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NEXT GENERATION AIR TRANSPORTATION SYSTEM

Issues Associated with Midterm Implementation of Capabilities and Full System Transformation

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Highlights of [GAO-09-481T](#), a testimony before the Subcommittee on Aviation Operations, Safety, and Security, Committee on Commerce, Science, and Transportation, U.S. Senate

Why GAO Did This Study

To prepare for forecasted air traffic growth, the Federal Aviation Administration (FAA), including its Joint Planning and Development Office (JPDO) and Air Traffic Organization (ATO), is planning for and implementing the Next Generation Air Transportation System (NextGen) in partnership with other federal agencies and the aviation industry. NextGen will transform the current radar-based air traffic control system into a more automated aircraft-centered, satellite-based system. GAO's previous work has identified issues related to the usefulness of NextGen planning documents, FAA's organizational structure to manage the transition to NextGen, and FAA's workforce to oversee and implement NextGen. Recently, the focus of NextGen planning and implementation has shifted to capabilities that can be achieved in the midterm, defined as 2012 through 2018.

GAO's testimony focuses on (1) JPDO's and ATO's progress in planning NextGen and changes in the NextGen management structure; (2) ongoing efforts to implement midterm capabilities to address capacity constraints, and issues related to these efforts; and (3) key human capital issues, research and development needs, and facilities maintenance and reconfiguration challenges going forward. GAO's testimony updates prior GAO work with FAA data and interviews with agency and union officials and industry stakeholders, including airline, aircraft, and avionics manufacturer representatives.

To view the full product, click on [GAO-09-481T](#)

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What GAO Found

JPDO and ATO have made progress in planning for and developing NextGen. JPDO has continued to update its basic planning documents, and in January 2009, ATO released the current version of its NextGen Implementation Plan, which focuses on the midterm implementation of capabilities. Recent versions of NextGen planning documents have partially addressed some of GAO's previously reported concerns about their usefulness, but industry participants continue to express frustration that the documents lack any specific timelines or commitments. Recent changes in the management structure for NextGen, though designed to address industry stakeholders' and others' concerns about fragmentation of authority and lack of accountability, have not fully addressed these issues and have raised further questions about parties' roles and responsibilities.

To help address current congestion and delays, industry stakeholders have frequently suggested that FAA shift its focus from planning for NextGen to maximizing what can be done with existing, proven capabilities and existing infrastructure. In January of this year, FAA created a NextGen Midterm Implementation Task Force, which responds to this suggestion and is to report its recommendations to FAA in August 2009. The task force plans to identify and prioritize capabilities that can be implemented in the midterm and potentially be deployed regionally to address key bottlenecks. Essential to the mid- and long-term success of these efforts is persuading the airlines to make costly investments in NextGen equipment—a step they are reluctant to take without clearly demonstrated benefits. Incentives that could encourage such investments include operational preferences—such as preferred airspace, routings, or runway access—and equipment investment tax credits. FAA will also have to validate, certify, and issue rules for these capabilities.

Going forward, FAA faces challenges in resolving human capital issues, addressing needed research and development, reconfiguring and maintaining existing facilities, and enhancing capacity. Human capital issues include involving stakeholders, such as controllers and technicians, in NextGen efforts and acquiring the systems engineering, contract management, leadership, and other skills needed for NextGen. FAA plans to fill 378 NextGen positions in fiscal years 2009 and 2010. Additionally, for NextGen, research and development efforts to address the environmental impact of aviation, human factors, and weather will be critical. Air traffic facilities will also have to be reconfigured to support NextGen, and existing facilities require maintenance to ensure safety and reliability. FAA is currently reviewing its facility needs. Finally, even with the efficiencies anticipated from implementing NextGen, FAA has determined that it will need additional airport and runway capacity. Efforts to enhance capacity will require substantial advance planning and cost and safety analyses.

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to testify before you this morning on efforts to transform the nation's current air traffic control (ATC) system to the Next Generation Air Transportation System (NextGen). Currently, the U.S. air transportation system handles about 50,000 flights over a 24-hour period. By 2025, air traffic is projected to increase to about 80,000 flights every 24 hours. Today's U.S. air transportation system will not be able to meet these air traffic demands. In fact, as we all know, today's system is straining to meet current demands. For example, in 2008, almost one in four flights either arrived late or was canceled, and the average flight delay increased despite a 6 percent decline in the total number of operations. The transformation to NextGen, together with other ongoing ATC modernization efforts, promises to enhance the capacity and efficiency of our air transportation system while maintaining safety and minimizing the environmental impact of air transportation.

In Vision 100,¹ enacted in 2003, Congress directed the Secretary of Transportation to establish the Joint Planning and Development Office (JPDO) to plan and coordinate the transition to NextGen in collaboration with other federal agencies² and the aviation industry. NextGen will transform the current radar-based ATC system into a more automated, aircraft-centered, satellite-based system, and will shift the operating paradigm from air traffic control to air traffic management. NextGen encompasses five major transformational programs—Automatic Dependent Surveillance Broadcast (ADS-B), System-Wide Information Management (SWIM), NextGen Data Communications (DataComm), NextGen Network Enabled Weather (NNEW), and National Airspace Voice

¹Vision 100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176, 117 Stat. 2490 (2003).

