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# NEXT GENERATION AIR TRANSPORTATION SYSTEM

## Preliminary Analysis of Progress and Challenges Associated with the Transformation of the National Airspace System

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Physical Infrastructure Issues



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# Highlights

Highlights of [GAO-06-915T](#), a testimony before the Subcommittee on Aviation, Committee on Commerce, Science, and Transportation, U.S. Senate

## Why GAO Did This Study

The health of our nation's air transportation system is critical to our citizens and economy. However, the current approach to managing air transportation is becoming increasingly inefficient and operationally obsolete. In 2003, Congress created the Joint Planning and Development Office (JPDO) to plan for and coordinate, with federal and nonfederal stakeholders, a transformation from the current air traffic control (ATC) system to the "next generation air transportation system" (NGATS).

Housed within the Federal Aviation Administration (FAA), JPDO has seven partner agencies that make up JPDO's senior policy committee: the Departments of Transportation, Commerce, Defense, and Homeland Security; FAA; the National Aeronautics and Space Administration (NASA); and the White House Office of Science and Technology Policy. This testimony, which provides preliminary results from GAO's ongoing work on JPDO, provides information on (1) the status of JPDO's efforts to plan for NGATS, (2) the key challenges facing JPDO as it moves forward with its planning efforts, and (3) the key challenges facing FAA as it implements the transformation while continuing its current operations. The statement is based on GAO's analysis of JPDO documents, interviews, and the views of a panel of experts, as well as on past GAO work.

[www.gao.gov/cgi-bin/getrpt?GAO-06-915T](http://www.gao.gov/cgi-bin/getrpt?GAO-06-915T).

To view the full product, including the scope and methodology, click on the link above. For more information, contact Gerald L. Dillingham, Ph.D., at (202) 512-2834 or [dillinghamg@gao.gov](mailto:dillinghamg@gao.gov).

## NEXT GENERATION AIR TRANSPORTATION SYSTEM

### Preliminary Analysis of Progress and Challenges Associated with the Transformation of the National Airspace System

#### What GAO Found

JPDO has developed a framework for planning and coordination with its federal partner agencies and nonfederal stakeholders that is consistent with the requirements of its authorizing legislation—Vision 100—and with several practices that our previous work has shown can facilitate federal interagency collaboration and the development of an enterprise architecture (i.e., system blueprint). JPDO's framework includes an integrated plan that provides a vision for NGATS, an organizational structure and processes for leveraging the resources and expertise of federal and nonfederal stakeholders, and an enterprise architecture that defines the specific requirements for NGATS.

As JPDO moves forward, it will face leadership, leveraging, and commitment challenges. Currently, JPDO lacks a permanent director and a permanent chairperson of its senior policy committee to provide the leadership needed to overcome barriers to interagency coordination. In addition, despite early successes, JPDO may have difficulty continuing to leverage its partner agencies' resources and expertise for NGATS because these agencies have missions and priorities in addition to NGATS and JPDO does not yet have signed, long-term agreements with the partner agencies on their respective roles and responsibilities. Finally, JPDO faces the challenge of convincing nonfederal stakeholders that the government is fully committed to implementing NGATS, given that, in some instances, it has discontinued work on new technologies for the national airspace system.

FAA faces challenges in institutionalizing recent improvements in its management and acquisition processes, as well as in obtaining the expertise and resources necessary to implement NGATS. First, institutionalizing FAA's process improvements is critical to successfully implementing NGATS. Second, FAA may lack the expertise needed to manage the NGATS effort. GAO has identified two potential approaches for FAA to supplement its capabilities that FAA is considering. Third, achieving cost savings is critical to funding the implementation of NGATS.

#### Air Traffic Management



Sources: GAO; PhotoDisc

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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to participate in today’s hearing to discuss the status of efforts by the Joint Planning and Development Office (JPDO) to plan for and coordinate the transformation of the nation’s current air traffic control (ATC) system to the “next generation air transportation system” (NGATS)—a system intended to safely accommodate an expected tripling of air traffic by 2025. Authorized in 2003, JPDO is housed within the Federal Aviation Administration (FAA), whose Air Traffic Organization (ATO) is responsible for modernizing and operating the nation’s current ATC system.<sup>1</sup> According to Vision 100,<sup>2</sup> the legislation that authorized JPDO, the transformation to NGATS will be completed by 2025 with the assistance of seven organizations that make up JPDO’s senior policy committee: the Departments of Transportation, Commerce, Defense, and Homeland Security; FAA; the National Aeronautics and Space Administration (NASA); and the White House Office of Science and Technology Policy. As JPDO plans the transformation to NGATS and coordinates the related efforts of its partner agencies, FAA will be responsible for both implementing the transformation and safely operating the current ATC system 24 hours a day, 7 days a week.

My statement today focuses on three key questions. (1) What is the status of JPDO’s efforts to plan for NGATS? (2) What key challenges does JPDO face in moving forward with its planning efforts? (3) What key challenges does FAA face in transitioning from the current ATC system and in implementing NGATS? My statement is based on our analysis of documents provided by JPDO and its partner agencies; the perspectives of agency officials and stakeholders with whom we have spoken; the results of a panel of experts that we convened; and our review of relevant literature, including JPDO’s December 2004 integrated plan and March 2006 progress report. The statement also draws on our prior work on FAA’s program for modernizing the national airspace system, which we have listed as a high-risk program since 1995.<sup>3</sup> To assess JPDO’s

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<sup>1</sup>Although ATO is immediately responsible for modernizing the ATC system, we will refer to FAA throughout this statement because it encompasses JPDO and is ultimately responsible for the modernization effort.

