GAO

April 2005

NATIONAL AIRSPACE SYSTEM

Experts' Views on Improving the U.S. Air Traffic Control Modernization Program

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GAO-05-333SP

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Why GAO Convened This Panel

In 1981, the Federal Aviation Administration (FAA) began a program to modernize the national airspace system and a primary component, the air traffic control (ATC) system. The ATC component of this program, which is designed to replace aging equipment and accommodate predicted growth in air traffic, has had difficulty for more than two decades in meeting cost, schedule, and performance targets. The performance-based Air Traffic Organization (ATO) was created in February 2004 to improve the management of the modernization effort.

On October 7, 2004, GAO hosted a panel to discuss attempts to address the ATC modernization program's persistent problems. Participants discussed the factors that they believed have affected FAA's ability to acquire new ATC systems. Participants also identified steps that FAA's ATO could take in the short term to address these factors, as well as longer term steps that could be taken to improve the modernization program's chances of success and help the ATO achieve its mission.

The participants included domestic and foreign aviation experts from industry, government, private think tanks, and academia. They are recognized for their expertise in aviation safety, economics, and engineering; transportation research and policy; and government and private-sector management.

What Participants Said

Overall, the participants identified cultural, technical, and budgetary factors that, in their view, have affected the progress of ATC modernization. To address these factors, they proposed what one participant termed a "two-pronged" approach—simultaneously taking care of "the here and now" and building a "viable future" for the ATO.

Cultural and Technical Factors Have Impeded ATC Modernization

According to participants, the key cultural factor impeding modernization has been resistance to change. Such resistance is a characteristic of FAA personnel at all levels, participants said, and management, in the experience of some, is more resistant than employees who may fear that new technologies will threaten their jobs. The key technical factor affecting modernization, participants said, has been a shortfall in the technical expertise needed to design, develop, or manage complex air traffic systems. Without the technical proficiency to "scrub" project proposals for potential problems early and to oversee the contractors who implement its modernization projects, they said, FAA has to rely on the contractors, whose interests differ from its own.

Budgetary Factors Have Constrained ATC Modernization

The most immediate budgetary constraint, participants said, is the multibillion-dollar shortfall that FAA is projecting between available revenues and modernization needs over the next 4 years. Participants also identified features of the federal budget process as constraints, noting, for example, that the federal budget cycle is too long and inflexible to meet the needs of a dynamic ATC system that requires much more managerial freedom and short-term decision making. They further noted that the budget process is influenced by the political process, and that the funding for capital projects is sometimes spread out over so many years that technologies are out of date by the time they are deployed. Annual funding uncertainties discourage strategic and capital planning, they said, and the budget fails to show priorities and relationships among proposed investments.

Short-term and Longer Term Changes Could Promote Success

Participants suggested that the ATO could facilitate cultural transformation by creating a vision and strategy that would unite stakeholders and by assembling project teams with different skills and interests whose members could forge common organizational interests by working together to solve common technology development problems. To help offset technical inadequacies, the participants suggested that the ATO could consult an advisory board, identify and consider purchasing needed technologies that other countries have developed, and hire more skilled engineers to provide in-house expertise. To address budgetary constraints, participants suggested, among other short-term steps, reducing spending to match revenues and developing strategies for presenting FAA's budget request more clearly to Congress. Longer term suggestions included giving the ATO the predictable funding and decision-making authority it needs to carry out a "sensible" capital investment plan.

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Abbreviations

AOV	Air Traffic Safety Oversight Service
ATC	air traffic control
ATO	Air Traffic Organization
COO	Chief Operating Officer
DOT/IG	Department of Transportation's Office of Inspector General
FAA	Federal Aviation Administration
JPDO	Joint Planning and Development Office
NAS	national airspace system
NEXCOM	Next-Generation Air-to-Ground Communications System
OEP	Operational Evolution Plan
OMB	Office of Management and Budget
RNAV	area navigation
RNP	required navigation performance
STARS	Standard Terminal Automation Replacement System
URET	User Request Evaluation Tool
WAAS	Wide Area Augmentation System

National Airspace System: Experts' Views on Improving the U.S. Air Traffic Control Modernization Program

In 1981, the Federal Aviation Administration (FAA) began what it initially envisioned as a 10-year modernization program to upgrade and replace the national airspace system's (NAS) facilities and equipment to meet projected increases in traffic volumes, enhance the system's margin of safety, and increase the efficiency of the air traffic control (ATC) system—a principal component of the NAS.[1] Through the ATC component of this modernization program, FAA planned to acquire a vast network of radar, navigation, communications, and information processing systems that would enhance aviation safety and accommodate predicted growth in air traffic in the NAS. However, the program has proved to be more challenging than anticipated, in terms of both technology and management, and FAA's efforts to achieve desired improvements in performance have typically taken longer and cost more than anticipated. As a result, planned improvements in safety and capacity have been delayed, and the costs, both of maintaining existing technologies and of replacing outdated ATC systems and infrastructure, have grown.[2] FAA no longer sees its modernization program as a multiyear initiative with a defined end; rather, it now sees the program as an ongoing investment in technological advances designed to improve aviation safety and capacity. To date, FAA has spent $43.5 billion on NAS modernization,[3] and it expects to spend an additional $9.6 billion through 2009, primarily to upgrade and replace ATC facilities and equipment. Of the $43.5 billion spent thus far, about $25.1 billion, or 58 percent, has gone to ATC upgrades and replacements, according to FAA.

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[1]The NAS is a complex network of interconnected systems that includes over 19,000 airports, 750 ATC facilities, and about 45,000 pieces of equipment.