²NextGen was designed as an interagency effort in order to leverage various agencies' expertise and funding to advance NextGen while avoiding duplication. The federal partner agencies are the Departments of Commerce (particularly its National Oceanic and Atmospheric Administration), Defense, Homeland Security, and Transportation; the Federal Aviation Administration; the National Aeronautics and Space Administration; and the White House Office of Science and Technology Policy.

Switch (NVS).³ JPDO—located organizationally within the Federal Aviation Administration (FAA)—is responsible for NextGen planning and coordination. FAA’s Air Traffic Organization (ATO), headed by its Chief Operating Officer (COO), is responsible for implementing the transition to NextGen. At the same time, FAA is planning and implementing other capabilities that have not been designated specifically as NextGen efforts but are also expected to enhance the capacity and efficiency of the air transportation system. FAA plans to implement these capabilities in the midterm, defined as 2012 through 2018, and eventually to integrate them with NextGen transformational programs.

My testimony this morning addresses (1) JPDO’s and ATO’s progress in planning NextGen and changes in the NextGen management structure; (2) ongoing efforts to implement midterm capabilities to address capacity constraints and delays, and issues related to these efforts; and (3) key human capital issues, research and development needs, and facilities maintenance and reconfiguration challenges going forward. My statement is based on recent related GAO reports and testimonies, updated with more recent FAA data, and our discussions with selected senior FAA officials; officials of the National Air Traffic Controller Association (NATCA) and the Professional Aviation Safety Specialists (PASS) unions; and aviation industry stakeholders, including the Air Transport Association, which represents U.S. airlines, and aircraft and avionics industry representatives. This work was conducted in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the work to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

³*ADS-B* is a satellite navigation system that is designed, along with other navigation technologies, to enable more precise control of aircraft during en route flight, approach, and descent. *SWIM* is an information management architecture for the national airspace system, acting as its “World Wide Web.” *SWIM* will manage surveillance, weather, and flight data, as well as aeronautical and system status information, and will provide the information securely to users. *DataComm* provides a digital communications link for two-way exchanges between controllers and flight crews for ATC clearances, instructions, advisories, flight crew requests, and reports. *NNEW* will serve as the core of the NextGen weather support services and provide a common weather picture across the national airspace system. *NVS* will replace existing switches and provide the foundation for all air/ground and ground/ground voice communications in the future ATC environment.

JPDO and ATO Have Issued Key NextGen Plans, but ATO Restructuring and Recent Executive Order Have Not Fully Resolved NextGen Management Issues

JPDO and ATO have issued key NextGen plans and have reorganized the management structure for NextGen. We have previously reported on stakeholders' concerns about the fragmented management structure for NextGen and resulting lack of clear accountability for NextGen's implementation. While recent FAA efforts have made progress on this front, they have yet to fully resolve stakeholders' concerns. Resolving this issue will be critical to advancing both the implementation of capabilities in the midterm and the full transformation to NextGen in the long term.

Planning Effort Has Shifted to Focus on Implementation, but Continues to Lack Specific Timelines and Commitments

Since 2003, JPDO and ATO have made progress in planning for and implementing NextGen. In accordance with Vision 100, JPDO created a multi-agency research and development plan for the transition to NextGen. This plan consists of three basic documents—a Concept of Operations, an Enterprise Architecture, and an Integrated Work Plan.⁴ Collectively, these three documents form a basis for interagency and industry planning and coordination. JPDO views these plans as iterative and intends to issue further versions as NextGen technologies are developed and implemented. As NextGen progressed from the planning to the implementation phase, ATO produced its NextGen Implementation Plan, which addresses the more detailed level of planning and activities necessary to achieve NextGen capabilities. According to ATO, it and JPDO have worked to align and ensure linkages between these planning documents. The current version of the NextGen Implementation Plan, released in January 2009, focuses on the midterm (2012 through 2018) implementation of NextGen capabilities.

⁴The Concept of Operations describes how the NextGen system is envisioned to operate in 2025 and beyond and identifies key research and policy issues. The Enterprise Architecture is a technical description of the NextGen system, akin to blueprints for a building; it is meant to provide a common tool for planning and understanding the complex, interrelated systems that will make up NextGen. JPDO's Integrated Work Plan is akin to a project plan and is meant to describe the capabilities needed to transition to NextGen from the current system and provide the research, policy, regulation, and acquisition timelines necessary to achieve NextGen by 2025.