<sup>2</sup>Pub. L. No. 108-176, Vision 100—Century of Aviation Reauthorization Act, December 12, 2003.

<sup>3</sup>ATC modernization has remained on our high-risk list since 1995. See GAO, *High Risk Series: An Update*, [GAO-05-207](#) (Washington, D.C.: January 2005).

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framework for facilitating coordination among its partner agencies, obtaining the participation of nonfederal stakeholders, and conducting technical planning for NGATS, we compared JPDO's practices with those that we have found to be effective in facilitating federal interagency collaboration and enterprise architecture<sup>4</sup> development.<sup>5</sup> We also reviewed the National Research Council's 2005 report on JPDO, which provided a technical assessment of the research, development, and technology components of JPDO's integrated plan. Later this year, we expect to issue a report on our assessment of the status of JPDO's efforts to plan for the development of NGATS. We are performing our work in accordance with generally accepted government auditing standards.

The following summarizes our findings to date:

- JPDO has developed a framework for planning and coordination with its partner agencies and nonfederal stakeholders that is consistent with the requirements of Vision 100 and with several practices that our previous work has shown can facilitate federal interagency collaboration and enterprise architecture development. Vision 100 established JPDO as a planning and coordinating body and outlined elements for creating NGATS and managing the related work. These elements, which make up JPDO's framework, include an integrated plan that provides a vision for NGATS, an organizational structure and processes for leveraging the resources and expertise of federal and nonfederal stakeholders, and an enterprise architecture that defines the specific requirements for NGATS.
- JPDO faces leadership, leveraging, and commitment challenges as it moves forward with planning for NGATS. Currently, two leadership positions critical to JPDO's success are vacant: JPDO has not had a permanent director for over 6 months, and since the Secretary of Transportation resigned, the senior policy committee has been without a permanent chairperson. In addition, despite early successes in leveraging

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<sup>4</sup>An enterprise architecture is a tool, or blueprint, for understanding and planning complex systems. The NGATS enterprise architecture will provide the means for coordinating among the partner agencies and private sector manufacturers, aligning relevant research and development activities, and integrating equipment. The enterprise architecture will describe the current national airspace system, NGATS, and the sequence of steps needed to implement the transformation to NGATS.

<sup>5</sup>GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies*, [GAO-06-15](#) (Washington, D.C.: Oct. 21, 2005) and GAO, *Federal Aviation Administration: Stronger Architecture Program Needed to Guide Systems Modernization Efforts*, [GAO-05-266](#) (Washington, D.C.: Apr. 29, 2005).

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its partner agencies' resources and expertise for NGATS initiatives, JPDO may have difficulty continuing to do so because its partner agencies have a variety of missions and priorities in addition to NGATS, and JPDO does not yet have formal, signed agreements with the agencies on their respective roles and responsibilities. JPDO also faces the challenge of convincing nonfederal stakeholders that the government is fully committed to NGATS because, in the past, the government has discontinued work on new technologies for the national airspace system, including one technology in which a nonfederal stakeholder had already invested.

- FAA faces challenges in institutionalizing recent improvements in its management and acquisition processes, as well as in obtaining the expertise and resources needed to implement NGATS. First, the successful implementation of NGATS will depend on FAA's incorporating the improved processes into its organizational structure and culture. Second, FAA may not have the expertise needed to manage the NGATS implementation effort. Our work has identified, and FAA is considering, two approaches for addressing this challenge—contracting with a lead systems integrator and obtaining technical advice from federally funded research and development corporations. Third, FAA will need resources to implement NGATS, some of which may have to come from savings in operating and maintaining the current ATC system.

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## Background

In late 2003, recognizing that the current approach to managing air transportation is becoming increasingly inefficient and operationally obsolete, Congress created JPDO to plan NGATS, a system intended to accommodate the threefold increase in air traffic demand expected by 2025. JPDO's scope is broader than that of traditional ATC modernization in that it is "airport curb to airport curb," encompassing such issues as security screening and environmental concerns. Additionally, JPDO's approach will require unprecedented collaboration and consensus among many stakeholders—federal and nonfederal—about necessary system capabilities, equipment, procedures, and regulations. Each of JPDO's partner agencies will play a role in the transformation to NGATS. For example, the Department of Defense has deployed "network centric" systems,<sup>6</sup> originally developed for the battlefield, that are being considered as a conceptual framework to provide all users of the national airspace

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<sup>6</sup>Network-centric systems aim to exploit technical advances in information technology and telecommunications to improve situational awareness and the speed of decision making.

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system—FAA and the Departments of Defense and Homeland Security—with a common view of that system.

Vision 100 required the Secretary of Transportation to establish JPDO within FAA to manage work related to NGATS. The Director of JPDO reports to the FAA Administrator and to the Chief Operating Officer within ATO. JPDO began operating in early 2004.

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## JPDO Has Made Progress in Planning for NGATS

JPDO has developed a framework for planning and coordination with its partner agencies and nonfederal stakeholders that is consistent with the requirements of Vision 100 and with several practices that our work has shown can facilitate federal interagency collaboration and enterprise architecture development. This framework includes an integrated plan, an organizational structure, and an enterprise architecture.

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## As Required by Vision 100, JPDO Developed an Integrated Plan and Reported on the Progress of That Plan

Vision 100 calls for the development of an integrated plan for NGATS and annual updates on the progress of that plan. JPDO's partner agencies developed an integrated plan and submitted it to Congress on December 12, 2004. The plan includes a vision statement for meeting the predicted threefold increase in demand for air transportation by 2025 and eight strategies that broadly address the goals and objectives for NGATS. In March 2006, JPDO published its first report to Congress on the progress made in carrying out the integrated plan.