[2]See GAO, *Air Traffic Control: FAA's Modernization Efforts--Past, Present, and Future*, GAO-04-227T (Washington, D.C.: Oct. 30, 2003); *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); and *High-Risk Series: An Update*, GAO-05-207 (Washington, D.C.: January 2005).

[3]For purposes of this report, NAS modernization refers to ATC facilities, equipment, and related expenses.

To improve FAA's management of the modernization program, Congress, in 1995, gave the agency acquisition and human capital flexibilities, which FAA has largely implemented.[4] According to our most recent work, FAA has made important progress and improvements in its acquisition of major systems,[5] but the modernization program remains challenging and some problems have persisted. In 2000, Congress and the administration took further steps to improve the modernization program's management. Through legislation and an executive order, they laid the foundation for a new, three-component structure, including an oversight body, called the Air Traffic Services Subcommittee;[6] a Chief Operating Officer; and the Air Traffic Organization (ATO), a performance-based organization to manage FAA's ATC investments and operations.[7] In February 2004, FAA merged its Office of Air Traffic Services, Office of Research and Acquisitions, and Free Flight Program Office to create the ATO. The new organizational structure sought to break some of the existing "stovepipes" and bring together the key organizational units responsible for, among other things, ATC modernization.

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[4]Fiscal Year 1996 Department of Transportation Appropriations Act, Public Law 104-50, Section 348.

[5]See 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); *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); *Information Technology: FAA Has Many Investment Management Capabilities in Place, but More Oversight of Operational Systems Is Needed*, GAO-04-822 (Washington, D.C.: Aug. 20, 2004); *Air Traffic Control: System Management Capabilities Improved, but More Can Be Done to Institutionalize Improvements*, GAO-04-901 (Washington, D.C.: Aug. 20, 2004); and GAO-05-207.

[6]This body was created as a subcommittee of a larger, preexisting organization, the Management Advisory Council, which Congress had established in 2000 to oversee the administration, management, conduct, direction, and supervision of the ATC system. When Congress reauthorized FAA in December 2003, it eliminated the subcommittee's oversight responsibilities, and the subcommittee is now purely advisory. According to FAA, the subcommittee can help the ATO achieve consensus on difficult issues and contribute business expertise.

[7]Wendell H. Ford Aviation Investment and Reform Act for the 21st Century, Public Law 106-181, Section 303, April 5, 2000; Executive Order 13180, December 7, 2000. Under the executive order, part of the ATO's purpose is to "develop methods to accelerate air traffic control modernization and to improve aviation safety related to air traffic control."

The terrorist attacks of September 11, 2001, temporarily reduced airport congestion, but a number of factors—including a drop in air traffic in the years following the attacks, the economic slowdown, and an increase in businesses' use of low-cost carriers—led to a significant decline in airline ticket tax receipts and in the Aviation Trust Fund, where the receipts are deposited.[8] Today, air traffic has rebounded to near pre-September 11 levels and congestion is increasing, but the Aviation Trust Fund balance appears to be smaller than expected. For fiscal year 2005, for example, FAA reduced its original estimate of this fund balance by nearly $3.5 billion, and the agency is reviewing its estimates for future years.

The House Committees on Government Reform and Transportation and Infrastructure asked us to conduct a comprehensive review of the NAS modernization program's ATC modernization effort, the performance-based organizational initiatives resulting in the creation of the ATO, and the funding challenges that the changed budget situation poses for the modernization program. As part of our efforts to respond to the committees' request, which we plan to address through two separate ongoing studies,[9] we convened a panel of international aviation experts and asked them the following questions:

- What factors have affected the schedule, cost, and performance of FAA's ATC modernization program, and what steps could the ATO take in the short term to address these factors?

- How have federal budget constraints affected ATC modernization, and what steps could the ATO take in the short term to address these constraints?

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[8]Congress appropriates funds for FAA's budget from both the Aviation Trust Fund and the General Fund. According to FAA's *FY 2006 Budget in Brief*, the Aviation Trust Fund accounted for $9.7 billion of FAA's $14.1 billion budget for fiscal year 2004, and the General Fund accounted for the remainder.

[9]These include a report on the status of individual ATC system acquisitions and a comprehensive report on the status of the complete NAS modernization program. In addition, in response to a request from the Senate Committee on Commerce, Science, and Transportation, we are currently obtaining information and plan to report on how other countries have commercialized their air traffic services, applying a performance-based approach. For this work, we asked the panelists to discuss any lessons that can be learned from commercializing air traffic services abroad. We plan to incorporate the panelists' comments on this topic in the report that we expect to issue for the Senate committee.

- What steps could FAA take in the longer term to improve the modernization program's chances of success and help the ATO achieve its mission?

This report summarizes the panelists' responses to these and related questions that arose during the panel discussions.

The panel consisted of foreign and domestic aviation experts from industry, government, private think tanks, and academia. Their fields of expertise included aviation safety, economics, and engineering; transportation research and policy; and government and private-sector management. Former FAA officials and current executives of the air traffic organizations in Canada and the United Kingdom[10] were among the experts, as was the chairman of EUROCONTROL's Performance Review Commission.[11] In addition, the Chief Operating Officer (COO) of the ATO presented an initial briefing on the status of and plans for the ATO. He responded to questions but did not remain for the panel discussion. (See app. I for a list of the panelists.)

The panelists convened at the National Academies Keck Center in Washington, D.C., on October 7, 2004, after reviewing background materials and discussion questions that we provided in advance. The background materials included reports by GAO, the Department of Transportation's Office of Inspector General (DOT/IG), FAA, and other government organizations; industry publications; studies supporting and opposing the corporatization of air traffic services; and a comparative Performance Review Commission report.