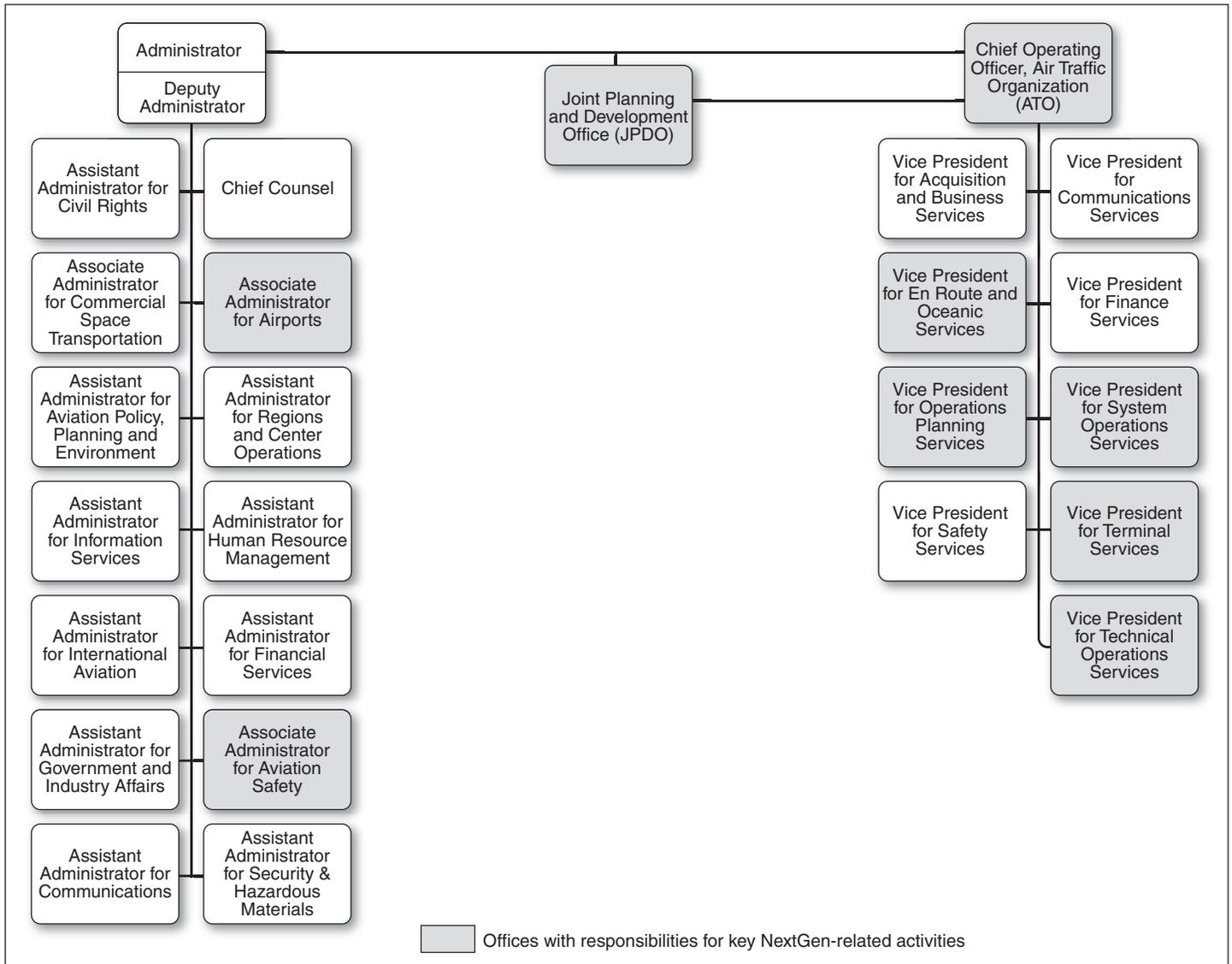
In a previous testimony,⁵ we raised some concerns about the usefulness of the NextGen planning documents, and we still have some concerns. For example, we reported that the planning documents lacked the type of specific information that industry stakeholders need for their own planning purposes, such as a catalog of critical needs, clearly defined and prioritized intermediate objectives, and a structured plan for achieving tangible results. Recent versions of NextGen planning documents have partially addressed some of these concerns, but industry stakeholders continue to express frustration that the planning documents lack any specific timelines or commitments. A senior FAA official has acknowledged that FAA will face ongoing challenges in attempting to communicate effectively with industry and other stakeholders to ensure that they fully understand the content and objectives of the initiative and remain engaged and committed to its planning and implementation.

NextGen Organizational Structure Has Undergone Changes, but Roles and Responsibilities Continue to Be Unclear

Initially, JPDO was established as a separate and independent office within FAA reporting directly to both the COO of ATO and the FAA Administrator (see fig. 1).

⁵GAO, *Next Generation Air Transportation System: Status of Key Issues Associated with the Transition to NextGen*, [GAO-08-1154T](#) (Washington, D.C. Sept. 11, 2008).