The integrated plan is consistent with effective collaboration practices we have identified. According to our research on federal interagency collaborations, agencies must have a clear and compelling rationale for working together to overcome significant differences in their missions, cultures, and established ways of doing business. In working together to develop JPDO's integrated plan, the partner agencies agreed on a vision statement to transform the air transportation system and on broad statements of future system goals, performance characteristics, and operational concepts.

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## JPDO Developed an Organization for Involving Federal and Nonfederal Stakeholders

Vision 100 includes requirements for JPDO to coordinate and consult with its partner agencies, private sector experts, and the public. Accordingly, JPDO established an organizational structure to involve federal and nonfederal stakeholders throughout the organization. This structure includes a federal interagency policy committee, an institute for nonfederal stakeholders, and integrated product teams (IPT) that bring

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together federal and nonfederal experts to plan for and coordinate the development of technologies that will address JPDO's eight broad strategies.

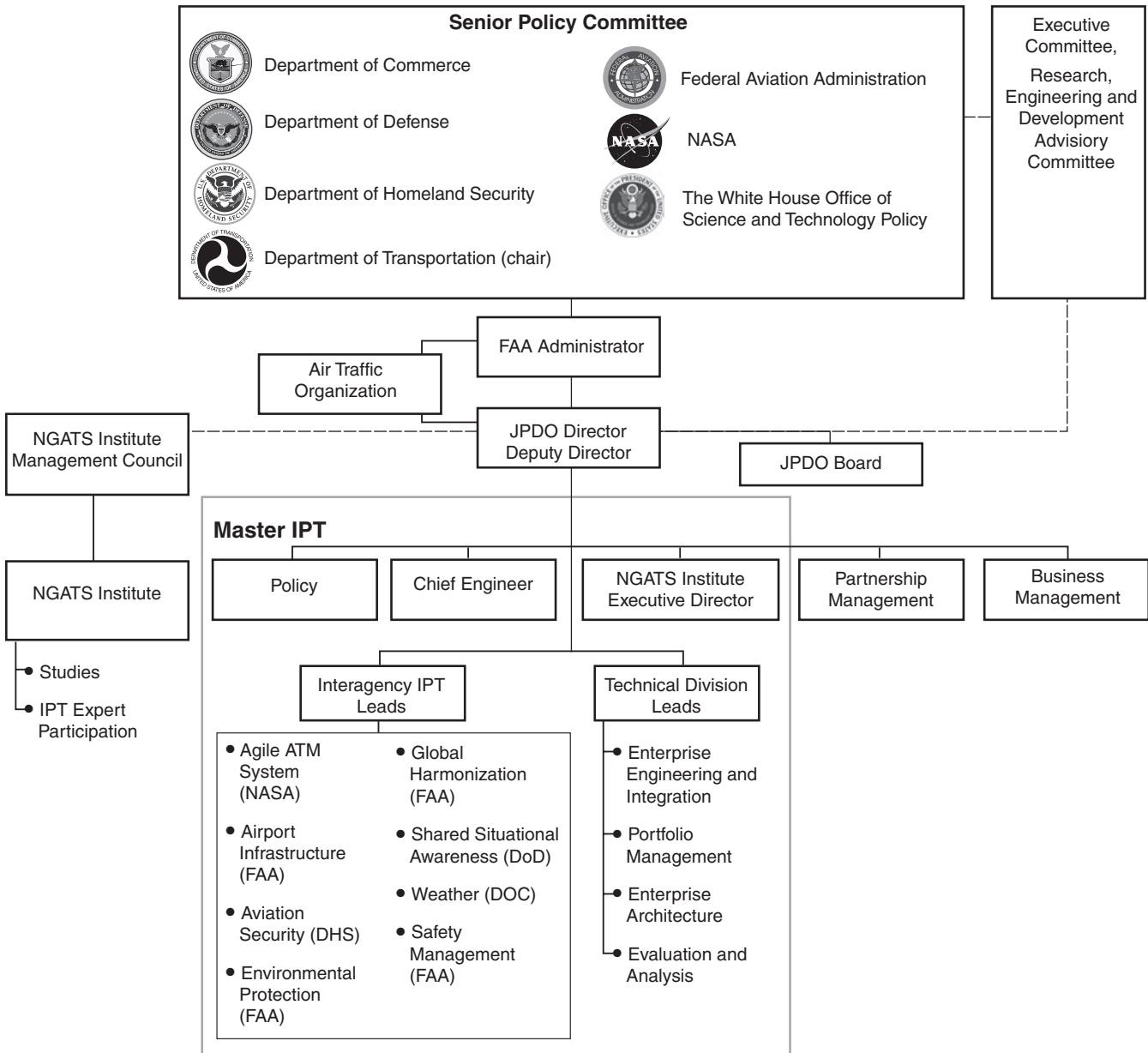
- JPDO's senior policy committee was formed and is headed by the Secretary of Transportation, as required in Vision 100. The committee includes senior-level officials from JPDO's partner agencies and has met three times since its inception.
- The NGATS Institute (the Institute) was created by an agreement between the National Center for Advanced Technologies<sup>7</sup> and FAA to incorporate the expertise and views of stakeholders in private industry, state and local governments, and academia. The NGATS Institute Management Council, composed of top officials and representatives from the aviation community, oversees the policy and recommendations of the Institute and provides a means for advancing consensus positions on critical NGATS issues. In March 2006, the Institute held its first public meeting to solicit information from the public and other interested stakeholders who are not involved in the council or the IPTs. These types of meetings are designed to address the Vision 100 requirement that JPDO coordinate and consult with the public.
- The IPTs are headed by representatives of JPDO's partner agencies and include more than 190 stakeholders from over 70 organizations, whose participation was arranged through the Institute.

