million from the Research, Engineering, and Development [RE&D] account).

We note that the bulk of NextGen funds will be allocated to *developmental efforts*, including demonstration projects. There are unknowns with respect to performance requirements for new automation systems and data-link communications. The development of new automation systems is a particular concern given their complexity and the fact that almost flawless performance will be required. FAA will not have a firm grasp on costs until it has a mature enterprise architecture and a NextGen R&D plan that clearly indicates the contributions of other agencies.

The costs for airspace users to equip with new avionics will be significant. The JPDO's most recent progress report estimates the cost for airspace users to be between $14 billion and $20 billion for the long term. This underscores the need for FAA to have a clear understanding of complex transition issues and what will be required to get expected benefits.

Another cost driver focuses on the extent to which FAA intends to consolidate facilities based on modern technology. We recommended that when FAA reports

NextGen costs to Congress, it should do so along three vectors—research and development needed, adjustments to existing projects, and costs for new initiatives. FAA agreed and stated that it will build a comprehensive cost estimate this year.

More work remains to set expectations, requirements, and milestones—or *"transition benchmarks"*—for developing when new procedures, new ground systems, and aircraft need to be equipped to realize benefits. During an April 2006 workshop, industry participants asked FAA for a "service roadmap" that (1) specifies required aircraft equipage in specific time increments, (2) bundles capabilities with clearly defined benefits and needed investments, and (3) uses a 4- to 5-year equipage cycle that is coordinated with aircraft maintenance schedules. Once concepts and plans have matured, it will be important for FAA to provide this information to industry.

FAA and the JPDO need to develop approaches for risk mitigation and systems integration. FAA and the JPDO must articulate how they will do things differently to avoid problems that affected modernization efforts in the past (such as cost growth, schedule slips, and performance shortfalls). Developing and implementing NextGen will be an enormously complex undertaking. As the JPDO notes in its December 2004 Integrated Plan,[13] "there has never been a transformation effort similar to this one with as many stakeholders and as broad in scope." The central issue focuses on what will be done differently from past modernization efforts with NextGen initiatives (other than conducting demonstration projects) to ensure success and deliver much needed benefits to FAA and airspace users.

FAA's decision to use the Operational Evolution Plan (the Agency's blueprint for capacity) to help implement NextGen is a good first step. Nevertheless, the transition to NextGen will pose complex software development and integration problems and require synchronized investments between FAA and airspace users over a number of years.

To maintain support for NextGen initiatives, we recommended that the JPDO and FAA articulate how problems that affected past modernization efforts will be mitigated and what specific skill sets with respect to software development and system integration will be required. This will help reduce cost and schedule problems with NextGen initiatives. FAA concurred with our recommendation and stated that it will form a panel of experts to examine the issues we raised.

FAA is requesting $50 million in its FY 2008 budget for demonstration projects, which are important opportunities to reduce risk. In the past, FAA has experienced problems with certifying systems as safe, which led to cost growth and schedule slips. Therefore, we recommended, and FAA agreed, that planned NextGen demonstration

[13] JPDO "Next Generation Air Transportation System – Integrated Plan," December 2004.

projects develop sufficient data to establish a path for certifying new systems and identify the full range of adjustments to policies and procedures needed for success.

FAA needs to review ongoing modernization projects and make necessary cost, schedule, and performance adjustments. As FAA's budget request points out, approximately 30 existing capital programs serve as "platforms" for NextGen. We recommended that FAA review ongoing modernization programs to determine what adjustments in cost, schedule, and performance will be required. This is critical because NextGen planning documents suggest that billions of dollars will be needed to adjust ongoing programs, like ERAM and TFM-M.

During FY 2007 through FY 2008, over 25 critical decisions must be made about ongoing programs. These decisions will directly impact how quickly new capabilities can be deployed and will involve establishing requirements for future ERAM software releases, making investments to support existing radars, and incorporating weather information into SWIM.