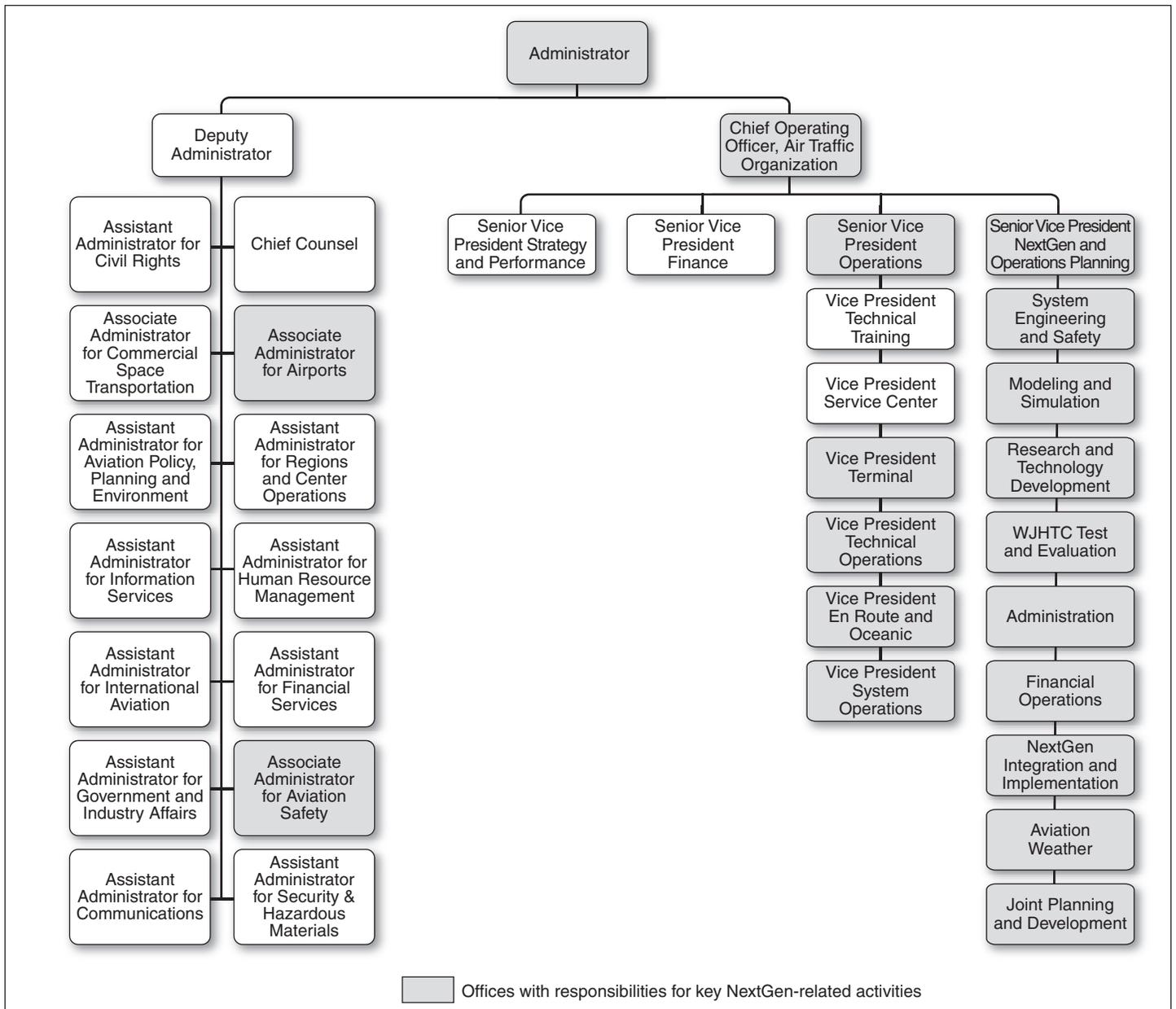
Figure 1: FAA Organization, November 2007



Source: FAA.

In May 2008, FAA announced a reorganization of its NextGen management structure and named a Senior Vice President for NextGen and Operations Planning who reports to ATO's COO (see fig. 2.). The reorganization eliminated JPDO's dual reporting status, and the JPDO Director now reports directly to the newly created Senior Vice President for NextGen and Operations Planning. The reorganization also led to JPDO's placement lower in FAA's organizational structure—it is now a fourth-level organization.

Figure 2: Current FAA and ATO Organization



Source: FAA.

According to ATO's COO, a purpose of the reorganization was to respond to industry stakeholders' concerns about the fragmentation of authority

and lack of accountability for NextGen, which might delay its implementation. In particular, stakeholders have expressed frustration that a program as large and important as NextGen does not follow the industry practice of having one person with the authority to make key decisions. In the COO's view, the reorganization creates one "team" with one person in charge to plan, implement, and oversee NextGen. According to FAA, the Senior Vice President for NextGen and Operations Planning is responsible for integrating and implementing all elements of NextGen. However, this individual does not have budget authority over several key NextGen projects, according to a recent testimony from the Department of Transportation's (DOT) Inspector General.⁶

In November 2008, the President issued Executive Order 13479,⁷ which took the positive step of treating NextGen as an important national initiative, but potentially added another level of complexity and uncertainty to the management structure for NextGen. The order directed the Secretary to create a staff to support the Senior Policy Committee, an advisory body chaired by the Secretary of Transportation whose members are the heads of the federal partner agencies and whose purpose is to provide policy guidance for NextGen planning. Previously, JPDO coordinated the agenda of the Senior Policy Committee, but now, according to FAA, the new support staff will coordinate the committee's agenda, although JPDO will continue to be involved in the development of issues and topics for the committee. Furthermore, notwithstanding JPDO's statutory responsibility for coordinating with the federal partner agencies, the director of the support staff will serve as the senior DOT liaison between the Secretary and the federal partner agencies. It remains unclear how these changes will affect JPDO's role relative to the Senior Policy Committee or to other federal partner agencies. The executive order also directed the Secretary to establish a committee to advise the Secretary on the implementation of NextGen. According to FAA's interpretation of the executive order, the new advisory committee will be an external (nongovernmental) committee whose role will be to provide an external stakeholder perspective. The role of this committee could potentially duplicate the roles of other advisory bodies associated with the NextGen

⁶*Federal Aviation Administration: Actions Needed to Achieve Mid-Term NextGen Goals.* Statement by Calvin L. Scovel III, Inspector General, U.S. Department of Transportation before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives, U.S. Congress (Washington D.C, March 18, 2009).

⁷Transformation of the National Air Transportation System, Exec. Order No. 13479 (2008).

initiative. FAA has said that it and JPDO are working with DOT to clarify roles and responsibilities in executing the executive order.