Figure 1 shows JPDO's position within FAA and the JPDO structures that bring together federal and nonfederal stakeholders, including the Institute and the IPTs.

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<sup>7</sup>The National Center for Advanced Technologies is a nonprofit unit within the Aerospace Industries Association.

**Figure 1: Organization of JPDO**



Source: JPDO.

JPDO’s organizational structure incorporates some of the practices we have found effective for federal interagency collaborations. For example, our work has shown that mutually reinforcing or joint strategies can help



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align partner agencies' activities, core processes, and resources to accomplish a common outcome. Each of the eight IPTs is aligned with one of the eight strategies outlined in JPDO's integrated plan, and each is headed by a partner agency that has taken the lead on a specific strategy. Our research has also found that collaborating agencies should identify the resources needed to initiate or sustain their collaborative effort. To leverage human resources, JPDO has staffed the various levels of its organization—including JPDO's board, the IPTs, and technical divisions—with partner agency employees, many of whom work part time for JPDO. Finally, our work has shown that involving stakeholders can, among other things, increase their support for a collaborative effort. The Institute provides for involving nonfederal stakeholders, including the public, in planning NGATS.

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### JPDO Has Begun to Leverage the Resources of Its Partner Agencies for NGATS

Vision 100 requires JPDO to coordinate NGATS-related programs across the partner agencies. To address this requirement, JPDO conducted an initial interagency review of its partner agencies' research and development programs during July 2005 to identify work that could support NGATS. Through this process, JPDO identified early opportunities that could be pursued during fiscal year 2007 to coordinate and minimize the duplication of research programs across the partner agencies and produce tangible results for NGATS. For example, one identified opportunity is to align aviation weather research across FAA, NASA, and the Departments of Commerce and Defense; develop a common weather capability; and harmonize and incorporate into NGATS those agency programs designed to seamlessly integrate weather information and aircraft weather mitigation systems. In addition, the Automatic Dependent Surveillance-Broadcast (ADS-B)<sup>8</sup> and System Wide Information System (SWIM)<sup>9</sup> programs at FAA were identified as opportunities for accelerated funding to produce tangible results for NGATS. JPDO is currently working

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<sup>8</sup>ADS-B is a surveillance technology that transmits an aircraft's identity, position, velocity, and intent to other aircraft and to ATC systems on the ground, thereby enabling pilots and controllers to have a common picture of airspace and traffic. By providing pilots with a display that shows the location of nearby aircraft, the system enables pilots to collaborate in decision making with controllers, safely allowing reduced aircraft separation and thereby increasing capacity within the national airspace system.

<sup>9</sup>SWIM is expected to help in the transition to network-centric operations by providing the infrastructure and associated policies and standards to enable information sharing among all authorized system users, such as the airlines, civilian government agencies, and the military.

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with the Office of Management and Budget to develop a systematic means of reviewing the partner agencies' budget requests so that the NGATS-related funding in each request can easily be identified. Such a process would help the Office of Management and Budget consider NGATS as a unified federal investment, rather than as disparate line items distributed across several agencies' budget requests.

JPDO's effort to leverage its partner agencies' resources for NGATS demonstrates another practice important to sustaining collaborations. Our work on collaborations has found that collaborating agencies, by assessing their relative strengths and limitations, can identify opportunities for leveraging each others' resources and thus obtain benefits that would not be available if they were working separately. JPDO's first interagency review of its partner agencies' research and development programs has facilitated the leveraging of technological resources for NGATS. The budget process under development with OMB provides a further opportunity to leverage resources for NGATS.

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### Consistent with Vision 100, JPDO Is Developing an Enterprise Architecture

Vision 100 requires JPDO to create a multiagency research and development roadmap for the transition to NGATS. To comply with Vision 100, JPDO has been working on an enterprise architecture and expects to complete an early version of the architecture by September 2006. Many of JPDO's future activities will depend on the robustness and timeliness of this architecture development. The enterprise architecture will describe FAA's operation of the current national airspace system, JPDO's plans for NGATS, and the sequence of steps needed for the transformation to NGATS. The enterprise architecture will provide the means for coordinating among the partner agencies and private sector manufacturers, aligning relevant research and development activities, and integrating equipment.

JPDO has taken several important steps to develop the enterprise architecture—one of the most critical planning documents in the NGATS effort. For example, JPDO has drafted a concept of operations—a document that describes the operational transformations needed to achieve the overall goals of NGATS. JPDO has used this document to identify key research and policy issues for NGATS. For example, the concept of operations identifies several issues associated with automating the ATC system, including the need for a backup plan in case automation fails, the responsibilities and liabilities of different stakeholders during an automation failure, and the level of monitoring needed by pilots when automation is ensuring safe separation between aircraft. As the concept of

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operations matures, it will be important for air traffic controllers and other affected stakeholders to provide their perspectives on this effort so that needed adjustments can be made in a timely manner. JPDO officials recognize the importance of obtaining stakeholders' comments on the concept of operations and are currently incorporating stakeholders' comments into the concept of operations. JPDO expects to release its initial concept of operations by the end of July.