As agreed with the panelists, the purpose of this panel was to engage in an open, not-for-attribution dialogue. However, information from the briefing by the ATO's COO and the COO's responses to the panelists' follow-up questions are attributed to him because his presentation was critical to the panelists' discussion. This material appears, together with relevant

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[10]The head of Germany's air navigation services responsible for air traffic control, DFS (Deutsche Flugsicherung GmbH), provided written responses to our questions.

[11]EUROCONTROL is the European Organization for the Safety of Air Navigation. The Performance Review Commission, one of EUROCONTROL's oversight bodies, was established to ensure effective management of European Air Traffic Management, through target-setting and the establishment of a transparent and independent performance review system.

information from some of our issued reports and work in progress, in the italicized text at the end of each major section of this report. (See Related GAO Products at the end of this report for a list, by topic, of reports, testimonies, and other products we have issued in recent years on topics related to those discussed by the panel.) Otherwise, this report summarizes the collective discussion by topic and does not necessarily represent the views of any individual panelist, GAO, or the National Academies. We did not verify the panelists' statements, although we did ask the panelists, in some instances, to clarify certain details. See appendix II for GAO contacts and staff acknowledgments.

Limitations and Qualifications

The discussion summarized in this report should be interpreted in the context of two key limitations and qualifications.

First, the panel was only an initial step in a possible long-term, evolving effort to develop and sustain discussion on ATC modernization. As such, it brought together generalists, rather than specialists, to address broad themes and consider how to organize a more comprehensive approach. Because our scope was limited, we could not include a large number of leading experts, institutions, and networks involved in specialized efforts. Furthermore, although many points of view were represented, the panel was not representative of all potential stakeholders.

Second, even though we, in cooperation with the National Academies, conducted preliminary research and heard from national experts in their fields, a day's conversation cannot represent the current practice in this vast arena. More thought, discussion, and research are needed to develop greater agreement on what we really know, what needs to be done, and how to do it.

These two key limitations and qualifications provide contextual boundaries. Nevertheless, the panel provided a rich dialogue on ATC modernization, and the panelists developed strong messages in responding to each of the three questions. Those messages are highlighted below.

Results in Brief

Overall, the panelists identified cultural, technical, and budgetary factors that they thought had affected the progress of the modernization program. To address these factors, the panelists proposed what one panelist termed a "two-pronged" approach—simultaneously taking care of "the here and now" and building a "viable future" for the ATO.[12] Envisioning "parallel efforts," the panelists identified multiple steps that the ATO could take in the short term within its existing legislative and organizational framework, as well as structural changes that could be made in the longer term to enhance the modernization program's prospects for success.

According to panelists, the key cultural factor impeding modernization has been resistance to change. Such resistance is a characteristic of FAA personnel at all levels, panelists said, and management, in the experience of some panelists, is more resistant than employees who may fear that new technologies will threaten their jobs. Panelists noted that resistance to change is at odds with the financially stressed aviation industry's need for new air traffic systems and procedures that will enhance capacity and efficiency and reduce costly delays. Panelists suggested that the ATO could facilitate cultural transformation by (1) creating a vision and strategy that would unite stakeholders and (2) assembling project teams with different skills and interests—engineers, finance officers, information technology experts, and controllers—whose members could work together to solve common technology development problems and, in so doing, forge common organizational interests. The key technical factor affecting modernization, panelists said, has been a shortfall in the technical expertise needed to design, develop, or manage complex air traffic systems. Without the technical proficiency to "scrub" project proposals for potential problems early and to oversee the contractors who implement its modernization projects, they said, FAA has to rely on the contractors, whose interests differ from its own. To help offset its technical inadequacies, the panelists suggested that the ATO could take steps such as consulting an advisory board, identify and consider purchasing needed technologies that other countries have developed, and hire more skilled engineers to provide in-house expertise.

According to the panelists, budget constraints have affected ATC modernization in several ways, and the ATO could take a number of steps

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[12]The panelists used the terms "FAA" and "ATO" interchangeably. Therefore, references to FAA should be considered references to the ATO in this context.

in the short term to address them. The most immediate budgetary constraint identified by the panel is the multibillion-dollar shortfall that FAA is projecting between available revenues and modernization needs over the next 4 years. One panelist predicted that this shortfall would have gradual rather than catastrophic effects and would manifest itself through a slow but sure increase in air traffic delays. The panelists also identified features of the federal budget process that they believe constrain modernization. They said, for example, that the federal budget cycle is too long and inflexible to meet the needs of a dynamic ATC system that requires much more managerial freedom and short-term decision making. In addition, they noted that the budget process is influenced by the political process, and that the funding for capital projects is sometimes spread out over so many years that technologies are out of date by the time they are deployed. Annual funding uncertainties discourage strategic and capital planning, they noted, and the budget fails to show priorities and relationships among proposed investments. To address these constraints, the panelists suggested various actions that the ATO could take in the short term, including accepting the budget process as it is and reducing spending to match revenues, developing strategies for presenting FAA's budget request more clearly to Congress, implementing regulatory and procedural changes to allow the use of existing cost-saving technologies, contracting with the private sector to provide certain air traffic services, and obtaining information on other countries' ATC technologies and on international technical standards.