It is difficult to tell how well the reorganization and the implementation of the executive order will address stakeholders' concerns about the fragmentation of authority for NextGen. For example, although the reorganization places JPDO and the office responsible for NextGen integration and implementation under the leadership of the same Senior Vice President, other activities critical to NextGen's implementation lie outside this official's jurisdiction. Several types of aviation operations are under the leadership of the Senior Vice President for Operations, and responsibilities for airport and aviation safety activities fall outside ATO altogether and are headed by FAA Associate Administrators. According to FAA, the NextGen Management Board, which is composed of Associate Administrators, the COO, Senior Vice Presidents, and the Director of the JPDO, ensures agencywide support for NextGen. However with no direct line of authority between the Senior Vice President for NextGen and Operations Planning and these other operations and activities, accountability for NextGen outcomes is unclear, creating the potential for delays in implementation. It is also unclear how the reorganization and the implementation of the executive order will affect the overall role created for JPDO by Vision 100. For example, according to one industry stakeholder, their ability to understand and be involved in the NextGen-related efforts of federal partner agencies has been hampered by JPDO's placement under ATO's management.

Several stakeholders have suggested that an office above the Senior Vice President for NextGen and Operations Planning and these other units—an office that would report directly to the FAA Administrator or the Secretary of Transportation—is needed to ensure accountability for NextGen results. In contrast, another stakeholder suggested that further reorganization may not be needed, but FAA's existing leadership could play a greater role in clarifying the responsibilities of the various offices involved in planning and implementing NextGen and in clearly assigning accountability for NextGen outcomes.

Industry Stakeholders Seek More Rapid Midterm Implementation of Existing Capabilities, but Progress Depends Both on Airlines' Investments and on FAA's Validation, Certification, and Rulemaking

To help address current congestion and delays, many stakeholders have suggested that FAA focus on maximizing what can be done with existing, proven capabilities and existing infrastructure. We have previously characterized this approach as “NowGen.” For example, industry stakeholders highlighted “off-the-shelf” technologies, including Traffic Management Advisor (TMA), Traffic Flow Management (TFM), and User Request Evaluation Tool (URET), as well as performance-based navigation⁸ and tailored arrival procedures. Such technologies and procedures are being implemented in airports now and, according to these stakeholders, could be implemented more widely and used more effectively to address capacity constraints. For example, TMA—a decision-support tool that helps controllers manage air traffic flows more efficiently—has been used at some airports to increase capacity. However, according to one stakeholder, some airports equipped with TMA are not using it to its fullest extent to increase capacity. Industry stakeholders also maintain that using existing performance-based navigation procedures during low-visibility conditions—when the required distances separating aircraft are normally increased for safety reasons—would enable greater use of closely spaced parallel runways, thereby increasing capacity.

In part to help accelerate the implementation of existing capabilities in the midterm—including technologies that are part of NextGen’s five transformational programs, such as ADS-B—FAA has created a NextGen Midterm Implementation Task Force through RTCA.⁹ According to the NextGen Implementation Plan, the task force will focus on maximizing the benefits of midterm NextGen operational capabilities and addressing business and investment-related issues associated with implementing these capabilities. A member of the task force indicated that it will be identifying a handful of capabilities that can be implemented in the midterm and prioritizing them according to their relative net benefits. Furthermore, the task force will be examining the potential for deploying capabilities regionally to address key bottlenecks in the national air

⁸Performance-based navigation, which includes Area Navigation (RNAV) and Required Navigation Performance (RNP), is a framework for defining navigation performance requirements (“navigation specifications”) that can be applied to an air traffic route, an instrument procedure, or a defined airspace. Performance-based navigation provides a basis for the design and implementation of automated flight paths.

⁹RTCA, Inc. is a private, not-for-profit corporation that develops consensus-based recommendations on communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues. RTCA functions as a Federal Advisory Committee. FAA uses its recommendations as a basis for policy, program, and regulatory decisions.

transportation system before deploying them nationally. Current plans call for the task force to provide final conclusions and recommendations to FAA in August 2009.

Midterm Implementation Depends on Airlines' Acquisition of Required Avionics

Implementing these capabilities in the midterm, as well as over the long term, depends not only on FAA, but also on aircraft operators, who must acquire the necessary equipment. For example, aircraft must be equipped with appropriate technology to use ADS-B. Some airlines have purchased some of the necessary technology, but over all, airlines are waiting for FAA to specify requirements and address funding concerns. In addition, industry stakeholders have expressed concerns about the progress made by FAA in adequately explaining and demonstrating the benefits of equipping aircraft with advanced avionics equipment, which comes at a significant cost to the aviation industry. For example, one industry stakeholder told us that, without an explicit FAA commitment to reduce separation standards—a key benefit of deploying aircraft with ADS-B equipment—the industry has little incentive to voluntarily purchase the equipment. One objective of the new NextGen Midterm Implementation Task Force is to help operators identify the benefits of acquiring NextGen-compatible equipment sooner rather than later.

A range of potential requirements and incentives could encourage aircraft operators to purchase equipment. These could include mandated deadlines or operational preferences—such as preferred airspace, routings, or runway access. Industry stakeholders have expressed concerns that the array of operational benefits available to early equippers has yet to be identified and defined, and have also questioned the extent to which such preferences would result in tangible benefits. Another proposed option would combine mandated deadlines and operational preferences with equipment investment tax credits that would financially support equipment implementation for a limited initial set of aircraft operators. The credits would provide a competitive advantage for early equippers. Airlines that continue to delay equipage will become more and more disadvantaged, thus providing an incentive for these airlines to equip.