Another step that JPDO has taken to develop the enterprise architecture is to form an Evaluation and Analysis Division (EAD), composed of FAA and NASA employees and contractors. This division is assembling a suite of models to help JPDO refine its plans for NGATS and iteratively narrow the range of potential solutions. For example, EAD has used modeling to begin studying how possible changes in the duties of key personnel, such as air traffic controllers, could affect the workload and performance of others, such as airport ground personnel. According to JPDO officials, the change in the roles of pilots and controllers is the most important human factors issue involved in creating NGATS. JPDO officials noted that the Agile Airspace and Safety IPTs include human factors specialists and that JPDO's chief architect has a background in human factors. However, EAD has not yet begun to model the effect of the shift in roles on pilots' performance because, according to an EAD official, a suitable model has not yet been incorporated into the modeling tool suite. According to EAD, addressing this issue is necessary, but will be difficult because data on pilot behavior are not readily available for use in creating such models. Furthermore, EAD has not yet studied the training implications of various NGATS-proposed solutions because further definition of the concept of operations for these solutions is needed. As the concept of operations and enterprise architecture mature, EAD will be able to study the extent to which new air traffic controllers will have to be trained to operate both the old and the new equipment.

To develop and refine the enterprise architecture for NGATS, JPDO is following an effective technology development practice that we identified and applied to enterprise architecture development. This phased, "build a little, test a little" approach is similar to a process we have advocated for FAA's major system acquisition programs. This phased approach will also allow JPDO to incorporate evolving market forces and technologies in its architecture and thus better manage change. Consequently, additional refinements are expected to be made to the enterprise architecture.

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## As Required by Vision 100, JPDO Has Begun Efforts to Estimate the Costs of NGATS

Vision 100 requires JPDO to identify the anticipated expenditures for developing and deploying NGATS. To begin estimating these expenditures realistically, JPDO is holding a series of investment analysis workshops with stakeholders to obtain their input on potential NGATS costs. The first workshop, held in April 2006, was for commercial and business aviation, equipment manufacturers, and ATC systems developers. The second workshop is planned for August for operators of lower-performance aircraft used in both commercial and noncommercial operations. The third workshop, planned for early September, will focus on airports and other local, state, and regional planning bodies.

Although these workshops will help JPDO develop a range of potential costs for NGATS, a mature enterprise architecture is needed to provide the foundation for developing NGATS costs. Several unknown factors will drive these costs. According to JPDO, one of these drivers is the technologies expected to be included in NGATS. Some of these technologies are more complex and thus more expensive to implement than others. A second driver is the sequence for replacing current technologies with NGATS technologies. A third driver is the length of time required for the transformation to NGATS, since a longer period would impose higher costs. JPDO's first draft of its enterprise architecture, expected in September 2006, could reduce some of these variables, thereby allowing improved, albeit still preliminary, estimates of NGATS' costs.

Although the enterprise architecture for NGATS is not yet complete, both FAA and its Research, Engineering and Development Advisory Committee (REDAC) have developed preliminary cost estimates, which officials of both organizations have emphasized are not yet endorsed by any agency. FAA estimates that the facilities and equipment cost to maintain the ATC system and implement the transformation to NGATS will be about \$66 billion, or about \$50 billion in constant 2005 dollars. The annual cost would average \$2.7 billion per year in constant 2005 dollars from fiscal year 2007 through fiscal year 2025, or about \$200 million more each year than FAA's fiscal year 2006 facilities and equipment appropriation.

REDAC's Financing NGATS Working Group has developed a \$15 billion average annual cost estimate for NGATS that includes costs not only for facilities and equipment but also for operations; airport improvement; and research, engineering, and development—the remaining three components of FAA's appropriation. As table 1 indicates, the working group began with FAA's facilities and equipment estimate and went on to calculate the remaining costs for FAA to maintain the current ATC system and

implement the transformation to NGATS. REDAC’s estimate for NGATS’s total cost averages about \$1 billion more annually than FAA’s total appropriations for fiscal year 2006.

**Table 1: FAA’s and REDAC’s Cost Estimates for NGATS**

Dollars in billions

	FAA		REDAC <sup>a</sup>	
	Total NGATS cost	Average annual cost	Total NGATS cost	Average annual cost
Facilities and equipment	\$50.5	\$2.7	\$50.5	\$2.7
Operations	b	b	\$162.1	\$8.5
Airport improvement	b	b	\$67.5	\$3.6
Research, engineering, and development	b	b	\$12.4	\$0.7
<b>Total</b>	b	b	<b>\$292.5</b>	<b>\$15.5</b>

Source: GAO analysis of FAA and REDAC information.

<sup>a</sup>This is the working group’s estimate under its “base case” scenario, which assumes that FAA’s operations cost would increase between 2006 and 2010, but then become constant through 2025 as productivity increases offset the higher cost of increased demand. The working group also calculated a lower-cost “best case” scenario and a higher-cost “worst case” scenario using differing assumptions of productivity gains.

<sup>b</sup>FAA did not estimate these costs.

Besides being preliminary, these estimates are incomplete—FAA’s more than REDAC’s because FAA’s does not include any costs other than those for facilities and equipment. An FAA official acknowledged that the agency would likely incur additional costs, such as for safety certifications or operational changes responding to new NGATS technologies. Additionally, FAA’s facilities and equipment cost estimate assumes that the intermediate technology development work, performed to date by NASA, has been completed. As I will discuss shortly, it is currently unclear who will now perform this work, but if FAA assumes responsibility for the work, REDAC has estimated additional FAA funding needs of at least \$100 million a year. Furthermore, neither FAA’s nor REDAC’s estimate includes the other partner agencies’ costs to implement NGATS, such as those that the Department of Homeland Security might incur to develop and implement new security technologies. Finally, these estimates treat NGATS’s development and implementation period as an isolated event. Consequently, the costs drop dramatically toward 2025. In reality, officials who developed these estimates acknowledge that planning for the subsequent “next generation” system will likely be underway as 2025

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approaches and the actual modernization costs could therefore be higher in this time frame than these estimates indicate.