For the longer term, some panelists suggested structural changes, which would generally require legislation. The goal of these longer term initiatives would be to give the ATO the predictable funding and decision-making authority these panelists said it needs to carry out a "sensible" capital investment plan. The suggested initiatives included replacing taxes with user fees based on the cost of air traffic services, allowing the ATO to manage those fees, and giving the ATO borrowing and leasing authority. The panelists advocating these kinds of initiatives said the initiatives would help the ATO address the predicted funding shortfall and free it from the constraints of the federal budget process, as well as enable the ATO to pay for the technical expertise and the technologies it needs to deliver efficient, cost-effective service. In addition, these panelists said, removing the ATO's funding from the appropriations process would establish a direct relationship between the ATO and its customers that could promote efficiencies and improve service. According to these panelists, customers would monitor the ATO's spending to ensure that the ATO addressed their priorities, and the ATO would provide better service because it would try to

please the customers rather than the appropriators who now fund its activities. Restructuring the financing of the modernization program could streamline and strengthen the ATO's management, they said. According to these panelists, this kind of financing arrangement would allow program managers to make decisions quickly, on the basis of business rather than political considerations, and could provide the ATO with the management tools needed to fully execute its mission. While not disagreeing with the potential benefits of the proposed structural changes, other panelists cautioned against investing too much effort in them, since, in the view of these other panelists, the changes were, for the most part, politically infeasible. Moreover, as one panelist noted, even if the structural changes were implemented, it would be important to consider what problems they were creating as well as what problems they were addressing. He suggested, for example, that a weight-based user fee might incentivize smaller planes and more planes, thereby having the unintended effect of increasing demands on the ATC system's capacity. Finally, one panelist said, restructuring could resolve the conflict of interest inherent in FAA's dual responsibility as the regulator and the operator of air traffic services.

Panelists Identified Cultural and Technical Factors That Have Affected ATC Modernization and Suggested Short-term Steps to Address Them

The panelists attributed many of the ATC modernization program's chronic problems to cultural and technical factors. In particular, they cited resistance to change at all levels within the agency and insufficient technical expertise as key factors impeding modernization. They identified multiple, currently available options for addressing these factors.

Panelists Cited Resistance to Change as a Key Cultural Factor Impeding Modernization

Although the panelists did not explicitly define "culture," they used the term generally to denote an environment in which multiple stakeholders with entrenched interests struggle to preserve their interests and to retain control or influence. They described FAA's culture as resistant to change and identified resistance to change as a characteristic of FAA personnel at all levels. One panelist cited FAA's ingrained preference for ground-based systems and for sticking with what has worked in the past rather than rocking the boat by trying out new technologies, especially since "the boss isn't telling you to rock the boat." A second panelist described FAA as "very,

very resistant" to having private organizations, rather than FAA, develop new procedures and systems for FAA to approve and institute.

Several panelists saw resistance to change as a consequence of federal employment—of the security that comes from having a regular paycheck, cost-of-living pay increases, and protections against layoffs. A government organization is insulated from the economic pressures that the private sector faces, one of the panelists indicated. In his view, federal employees do not have the firsthand experience with layoffs and business failures to understand, as private aviation industry employees do, why improvements to the ATC system's efficiency are needed to help revitalize the struggling aviation industry.

Other panelists emphasized the reluctance of management to change. According to a panelist with experience in restructuring a foreign air traffic organization, the senior and middle managers could not or would not adjust to the change and had to be let go within the first 2 years. The other employees also had difficulty adjusting and were still adjusting in some respects, he said, but getting management on the right page was the real challenge. Another panelist emphasized that cultural change starts at the top and questioned why the ATO's new COO had, according to the panelist's count, replaced only two top managers in the ATO and simply reassigned other managers. Still another panelist suggested that cultural change within the ATO alone would not be sufficient to ensure the ATO's success, because so much of the ATO's fate depends on other organizations, including FAA, DOT, the Office of Management and Budget (OMB), and Congress.

A number of panelists described the air traffic controllers' union as also resistant to change. According to one panelist, for example, the union delayed the adoption of technologies such as the User Request Evaluation Tool (URET) because some controllers saw them as a threat to its membership.[13] Another panelist cited the union's long-term opposition to the implementation of a software program that tracks productivity—a key measure for a performance-based organization.[14] The union is "very political," several panelists asserted, and one panelist charged that it was "hindering the progress" of a performance-based organization.

Resistance to change can be an issue outside FAA as well as within it, panelists noted. For example, one panelist questioned how much support the ATO was getting from DOT, OMB, and congressional committees for changing "some extremely entrenched political fiefdoms." Another panelist said that he had found the congressional authorizing committees amenable to changes, but the appropriators liked things the way they were.

Panelists Suggested Steps That the ATO Could Take in the Short Term to Address Cultural Impediments to Modernization

According to some panelists, creating a common vision, bringing in a new management team, and employing strategies that bring disparate stakeholders together could immediately help the ATO address the cultural factors that have impeded modernization. The following are steps that panelists proposed to facilitate the ATO's cultural transformation:

- According to one panelist, the ATO needs to give people a vision and a clear plan, or strategy, that they can understand. People have to know

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[13]URET is a computer program that aids controllers in granting pilot's requests to change their flight paths for more direct routes or for different altitudes and allows controllers to look 20 minutes into the future of a flight path. If a pilot wants a different route, the controller punches in the request and is immediately advised if the request is safe. Previously, the controller relied on paper flight strips and mental calculations. According to FAA, as a result of URET, pilots now receive more direct routes and the airlines are saving time and money.

[14]The National Air Traffic Controllers Association, the federal-sector labor union representing air traffic controllers, engineers, and other safety-related professionals, testified in June 2004 that "controller time on position," a measure of time that tracks when controllers are working with the primary responsibility for an operational ATC position, tracks only a portion of the controller's job functions and, therefore, is not an accurate measure. Testimony of Ruth E. Marlin, Executive Vice President, National Air Traffic Controllers Association Before the U.S. House of Representatives, Committee on Transportation and Infrastructure, Subcommittee on Aviation, *Status of the Air Traffic Controller Workforce*, June 15, 2004.

what is expected of them, how they fit into the strategy, and what the vision is for their organization.