FAA needs to develop a strategy for technology transfer. Technology transfer—the movement of technology from one organization to another—is a central issue for the JPDO because the law requires that new capabilities developed by other Federal agencies (or the private sector) be transitioned into the NAS. The JPDO will have to pay greater attention to this matter as it moves forward to reduce development times with NextGen initiatives.

Our past work shows that FAA has experienced mixed results in transitioning systems developed by others into the NAS. For example, FAA ultimately abandoned work on a promising new controller tool developed by NASA (the Passive Final Approach and Spacing Tool) for sequencing and assigning runways to aircraft because of complex software development (including site-specific customization) and cost issues and because the benefits were unlikely transferable to other airports.

As we noted in our review of FAA's Free Flight Phase 1 Program,[14] the use of "technology readiness levels"[15] could be useful to help assess the maturity of systems and ease issues associated with technology transfers. Stated simply, these are the problems associated with efficiently transitioning a new technology from concept to viable product in the shortest possible time and at the least cost. JPDO progress reports and planning documents we have reviewed do not use technology readiness levels. We recommended that the JPDO use technology readiness levels in assessing the maturity of research conducted in other agencies.

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[14] OIG Report Number AV-2002-067, "Free Flight Phase 1 Technologies: Progress to Date and Future Challenges," December 14, 2001.

[15] Technology Readiness Levels – DOD and NASA use a nine-point scale to differentiate the maturity of technologies Level 1 (Basic Principles Observed and Reported) to Level 9 (Actual System, Proven Through Successful Mission Operations).

Both NASA and DOD have experience with categorizing technology maturity, which could help reduce cost, schedule, and technical risks with implementing JPDO initiatives. FAA partially concurred with our recommendation to use technology readiness levels but pointed out that efficient transition of new technologies will also require close cooperation between researchers and users of existing systems. We agree overall technology transfer efforts could be buttressed by the establishment of "transition" or "maturation" teams to create a developmental pipeline for new systems.

FAA needs to conduct sufficient human factors research to support anticipated NextGen changes. The JPDO is planning to make fundamental changes in how the NAS operates and how controllers manage traffic to accommodate three times more aircraft in the system. Additionally, changes must address cultural issues within FAA that could potentially inhibit the implementation of NextGen; this will require doing business differently than the way it is done now.

History has shown that insufficient attention to human factors can increase the cost of acquisition and delay much needed benefits. For example, problems in the late 1990s with FAA's Standard Terminal Automation Replacement System were directly traceable to not involving users early enough in the process.

The need for focused human factors research extends well beyond the traditional, computer-machine interface (such as new controller displays) and has important workforce and safety implications. For example, FAA expects the controller's role to change from direct, tactical control of aircraft to one of overall traffic management. There also will be significant human factors concerns for pilots as they will be expected to rely more on data-link communications.

A key issue for human factors research is what can reasonably be expected of new automation systems and cockpit displays. In its concept of operations for NextGen, FAA identified the following issues that will require additional human factors work:

- How will increased automation and new technologies affect flight crew workload?
- What effect do the changing roles and responsibilities have on safety?
- What alerts and information displays does a pilot need to safely oversee conflict detection and resolution when no one on the ground is responsible for tactical separation?
- If automation fails, what is the back-up plan in terms of people, procedures, and automation?

To address these important questions, FAA will have to prioritize its ongoing human factors work and ensure that it is targeted to address critical issues affecting controllers and pilots. This will also require close cooperation with NASA, which also conducts human factors research. We agree with the JPDO that simulations and modeling will be important to gain a full understanding of the human factors issues and corresponding requirements for NextGen initiatives. We recommended that the JPDO conduct sufficient human factors analyses and studies to ensure that the changes envisioned for NextGen can be safely accomplished. FAA concurred and is developing a plan that identifies roles and responsibilities for JPDO partner agencies, including human factors research.

Mr. Chairman, that concludes our testimony. I would be pleased to answer any questions that you or other Members of the Subcommittee might have.