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## JPDO Faces Leadership, Resource, and Commitment Challenges as It Moves Forward with Planning for NGATS

JPDO faces several challenges in planning for NGATS, including addressing leadership vacancies, leveraging resources and expertise from its partner agencies, and convincing nonfederal stakeholders that the government is fully committed to NGATS.

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## Two Key JPDO Leadership Positions Are Vacant

JPDO has not had a permanent director since January 2006 and, with the recent resignation of the Secretary of Transportation, the senior policy committee is without a permanent chairperson. Our work has shown that, to overcome barriers to interagency coordination, committed leadership by individuals at the top of all involved organizations is critical. Leadership will also be important to provide a “champion” for JPDO and to sustain the partner agencies’ focus on and contributions to the transformation to NGATS. Moreover, without a chairperson of the senior policy committee, no one within JPDO is responsible for sustaining JPDO’s collaboration and overseeing its work.

These vacancies raise concerns about the continued progress of JPDO and NGATS. After ATO was authorized, we reported that without a chief operating officer, FAA was unable to move forward with the new air traffic organization—that is, to bring together the ATC system’s acquisition and operating functions, as intended, into a viable performance-based organization (PBO).<sup>10</sup> This PBO was designed to be part of the solution to the chronic schedule delays, cost overruns, and performance shortfalls in FAA’s ATC modernization program. We believe that filling the two vacant positions is critical to ensure continued progress for JPDO and NGATS.

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<sup>10</sup>GAO, *National Airspace System: Current Efforts and Proposed Changes to Improve Performance of FAA’s Air Traffic Control System*; [GAO-03-542](#) (Washington, D.C.: May 30, 2003).

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## Leveraging Resources and Expertise Poses a Challenge over Time

JPDO officials view leveraging the partner agencies' resources and expertise as one of their most significant challenges. According to JPDO officials, leveraging efforts have worked well so far, but JPDO's need for resources and expertise will increase with the development of NGATS, and for at least two reasons, JPDO may have difficulty meeting this need. First, JPDO's partner agencies have a variety of missions and priorities in addition to NGATS, and their priorities may change. Recently, for example, NASA reduced its aeronautics budget and decided to focus on fundamental<sup>11</sup> research, in part because the agency believes such research is more in keeping with its mission and unique capabilities. These changes occurred even though NASA's current reauthorization act requires the agency to align its aviation research projects to directly support NGATS goals. In light of the changes, it is unclear what fundamental research NASA will perform to support NGATS and who will perform the development steps for that research—that is, the validation and demonstration that must take place before a new technology can be transferred to industry and incorporated into a product. JPDO and FAA officials said that not enough is understood about NASA's plans to assess the impact of NASA's action on NGATS, but many experts told us that NASA's new focus on fundamental research creates a gap in the technology development continuum. Some believe that FAA has neither the research and development infrastructure nor the funding to do this work. As I previously mentioned, REDAC, in a draft report, estimated that FAA would need at least \$100 million annually in increased funding to perform this research and development work. REDAC further estimated that establishing the necessary infrastructure within FAA could delay the implementation of NGATS by 5 years.

Second, JPDO may have difficulty leveraging its partner agencies' resources and expertise because it does not yet have formal, long-term agreements with the agencies on their roles and responsibilities in creating NGATS. According to JPDO officials, they are working to establish memorandums of understanding (MOU) signed by the heads of the partner agencies that will broadly define the partner agencies' roles and responsibilities at a high level. JPDO is also developing more specific MOUs with individual partner agencies that lay out expectations for

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<sup>11</sup>NASA uses the term fundamental to refer to research that includes continued long-term, scientific study in core areas such as physics, chemistry, materials, experimental techniques, and computational techniques to enable new capabilities and technologies for individual and multiple disciplines.

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support on NGATS components, such as information sharing through network-centric operations.

Obtaining the specialized expertise of some stakeholders poses an additional challenge for JPDO. Air traffic controllers, for example, will play a key role in NGATS, but their union is not participating in JPDO. Currently, the ATC system relies primarily on air traffic controllers to direct pilots to maintain safe separation between aircraft. Under NGATS, this premise could change and, accordingly, JPDO has recognized the need for human factors research on issues such as how tasks should be allocated between humans and automated systems and how the existing allocation of responsibilities between pilots and air traffic controllers might change. The input of current air traffic controllers who have recent experience controlling aircraft is important in considering human factors and safety issues because of the controllers' familiarity with existing operating conditions.

The air traffic controllers' labor union, the National Air Traffic Controllers Association (NATCA), has not participated in NGATS since June 2005, when FAA terminated a labor liaison program that assigned air traffic controllers to major system acquisition program offices and to JPDO. FAA had determined that the benefits of the program were not great enough to justify its cost. The NGATS Institute Management Council includes a seat for the union, but a NATCA official told us that the union's head had been unable to attend the council's meetings. According to JPDO officials, the council has left a seat open in hopes that the controllers will participate in NGATS as the new labor-management agreement between NATCA and FAA is implemented.

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### Convincing Nonfederal Stakeholders That the Government Is Fully Committed to NGATS Presents Another Challenge

Convincing nonfederal stakeholders that the government is fully committed to NGATS poses a challenge because, in the past, the government has stopped some modernization efforts, including one in which an airline had already invested in supporting technologies. Specifically, FAA developed a datalink communications system that transmitted scripted e-mail-like messages between controllers and pilots. One airline equipped some of its aircraft with this new technology, but because of funding cuts, among other things, FAA canceled the program.