- In addition to having a vision, another panelist said, it is important for the ATO to tie that vision to the user constituency, not confine it to the agency. FAA cannot do everything alone from the inside, because airplanes and airports, for example, need to be equipped with the technologies that will help realize the vision.

- Employing a team concept could help overcome resistance to the implementation of new technologies, according to another panelist. Putting engineers, finance people, controllers, and electronic technologists together, all on the same team, he said, could unite them as they moved through the stages of implementation. Therefore, when the time comes to field a technology, the focus would be on getting it up and running and operating safely—not, the panelist implied, on obstructing its implementation because it might threaten jobs.

- A change in management's approach could go a long way toward overcoming controllers' and other employees' resistance to change, one panelist noted. One foreign air traffic organization changed its whole approach to the unions and the staff, started talking to them as people, and began executing "participative working" programs, according to the panelist. Union representatives and managers take the same courses together and address issues of affordability together, he said, and, as a result, controllers' pay has increased, costs have dropped, and productivity has risen. The key to these positive results, he said, is psychological change—managers have stopped seeing employees as a problem and have started to see them as part of the solution.

- According to other panelists, however, people find it very difficult to change, and the only way to bring about a cultural transformation is to replace those who resist change, either by allowing them to retire or by hiring others to take their places. In the corporate world, one panelist observed, a new executive brings in a new management team to support a cultural turnaround. The new team is then loyal to the new executive. In the view of this panelist, the COO's hiring of only two new managers and reassignment of other managers would not be sufficient to turn the ATO's culture around. Another panelist further noted that an executive in the private sector replaced the top 200 people in his organization to achieve the transformation he was seeking.

Panelists Said FAA Personnel Lack Technical Expertise Needed to Develop Complex Systems and Oversee Contractors Effectively

Technical as well as cultural factors have impeded ATC modernization, according to several of the panelists. In the words of one speaker, FAA does not have "the engineering technical capability to deal with an extremely complex, highly nonlinear adaptive system that's got technical safety risk as a key technical parameter." According to another panelist, FAA does not apply rigorous systems engineering expertise early in nonadvocate technical reviews of project proposals to scrub them for potential issues. As a result, a number of FAA's programs—including complex ones such as the Wide Area Augmentation System (WAAS), as well as more "straightforward" ones such as the Standard Terminal Automation Replacement System (STARS) and the Next-Generation Air-to-Ground Communications System (NEXCOM)[15]—had fundamental system engineering technical issues that were not identified early in the program. The risks were not mitigated, and the programs experienced significant cost growth and schedule increases. "The system engineering organization in FAA is nothing more than a process organization," another panelist said. "The power resides with the program manager. It doesn't matter what the systems engineering people do, their job is to keep doing plans and processes. They think that meetings are products."

FAA's lack of systems engineering expertise is problematic not only when the agency reviews project proposals but also when it manages contracts, panelists observed. Although FAA personnel receive training in acquisition management, one panelist noted, they also need technical skills. If they simply learn how to carry out the acquisition process without really understanding the underlying technical interrelationships, they will fail, he said. In the words of another panelist, FAA may be able to hire smart contractors, but it needs personnel of its own who are smart enough to ask the right questions and smart enough to understand the answers. FAA lacks the technical expertise needed to design, develop, or manage complex air traffic systems, another panelist maintained, because the administration never allowed the agency to invest in highly qualified technical personnel. As a result, FAA is beholden to its contractors, who may or may not do a

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[15]WAAS is a navigation and landing system that uses global positioning system technology. According to FAA, WAAS is to improve safety by providing precision guidance to an aircraft in all phases of flight at thousands of airports and landing strips, including runways where there is no ground-based landing capability. STARS is a color computer display system used at FAA terminal radar control and Department of Defense facilities. NEXCOM will replace the existing analog ATC communications system with a digital system that has greater capabilities.

good job, but who certainly have a different motivation from FAA. As this panelist put it, FAA lacks a rudder, in a technical sense, for modernization.

Panelists Suggested Steps That the ATO Could Take in the Short Term to Address Insufficient Technical Expertise

To help address its lack of technical expertise, panelists suggested, the ATO could obtain advice from an independent board or information from other countries on technologies that they have already adopted. The panelists proposed some immediate steps that the ATO could take to address this deficiency, including the following:

- A technical advisory board made up of system engineers could review proposals for FAA and demand the kinds of data and tests needed to scrub the proposals and identify any big roadblocks.

- Hiring skilled engineers instead of relying on contractors might enable the ATO to develop systems more economically and efficiently, one panelist suggested. This panelist described how a foreign air traffic services organization develops new ATC systems in-house and seldom uses contractors. It now utilizes its engineers to build systems rather than manage contractors. As a result, he said, it is now developing the systems it needs faster and at less cost.

- Maximizing the use of commercial inputs was the recommendation of another panelist, who said that FAA needs to get out of the business of designing systems. According to him, most companies no longer develop their own large, complex systems; instead, they get other people to do that for them in the private sector. Another panelist also emphasized the availability of technical expertise in the private sector. However, according to a third panelist, commercial systems have a shorter economic service life than the systems that FAA designs.

- The ATO could profitably take advantage of the experiences of other countries' air traffic organizations, which are technically as good as FAA ever was or ever will be, one panelist said. He maintained that the ATO should institute "a fundamental requirement and a cultural expectation" that it will review existing technologies before it buys or tries to develop its own. With a multibillion-dollar budget for software and other information technology, he said, the ATO has ample opportunity to save money.