Midterm Implementation Also Depends on FAA's Validation, Certification, and Rulemaking Efforts

Before midterm NextGen implementation can occur, FAA must validate and certify¹⁰ technologies and issue rules for the use of procedures. FAA has made some progress in this area, including developing specifications for performance-based navigation procedures at selected airports, but much remains to be done. We and others have previously expressed concerns about the time and human resources required for these efforts and have identified them as a significant risk to the timely and cost effective implementation of NextGen.¹¹ In recent interviews, stakeholders have expressed similar concerns about the midterm implementation of existing or off-the-shelf technologies and capabilities. For example, an avionics manufacturer, an aircraft manufacturer, and an airline association we interviewed all cited the time it takes to develop rules for new procedures and the problems that result from deploying equipment before rules are finalized. Any activities needed to implement new policies and procedures, such as the expanded use of performance-based navigation procedures; to demonstrate new capabilities, such as the use of closely spaced parallel runways; to set parameters for the certification of new systems, such as ADS-B; and to develop new technologies will take time and be a priority in the mid- and long-term planning for NextGen. Just as important, the time required to complete such activities will have to be balanced against the need to ensure the reliability and safety of procedures and systems before they are used in the national airspace system.

¹⁰Validation is the process through which a technology is shown to operate in a real-life environment with a desired level of confidence. Certification is a form of FAA approval for the use of a technology, such as aircraft equipment, in the national airspace system.

¹¹After studying the lead time required to prototype, validate, and certify new technologies, we concluded that neither JPDO nor FAA had sufficient resources to complete these types of tasks, and could not develop them internally without causing significant delays to NextGen-related capabilities. See GAO, *Response to Questions for the Record; Hearing on the Future of Air Traffic Control Modernization*, [GAO-07-928R](#) (Washington, D.C.: May 30, 2007). We discuss the human capital element of this challenge in greater detail later in this testimony.

Addressing Ongoing Human Capital, Research and Development, and Facility and Capacity Challenges Will Be Critical for NextGen's Implementation Going Forward

A number of other challenges affect FAA's ability to move forward with NextGen's implementation. These challenges include resolving ongoing human capital challenges, addressing research and development needs, reconfiguring and maintaining existing facilities, and enhancing the physical capacity of airports.

Resolving Key Human Capital Challenges, Including Involving Internal Stakeholders and Acquiring Expertise, Will Be Critical to NextGen's Success

Involving internal stakeholders, such as current air traffic controllers and technicians, in planning for and deploying new technologies will be important to NextGen's success. In our view, input from current air traffic controllers with recent experience controlling aircraft, who will be responsible for managing traffic in the NextGen environment, and from current technicians, who will maintain NextGen equipment, is important when considering human factors and safety issues. Furthermore, our work on past ATC modernization projects has shown that a lack of stakeholder or expert involvement early and throughout a project can lead to cost increases and delays.¹²

We have previously reported that active air traffic controllers were not involved in the NextGen planning effort.¹³ In following up on this issue, we found that some progress has been made. According to FAA, it has used active controllers as subject matter experts in NextGen development; representatives of both the controllers' and the technicians' unions have seats on the NextGen Management Board; and the controllers' union is participating in the NextGen Midterm Implementation Task Force. Controller union officials have likewise reported participating in several NextGen planning and decision-making groups, including the Institute

¹²See GAO, *Air Traffic Control: FAA Needs to Ensure Better Coordination When Approving Air Traffic Control Systems*, [GAO-05-11](#) (Washington, D.C.: Nov. 17, 2004) and [GAO-08-1154T](#).

¹³See [GAO-08-1154T](#).

Management Council,¹⁴ and acknowledge that active controllers serve as subject matter experts for NextGen working groups. However, these union officials have expressed concern that the union is not involved in selecting the subject matter experts. According to the technicians' union, it does not generally participate in NextGen efforts, although it has a liaison working on ADS-B and is seeking to participate in the NextGen Midterm Implementation Task Force.

Acquiring expertise in areas such as systems engineering and contract management is another human capital challenge FAA faces going forward. Because of the scope and complexity of the NextGen effort, the agency may not currently have the in-house expertise to manage the transition to NextGen without assistance. In November 2006, we recommended that FAA examine the strengths and weaknesses of its technical expertise and contract management expertise in light of the skills required to define, implement, and integrate the numerous complex programs inherent in the transition to NextGen.¹⁵ In response to our prior recommendation, ATO contracted with the National Academy of Public Administration (NAPA) to (1) determine the mix of skills needed by the nonoperational (acquisition) workforce to implement NextGen and (2) identify the strategies for acquiring the necessary workforce competencies.

In September 2008, NAPA completed its study and reported to FAA. The study found that ATO will need to develop or strengthen skills in the areas of software development, systems engineering, research and development, strategic planning, financial budget analysis, and contract administration, among others. However, the study identified leadership as the single most important element of success for large-scale systems integration efforts like NextGen and highlighted leadership as a NextGen implementation challenge. The study, therefore, recommended that FAA tailor its leadership development program to focus on the specific leadership skills needed for managing this large, complex, evolving program, to include communication, collaboration, change management, and accountability

¹⁴The Institute Management Council, consisting of 16 senior leaders from the aviation community, oversees the policy, recommendations, and products of the NextGen Institute—which was established by FAA and the National Center for Advanced Technologies to provide JPDO with access to private-sector expertise, tools, and facilities for application to NextGen activities and tasks.