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Moreover, as we have reported,<sup>12</sup> some aviation stakeholders have expressed concern that FAA may not follow through with its airspace redesign efforts and are hesitant to invest in equipment unless they are sure that FAA will remain committed to its efforts. One expert suggested that the government might mitigate this issue by making an initial investment in a specific technology before requesting that airlines or other industry stakeholders purchase equipment.

Stakeholders' belief that the government is fully committed to NGATS will be important as efforts to implement NGATS technologies move forward. Achieving many of the benefits of NGATS will require users of the system—airlines and general aviation—to purchase NGATS-compatible technologies, such as ADS-B. This new air traffic surveillance system, which JPDO has identified as one of the early core technologies for NGATS, requires aircraft to be equipped with components that will be implemented in two phases. FAA anticipates significant cost savings from the implementation of the first phase, but the airlines do not expect to benefit until the second phase is complete. The technology should then allow pilots to fly more precise routes at night and in poor visual conditions. Another early core technology for NGATS, SWIM, is also intended to produce benefits for users, but again, it is not expected to do so for many years. Nonfederal stakeholders' support for these and other NGATS technologies will be important, and their support will depend, in part, on their assurance of the government's full commitment.

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## FAA Faces Institutionalization, Expertise, and Resource Challenges as It Transitions to NGATS

FAA faces challenges in implementing NGATS, including institutionalizing recent improvements in its management and acquisition processes, acquiring expertise to implement highly complex systems, and achieving cost savings to help fund NGATS technologies.

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<sup>12</sup>GAO, *National Airspace System: Transformation will Require Cultural Change, Balanced Funding Priorities, and Use of All Available Management Tools*, [GAO-06-154](#) (Washington, D.C.: Oct. 14, 2005).

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## Institutionalizing Recent Improvements in Management and Acquisition Processes Will Be Critical to the Successful Implementation of NGATS

With the establishment of ATO and the appointment of a Chief Operating Officer (COO) for it, FAA put a new management structure in place and established more businesslike management and acquisition processes to address the cost, schedule, and performance shortfalls that have plagued ATC modernization over the years. Under the new structure, FAA is a flatter organization, with fewer management layers, and managers are in closer contact with the services they deliver. FAA has also taken some steps to break down the vertical lines of authority, or organizational stovepipes, that we found hindered communication and coordination across FAA. For example, the COO holds daily meetings with the managers of ATO's departments and holds the managers collectively responsible for the success of ATO through the performance management system.

FAA has revised its management processes to increase accountability. For example, it has established a cost accounting system and made the units that deliver services within each department responsible for managing their own costs. Thus, each unit manager develops an operating budget and is held accountable for holding costs within specific targets. Managers track the costs of their unit's operations, facilities and equipment, and overhead and use this information to determine the costs of the services their unit provides. Managers are evaluated and rewarded according to how well they hold their costs within established targets. Our work has shown that it is important, when implementing organizational transformations, to use a performance management system to assure accountability for change.<sup>13</sup>

Finally, FAA is revising its acquisition processes, as we recommended,<sup>14</sup> and taking steps to improve oversight, operational efficiency, and cost control. To ensure executive-level oversight of all key decisions, FAA has revised its Acquisition Management System to incorporate key decision points in a knowledge-based product development process. Moreover, as we have reported, an executive council now reviews major acquisitions before they are sent to FAA's Joint Resources Council.<sup>15</sup> To better manage cost growth, this executive council also reviews breaches of 5 percent or

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<sup>13</sup>[GAO-03-542](#).

<sup>14</sup>GAO, *Air Traffic Control: FAA's Acquisition Management Has Improved, but Policies and Oversight Need Strengthening to Help Ensure Results*, [GAO-05-23](#) (Washington, D.C.: Nov. 12, 2004).

<sup>15</sup>[GAO-05-23](#).

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more in a project's cost, schedule, or performance. FAA has issued guidance on how to develop and use pricing, including guidelines for disclosing the levels of uncertainty and imprecision that are inherent in cost estimates for major ATC systems. Additionally, FAA has begun to base funding decisions for system acquisitions on a system's expected contribution to controlling operating costs. Finally, FAA is creating a training framework for its acquisition workforce that mirrors effective human capital practices that we have identified, and the agency is taking steps to measure the effectiveness of its training.

Since 2004, FAA has met its acquisitions performance goal—to have 80 percent of its system acquisitions on schedule and within 10 percent of budget. To sustain this record, FAA will need to institutionalize its reforms—that is, provide for their duration beyond the current administration at FAA and ATO by ensuring that the reforms are fully integrated into the agency's structure and processes at all levels and have become part of its organizational culture. Our work has shown that successfully institutionalizing change in large public and private organizations can take 5 to 7 years or more.<sup>16</sup>

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### Despite Recent Process Improvements, FAA Faces Challenges in Obtaining the Expertise Needed to Implement a System as Complex as NGATS

In the past, a lack of expertise contributed to shortfalls in FAA's management of ATC modernization projects. Although the personnel flexibilities that Congress authorized in 1995 allowed FAA to establish criteria for outstanding performance and match industry pay scales for needed expertise, industry experts have questioned whether FAA will have the technical expertise needed to implement NGATS—a task of unprecedented complexity, according to JPDO, FAA, and other aviation experts. In 2004, we found that FAA could not ensure that its own best practices were consistently used in managing acquisitions and, as a result, its major acquisitions were still at risk of cost overruns, schedule slippages, or performance shortfalls.<sup>17</sup> These findings are consistent with concerns about the expertise of acquisition managers governmentwide. According to a 2005 study by the Merit Systems Protection Board,<sup>18</sup> at least

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<sup>16</sup>GAO, *Results-Oriented Cultures: Implementation Steps to Assist Mergers and Organizational Transformations*, GAO-03-669 (Washington, D.C.: July 2, 2003).