In his opening remarks and in responding to panelists' questions, the ATO's COO made a number of observations on FAA's culture. He also noted that FAA plans to train or hire people with needed skills to address shortfalls in technical expertise. The following summarizes some of his key observations on FAA's culture and provides additional information from previous GAO reports and work in progress on how FAA is addressing some of the cultural and technical factors panelists identified as affecting ATC modernization:

Recognizing that cultural factors can play a critical role in an organization's success, the ATO has initiated organizational changes that are designed to create a foundation for cultural change and deliver benefits to customers efficiently. For example, the ATO

- *established collaborative teams of technical experts and ATC system users;*

- *reorganized air traffic services and the research and acquisition organization along functional lines of business to bring stakeholders together and integrate goals, as well as reward cooperation by linking investments to operations;*

- *reduced layers of management from 11 to 7 to help address the hierarchical nature of the organization; and*

- *conducted an organizationwide activity value analysis to determine the full range of activities that ATO headquarters is engaged in, the value customers place on those activities, and the potential for conducting any of those activities more effectively and efficiently.*

Although FAA anticipates that cultural change will take a long time, it is giving high priority to changing its leadership model by linking top management more closely to operations in the field and replacing "command and control" with communication across organizational levels. According to an FAA consultant's review of the agency's internal communication needs,[16]communication within FAA is, in many ways, broken, but a good number of employees want to help fix it. Employees willingly participated in discussions and focus groups, the report said,

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[16]*"Communicating the Future within the Federal Aviation Administration,"* Review of Findings from Summer 2004, Internal Research, August 13, 2004.

indicating a desire to improve the flow of information within the agency by sending a large number of detailed e-mails in response to a call for recommendations to improve internal communications.

In the past, according to the ATO's COO, FAA's management culture was "intensely hierarchical, risk averse," and "reactionary." But now, he said, FAA is attempting to foster "results-focused, proactive and innovative behavior." Changing the agency's leadership model is also designed, he said, to replace a "personality-driven culture" with a sustainable, stable, viable organization that can make rational decisions that transcend changes in political leadership.

The ATO is trying to better align FAA's priorities and stakeholders' interests by developing a strategy map that captures the outputs desired by the ATO's owners and customers, along with the outputs that must be achieved. Called the Strategic Management Process, this effort borrows heavily from a private-sector model and uses the ATO's strategic goals and objectives to drive investment decisions. According to FAA, the strategy map will enable owners and customers to clearly understand both the services that the ATO is providing and the effects of products in development on those services. As a result, FAA says, future budgetary conversations will revolve around the desired level of service, instead of focusing on a product, as past discussions typically did. According to FAA, the Strategic Management Process will ensure linkage between FAA's operating and capital budgets.

To become a "performance-based organization" and identify customer groups and their service needs, the ATO created "value-based" performance metrics; that is, it defined its performance in terms of customers' needs and connected efforts to satisfy those needs with cost. Ultimately, the ATO wants to know how much every unit of output costs so that it can allocate and compare costs and measure productivity. Thus, each organizational unit and facility is developing applicable metrics for performance so that the ATO can compare costs, identify factors that affect costs, and use this information to improve performance. For example, each en route facility is determining its hourly cost to control flights. The ATO can then compare and analyze these costs to identify positive and negative factors affecting performance and productivity.

FAA is implementing its 10-year strategy for air traffic controllers, the Air Traffic Controller Workforce Plan, released in December 2004. This

*plan is a response to a congressional mandate, based on a
recommendation we made in 2002, that FAA develop a plan for
addressing an impending wave of controller retirements and deal with
productivity issues.*

Panelists Said Funding Shortfall and Features of the Federal Budget Process Affect ATC Modernization and Suggested Short-term Steps to Address Them

The panelists identified and discussed the impact of funding constraints
and the federal budget process on ATC modernization. In their view, the
most immediate issue is a critical shortage of funds to meet the current
modernization program's plans and users' demands. Additionally, they said,
the federal budget process is slow, inflexible, and influenced by the
political process; annual appropriations are uncertain and discourage
planning; and the budget fails to show investment priorities and
relationships between FAA's capital and operating budgets. The panelists
suggested a number of steps that the ATO could currently take to address
these challenges.

With Funding Shortfall, Flight Delays May Gradually Increase, Panelists Said

Panelists viewed the ATO's apparent fiscal shortfall—which one panelist
said would amount to a 20 percent deficit in 4 years—as a severe challenge.
In terms of operations, the panelist said, this deficit was more likely to have
a gradual than an immediately catastrophic onset. He did not expect to see
major system outages but predicted, instead, "a slow but sure increase in
delays." However, as another panelist said, if the ATO did not carefully
analyze demand and determine how that demand could be served, the ATO
would find itself facing what a third panelist referred to as a "perfect
storm," reiterating a term the ATO itself has used.

Severe reductions in the funding for ATC modernization, if required to
address the currently projected shortfall, could exacerbate what one
panelist described as the government's traditional underfunding of the ATC
system's capital requirements. According to this panelist, the government
undercapitalizes any complex, rapidly evolving operational system,
including the ATC system, and overestimates the economic service lives of
information technology investments. Whereas the government typically
assumes such investments will last for 15 years, he said, a 7-year estimate
would be more reasonable.

Although the ATO has said that its business plan, when completed, will
provide policy makers with detailed information on the current funding
shortfall, panelists expressed concerns about the political implications of

showing large deficits. They suggested, for example, that FAA and DOT officials might be unwilling to publicly release data that could raise questions about their management.

Funding Air Traffic Services through the Budget Process Is Slow and Inflexible, Some Panelists Said

Several panelists maintained that the federal budget cycle is too long and inflexible to meet the needs of an ATC system. According to one panelist, it is "impossible" to run the U.S. ATC system within the classic federal structure. Such a "dramatic," "dynamic" system requires "more managerial freedom, much more day-to-day, week-to-week, month-to-month decision-making," he said. The federal budget process freezes plans for the system 12 or 18 months in advance, but for an ATC system to succeed, "you've got to be 12 or 18 days ahead."