¹⁵*Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the Next Generation Air Transportation System*, GAO-07-25 (Washington, D.C.: Nov. 13, 2006).

and measurement. Strategies presented to ATO for consideration in acquiring the skills needed for the NextGen transition include aggressively marketing the NextGen vision, enhancing internal research and development skills, and working collaboratively with FAA headquarters to develop a more integrated approach to NextGen workforce planning.

According to an FAA official, FAA plans to fill a total of 378 NextGen positions in fiscal years 2009 and 2010. NextGen staffing needs can be difficult to address, a senior FAA official said, because historically NextGen skills have been in short supply and competitively priced in the marketplace. However, the current economic conditions could make hiring for these positions less difficult than it otherwise might be. If not adequately addressed, this situation could contribute to delays in integrating new technologies and transforming the national airspace system.

Addressing Ongoing Research and Development Needs Is Key to Keeping the Vision of NextGen on Track

As NextGen moves forward, applied research will be needed to integrate its five transformational technologies, as well as the legacy facilities and systems that will also be part of NextGen, to ensure that all the components work safely and reliably together. According to FAA, the funding requested in its Capital Improvement Program for 2009 through 2013 reflects the research and development and capital investments deemed necessary to deliver NextGen capabilities in the midterm. The funding requested for FAA NextGen research and development has significantly increased, from a total of \$83 million in fiscal year 2009 to about twice that amount in each of the next 4 fiscal years.¹⁶ FAA believes that this level of FAA funding for NextGen research and development will complement investments made by federal partner agencies—particularly the National Aeronautics and Space Administration (NASA)—and will adequately support NextGen’s implementation. In addition, the American Recovery and Reinvestment Act has increased NASA’s budget for aeronautics research by \$150 million, although it does not indicate whether this additional funding will be focused on NextGen-specific research.¹⁷

¹⁶FAA has requested \$161 million in fiscal year 2010, \$164 million in fiscal year 2011, \$165 million in fiscal year 2012, and \$167 million in fiscal year 2013 for NextGen research. FAA has also requested additional funding for other research

¹⁷Pub. L. No. 111-5, title II, 123 Stat. 115 (2009).

NASA's aeronautics research has long supported FAA's air traffic modernization efforts. To help ensure that NASA's aeronautics research is effectively transferred to FAA, the two agencies have developed a strategy that initially establishes four research transition teams, which are aligned with JPDO's planning framework. This strategy also outlines the two agencies' responsibilities for the research—FAA will develop user requirements, and NASA will conduct the fundamental research in each of the four areas and then transfer projects back to FAA for further development. According to FAA, its collaboration with NASA on the research transition teams has better focused NASA's investments on FAA's requirements. Research transition teams have not, however, been established between FAA and the other partner agencies.

Prioritizing the research and development needed for NextGen is also important to avoid gaps and delays. The most recent version of JPDO's Integrated Work Plan identifies the sequence of research that must be completed before specific NextGen capabilities can be completed. This research, however, cannot be fully prioritized without identifying the benefits that can be expected from the different capabilities and technologies. According to JPDO officials, they are developing a matrix that will identify benefits and costs and build a business case for all the components of NextGen over the next year that will help in prioritizing research and development.

Going forward, further research and development is needed in a number of areas to implement NextGen, according to FAA, stakeholders, and our analysis. For example:

- *Environmental Impact Research:* According to a JPDO analysis, the environmental impact of aviation will be the primary constraint on the capacity and flexibility of the national airspace system unless this impact is managed and mitigated. In proposed legislation reauthorizing FAA, \$111 million for fiscal years 2009 through 2011 may be used for a new FAA research and development program to help reduce aviation noise and emissions. This program—the Continuous Lower Energy, Emissions, and Noise (CLEEN) initiative—would facilitate over the next 10 years the development, maturation, and certification of improved airframe technologies. Aeronautics industry representatives and experts we consulted said that the program's funding levels may not be sufficient to attain the goals specified in the proposal. According to these experts, the proposed funding levels would allow for the further development of one or possibly two projects. FAA recognizes the implications of the proposed

funding structure for CLEEN and characterizes the program as a “pilot.”

- *Human Factors Research:* Human factors research explores what is known about people and their abilities, characteristics, and limitations in the design of the equipment they use, the environments in which they function, and the jobs they perform. Compared with the current ATC system, NextGen will rely to a greater extent on automation, and the roles and responsibilities of pilots and air traffic controllers will change. For example, both pilots and controllers will depend more on automated communications and less on voice communications. Such changes in roles and responsibilities raise significant human factors issues for the safety and efficiency of the national airspace system. Until fiscal year 2005, NASA was a primary source of federal aviation-related human factors research, but NASA then began reducing its human factors research staff, reassigning some staff to other programs and reducing the contractor and academic technical support for human factors research. According to NASA, human factors research continues to be a critical component of its aeronautics research program, although its work is now focused at the foundational (earlier-stage) level. FAA plans to invest \$180.4 million in human factors research from fiscal year 2009 through fiscal year 2013. It remains to be seen whether or to what extent FAA’s research and development, which is typically more applied than NASA’s, will offset NASA’s reductions in human factors research.
- *Weather Related Research:* Improved weather information is essential to realize key NextGen capabilities that depend on accurate weather information for decision-making. According to FAA, 70 percent of delays are attributable to weather every year. NextGen Network Enabled Weather (NNEW) is one of the five NextGen transformational programs for which current research and development efforts are needed, even though their full benefits may not be realized until after the midterm. NNEW is intended to provide weather support services for decision-making in the NextGen environment. More specifically, NNEW is FAA’s contribution to the 4-dimensional weather cube¹⁸—a technology that will provide weather observations and analyses, including forecasts of expected weather conditions, for all users of the national airspace system. FAA is developing the requirements for this program, and the Department of Commerce, through its National Oceanic and Atmospheric Administration, will lead the development of the 4-dimensional weather cube, using the Department of Commerce’s resources and those of the partner agencies. FAA expects