<sup>17</sup>GAO-05-23.

<sup>18</sup>U.S. Merit Systems Protection Board, *Contracting Officer Representatives: Managing the Government's Technical Experts to Achieve Positive Contract Outcomes* (Washington, D.C.: Dec. 2005).

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50 percent of the government personnel who currently manage technical contracts reported needing training in areas such as contract law, developing requirements, requesting bids, developing bid selection criteria and price determinations, and monitoring contractor performance.

Recognizing the complexity of the NGATS implementation effort and the possibility that FAA may not have the in-house expertise to manage it without assistance, we have identified potential approaches for supplementing FAA's capabilities. One of these approaches is for FAA to contract with a lead systems integrator (LSI). Generally, an LSI is a prime contractor that would help to ensure that the discrete systems used in NGATS will operate together and whose responsibilities may include designing system solutions, developing requirements, and selecting major system and subsystem contractors. The government has used LSIs before for programs that require the integration of multiple complex systems. Our research indicates that although LSIs have certain advantages, such as the knowledge, understanding, skills, and ability to integrate functions across various systems, their use also entails certain risks. For example, because an LSI may have significantly more responsibility than a prime contractor usually does, careful oversight is necessary to ensure that the government's interests are protected and that conflicts of interest are avoided. Consequently, selecting, assigning responsibilities to, and managing an LSI could pose significant challenges for JPDO and FAA.

Another approach that we have identified involves obtaining technical advice from federally funded research and development corporations to help the agency oversee and manage prime contractors. These nonprofit corporations are chartered to provide long-term technical advice to government agencies in accordance with various statutory and regulatory rules to ensure independence and prevent conflicts of interest.

FAA officials indicated that they are considering at least these two approaches to help address any possible gaps the agency may have in its technical expertise. Given the complexity of implementing NGATS, we believe that FAA's consideration of these approaches to filling any gaps in its technical expertise is appropriate. We believe that either of these approaches could reduce the risks associated with implementing NGATS.

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## FAA Will Require Resources to Implement NGATS

The cost of operating and maintaining the current ATC system while implementing NGATS will be another important challenge in transitioning to NGATS—a system that, as noted, is broader in scope than the current ATC system and will require funding for security technologies and

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environmental activities as well as ATC technologies. Although additional funding for the current ATC system and for NGATS may come from increased congressional appropriations, some industry analysts expect that most of the funds for implementing NGATS will have to come from savings in operating and maintaining the current ATC system.

FAA is currently seeking to reduce costs by introducing infrastructure and operational efficiencies and expects to use the savings from these efforts to help fund the implementation of NGATS. For example, FAA has begun to decommission ground-based navigational aids, such as compass locators, outer markers, and nondirectional radio beacons, as it begins to move toward a satellite-based navigation system. In fiscal year 2005, FAA decommissioned 177 navigational aids, claiming savings of \$2.9 million. According to one expert, FAA could additionally generate revenue from these sites by leasing them for warehouses or cell phone towers. FAA also expects to reduce costs by streamlining its operations. For example, it is consolidating its administrative activities, currently decentralized across its nine regions, into three regions, and anticipates an annual savings of up to \$460 million over the next 10 years. Our work analyzing international air navigation service providers has shown that additional cost savings may be possible by further consolidating ATC facilities such as terminal radar approach control (TRACON) facilities and ATC centers. According to one estimate of potential FAA savings, consolidating the existing 21 air route traffic control centers into 6 centers could save approximately \$600 million per year. Finally, FAA expects to save costs through outsourcing. For example, it outsourced its automated flight service stations to a private contractor and expects to achieve savings of \$1.7 billion over 10 years. In addition, it expects savings of \$0.5 billion from 400 staffing reductions that occurred between the time the outsourcing began and the time the new contract was actually implemented. The agency expects to receive \$66 million—the first installment of these cost savings—in fiscal year 2007.

Until FAA has completed its estimates of both NGATS costs and the cost savings it will be able to achieve between now and 2025, it will not be able to determine how far these cost savings will go toward financing NGATS. Nonetheless, one analyst has preliminarily estimated that FAA's expected savings through infrastructure and operational efficiencies will fall far short of the amount needed to finance NGATS.<sup>19</sup> While more information is

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<sup>19</sup>Aviation Management Associates, Inc., *The "No New Money" Scenario for the Next Generation Air Transportation System*, (Alexandria, VA: Oct. 1, 2005).

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needed to estimate the amount of any shortfall with greater confidence, these preliminary and incomplete estimates signal the extent of the resource challenge.

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Mr. Chairman, this concludes my statement. We would be pleased to answer any questions that you and Members of the Subcommittee may have.

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## Contact and Staff Acknowledgments

For further information on this testimony, please contact Gerald Dillingham at (202) 512-2834 or [dillingham@gao.gov](mailto:dillingham@gao.gov). Individuals making key contributions to this statement include Kevin Egan, Elizabeth Eisenstadt, David Hooper, Heather Krause, Elizabeth Marchak, Edmond Menoche, Faye Morrison, Taylor Reeves, and Richard Scott.

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