The budget procedure requiring that capital investments be funded out of annual appropriations means that major acquisitions generally take many years to implement and projects may continue to be implemented even after they have outlived their usefulness. Particularly when annual appropriations fall short, panelists noted, projects' development and deployment may be delayed and their costs may increase with time. Furthermore, until the acquisitions are completed, the benefits of the new technologies are deferred, aging equipment may pose risks to users, and outdated software may require costly upgrades. By the time the acquisitions are fully deployed, panelists said, they may be out of date.

Panelists Described the Effects of the Political Process on the Federal Budget

Several panelists discussed the impact of the political process on the federal budget. According to one panelist, Members of Congress may base funding decisions on how jobs in their districts will be affected, rather than on how reasonable the business cases for actions may be. As evidence, he cited a Senate provision that prohibited FAA from closing its regional accounting departments and centralizing them to achieve cost efficiencies because the regional departments were big employers in congressional districts. Another panelist noted that political considerations may be more influential than broader issues. In his view, competition among appropriators for projects benefiting their constituents, regardless of the need for those projects, undermined need-based efforts to allocate scarce resources so that the NAS can serve as many people as possible. "I've been in too many of these meetings where we prioritize things," he said. "And if your constituency doesn't get something, I know you're not going to support me." Thus, Oklahoma, for example, may get the same ATC

technology as New York, despite resource constraints and major differences in air traffic demand.

The political process influences budget decisions in the administration as well as in Congress, some panelists said. According to one panelist, Congress has generally supported FAA's modernization program, but funding difficulties have ensued because the budget is consolidated and there are always pressures on it. Other panelists added that the ATO would have difficulty "deliver[ing] the bad news"—that is, publishing a business plan that projects deficit scenarios—unless revenue increases are forthcoming. According to this panelist, OMB would deny any requests for increased funding and would, instead, tell the ATO to find another way of doing business.

Panelists Said Uncertain Annual Funding Discourages Effective Planning

Panelists noted that funding from annual appropriations is uncertain, and that this uncertainty is incompatible with strategic and capital planning. The amount of money available for appropriation each year cannot be predetermined, one panelist said, and the size of the appropriation may vary from year to year. This uncertainty focuses attention on which technology will receive the funding (the inputs) rather than on what improvements in safety or capacity the technology is supposed to deliver (the outputs), he said. In debating whether this investment or that investment should receive funding, planners have lost sight of the big picture, he suggested, and the ATO has spent most of its capital investment dollars on sustaining and maintaining existing systems. Only about 14 percent of its expenditures, he recalled, were for flight enhancement. "Who anywhere would have a capital investment plan that was predominantly about standing still?" he asked.

Another panelist also considered the federal budget process incompatible with strategic planning. In his words, "it is absolutely a problem at FAA" that "budget drives strategy and strategy does not drive budget." Although FAA is good at forecasting demand, he said, it does not evaluate "the anatomy of demand" and determine how that demand will be served. Panelists noted, for example, that the number of regional jets, low-fare airlines, and unmanned aerial vehicles are increasing, but FAA has not developed a business model or plans for managing the increased air traffic.

Other panelists suggested that the federal budget process discourages realistic capital planning. FAA's capital investment plan is "mired in predictable annual fits and starts subject to micromanagement by

Congress," one panelist said, rather than integrated, organized, and periodically revised. Another panelist observed that FAA asks for more than it can get and then carries the difference over from year to year, creating "a bow wave" of unfunded requests for capital projects that it seldom reduces. Furthermore, as a third panelist pointed out, the budget process establishes incentives for unrealistic planning: Project managers first overpromise capabilities and underestimate costs to increase the chances that new projects will be accepted. Then, after projects are accepted, they overestimate costs because they assume their requests will be cut. Although managers could include options in their budget submissions to indicate what could be accomplished at different funding levels, they do not do so because they assume items identified as options will be cut. Finally, managers are reluctant to revise ongoing projects because they do not want to be seen as fickle. By contrast, another panelist said, a private company that operates under a board of directors and obtains revenue from customers does not have incentives to play budget games to get projects approved. "Your money is your own money," he said.

Some Panelists Believed That the Federal Budget Fails to Show Priorities and Relationships

Some panelists criticized the federal budget for failing to show priorities and relationships among proposed investments. In the budget, one panelist said, "everything is as important as everything else." Another panelist observed that the budget sets no capital investment priorities. According to a third panelist, a line item budget tears apart a highly layered, interdependent system and does not reveal synergies between projects. Then, when the budget request goes to Congress, he said, "you have no opportunity to try to explain to anybody the interconnections of these programs." As a result, when the appropriators decide not to fund a project, they may not understand how their decision will affect other projects.

Several panelists discussed the "firewall" that federal budget procedures create between the FAA's capital (Facilities and Equipment) and operating (Operations) accounts, noting that separating these two types of costs makes it difficult to recognize interactions between them.[17] "You can't make rational decisions if somebody is handing you those two separate pieces with a wall between them," one panelist said. He added that the

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[17]The vast majority of funds for FAA's ATC modernization program and operations comes from taxes on airline tickets that are deposited into the Aviation Trust Fund. Congress then appropriates the trust fund revenues for line items in FAA's budget. Under federal budget procedures, funds are appropriated separately for capital projects and for operations.

firewall discourages analyses of life-cycle costs and may lead, in some instances, to investments in technologies that end up in a warehouse because the ATO cannot afford to operate them. Similarly, another panelist observed that the separation of capital and operating costs in FAA's accounting system makes it difficult to see the implications of capital investment decisions for operating costs, even though "everything we put in the field winds up increasing the ops budget." Furthermore, as another panelist noted, the firewall makes it difficult to see the relationship between software replacement (capital) and maintenance (operating) costs. Thus, decisions to postpone purchases of new or upgraded software may save capital investment costs, but rising maintenance requirements may increase operating costs. Eventually, he said, the maintenance costs may "far exceed" the replacement costs.