¹⁸The 4-dimensional weather cube describes the atmosphere in three dimensions (latitude, longitude, and altitude) and adds the dimension of time.

to finish defining the requirements for NNEW in March 2009. After validating the requirements, FAA will solicit reviews from the relevant stakeholders on the extent to which their requirements are aligned with those of the other agencies. This is a collaborative effort whose success will depend on contributions from all parties. Delays in aligning agency requirements, as well as the lack of meteorological knowledge, could lead to delays in implementing NextGen systems.

Beyond these research efforts, FAA has continued to move forward in planning and conducting demonstrations of some key NextGen technologies. For example, a recently announced demonstration with US Airways and Aviation Communications and Surveillance Systems at the Philadelphia International Airport will test ADS-B technology that allows an aircraft with the necessary avionics to transmit its own position as well as to receive information from other similarly equipped aircraft. FAA is providing \$6 million to purchase the necessary avionics equipment for the aircraft involved in the demonstration. FAA has also initiated projects to demonstrate the benefits of integrating NextGen capabilities. For example, in December 2008, FAA signed a memorandum of agreement with NetJets—an Ohio-based air service provider with a fleet of 600 aircraft. In this demonstration, FAA will test a number of NextGen technologies and procedures including ADS-B. The company will provide real-time data, allowing FAA to validate performance requirements. This demonstration will help FAA identify the costs and benefits associated with NextGen implementation.

Reconfiguring and Maintaining the Existing ATC System and Increasing Physical Capacity Are Also Key Challenges

To fully realize NextGen's capabilities, a new configuration of ATC facilities will be required. FAA has not developed a comprehensive reconfiguration plan, but says that preliminary efforts are underway to plan concepts for future FAA facilities. Going forward, it will also be critical for FAA to ensure the safety and efficiency of its existing ATC system, since it will be the core of the national airspace system for a number of years and some of its components will become part of NextGen. FAA faces an immediate task to maintain and repair existing facilities so that the current ATC system continues to operate safely and reliably. FAA has estimated a one-time cost of \$268 million to repair 400 existing terminal facilities. Once FAA develops and implements a facility reconfiguration plan, the costs of facility repairs and maintenance may be reduced. The American Recovery and Reinvestment Act of 2009 provides \$200 million to be made available within the next 2 years for improvements in power systems, air route traffic control centers, air traffic control towers, terminal radar approach control facilities, and

navigation and landing equipment and indicates that projects that can be completed in 2 years should be given priority.¹⁹ The availability of these funds increases the importance of FAA's developing facility consolidation and reconfiguration plans to ensure that the funds are spent efficiently and effectively. FAA has acknowledged the need to keep long-term plans in mind so that it does not invest unnecessarily in facilities that will not be used for NextGen.

Finally, FAA has determined that, even after planned improvements have been completed at 35 of the busiest airports, 14 airports—including some of the 35 busiest—will still need enhanced physical capacity by 2025. Planning infrastructure projects to increase capacity, such as building additional runways, can be a lengthy process, and will require substantial advance planning and safety and cost analyses. Furthermore, without substantial reductions in emissions and noise around the nation's airports and continuing efforts at all levels of government, including increased research and development activities, achieving the goal of safely expanding the capacity and efficiency of the national airspace system to meet 21st century needs may not be attainable.

Thank you, Mr. Chairman. I would be pleased to answer any questions that you or Members of the Subcommittee may have at this time.

GAO Contact and Staff Acknowledgments

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¹⁹Pub. L. No. 111-5, title XII, 123 Stat. 115, 205 (2009).

Appendix I: Related GAO Products

Next Generation Air Transportation System: Status of Transformation and Issues Associated with Midterm Implementation of Capabilities. [GAO-09-479T](#). Washington, D.C. March 18, 2009.

Next Generation Air Transportation System: Status of Systems Acquisition and the Transition to the Next Generation Air Transportation System. [GAO-08-1078](#). Washington, D.C.: September 11, 2008.

Responses to Questions for the Record; Hearing on the Future of Air Traffic Control Modernization. [GAO-07-928R](#). Washington, D.C.: May 30, 2007.

Next Generation Air Transportation System: Status of the Transition to the Future Air Traffic Control System. [GAO-07-784T](#). Washington, D.C.: May 9, 2007.

Joint Planning and Development Office: Progress and Key Issues in Planning the Transition to the Next Generation Air Transportation System. [GAO-07-693T](#). Washington, D.C.: March 29, 2007.

Federal Aviation Administration: Key Issues in Ensuring the Efficient Development and Safe Operation of the Next Generation Air Transportation System. [GAO-07-636T](#). Washington, D.C.: March 22, 2007.

Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the National Airspace System. [GAO-07-25](#). Washington, D.C.: November 13, 2006.

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