Finally, other panelists said, the budget is not integrated to show what investments buy in terms of productivity, safety, or environmental benefits, and FAA's capital budget fails to show the impact of investments on the country. This can lead to mismatches—that is, to funding projects that will provide limited benefits for users.

Panelists Identified Short-term Steps within the Budget Process and Other Steps That the ATO Could Take under Its Existing Authorities to Address Budget Constraints

While recognizing the magnitude of the ATO's projected funding shortfall over the next few years, the panelists identified a number of steps that the ATO could take to address its current financial situation. These steps included accepting the budget process as it is and reducing spending to match revenues, developing strategies for presenting the ATO's budget request more clearly to Congress, implementing regulatory and procedural changes to allow the use of existing cost-saving technologies, contracting with the private sector to provide certain air traffic services, and obtaining information on other countries' ATC technologies and on international technical standards.

Short-term Steps within the Budget Process

Several panelists emphasized the importance of accepting the budget process as it is and of doing what can be done in today's government system:

- One panelist thought that the ATO should scope the modernization program so that it realistically reflects the resources that can be expected within the next 5 years and then put together and communicate a strategy and a vision to guide the agency's 36,000 people. He called for the ATO to adjust its capital requirements to what can

realistically be funded and to review and cut its programs in light of the current budget constraints.

- This panelist also recommended looking at longer term alternatives to annual appropriations that are available within the government and work well for other organizations, such as "working capital accounts and all kinds of industrial funding schemes."

- Another panelist encouraged the ATO to focus its capital investment on avoiding outages—that is, on replacing equipment that would otherwise fail. This panelist also said that FAA needs a customer-oriented business strategy and a business plan.

- One panelist, who observed that operating costs account for about three-quarters of the ATO's total costs,[18] suggested that the upcoming wave of air traffic controller retirements[19] would create "an opportunity to redistribute and even to trim the work force in some areas," as well as reduce personnel costs by offering incentives for early retirement.

- Improving controllers' productivity would be another way to save money, a fourth panelist said, but he characterized his suggestion as "touch[ing] the third rail of aviation politics."

- Another panelist emphasized the importance of starting to plan now to accommodate the airplanes that are being bought today to provide service for the next generation, which he variously estimated at 20, 30, or 40 years.

Some panelists proposed strategies for the ATO to present its budget request more clearly to Congress:

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[18]According to DOT/IG, salaries and benefits make up approximately 73 percent of FAA's operating budget. See DOT/IG, *Key Issues for the Federal Aviation Administration's FY 2005 Budget,* CC-2004-038 (Washington, D.C.: Apr. 22, 2004).

[19]In 2002, we reported that almost one-half of FAA's controller workforce (about 7,000 controllers) would retire over the next 10 years and about 93 percent of controller supervisors would be eligible to retire by the end of 2011. See GAO, *Federal Aviation Administration: Plan Still Needed to Meet Challenges to Effectively Managing Air Traffic Controller Workforce*, GAO-04-887T (Washington, D.C.: June 15, 2004) and *Air Traffic Control: FAA Needs to Better Prepare for Impending Wave of Controller Attrition*, GAO-02-591 (Washington, D.C.: June 14, 2002).

- For example, one panelist said that the ATO needed to understand the interconnections between ATC systems and break the big picture into nuggets so that it could clarify for the appropriators why they should not break apart the ATO's capital investment plan and selectively fund only some components.

- Another panelist maintained that the ATO could mitigate the effects of the firewall between its capital and operating budgets by modifying its budget submissions to show the future cost implications of current investment decisions.

Steps outside the Budget Process under Current Authorities

Several panelists identified options outside the budget process that the ATO could pursue under its current authorities. They said, for example, that the ATO could pursue procedural and regulatory changes that would take advantage of existing technologies to increase capacity, pilot test contracts with the private sector to provide certain air traffic services, and obtain information on technologies and procedures developed in other countries that could be used in the United States.

Regulatory and Procedural Changes Could Allow the Use of Existing Technologies to Enhance Capacity and Efficiency

Several panelists discussed the potential benefits of a more widespread use of a concept called area navigation (RNAV), which allows operators of properly equipped aircraft to use onboard navigation capabilities to fly desired flight paths without requiring direct flight over ground-based navigation aids. This provides for more direct routing, avoiding suboptimal routes prescribed by conventional "highways in the sky" that are defined by point-to-point flying over ground-based navigation aids. The RNAV concept and a major new method for exploiting it, called required navigation performance (RNP), permit flight in any airspace as long as aircraft have been certified to meet the required accuracy level for navigation performance. RNAV and RNP hold promise for saving system users time and money—largely by reducing flight times and fuel consumption by allowing users to fly shorter routes or avoid bad weather. In addition, RNAV and RNP could potentially increase the capacity of the ATC system to handle air traffic by reducing the required distance (separation) between aircraft equipped with advanced navigation capabilities if the aircraft can safely operate closer to one another than FAA's regulations currently allow.

According to some panelists, many aircraft have had the navigation capabilities to implement RNP for many years, but operators have not been

able to use these capabilities to their full potential in the United States because FAA has not approved procedures for its use. However, the airlines are "crying for" FAA to approve RNP, one of the panelists said, because aircraft equipped with RNP capabilities could then fly alternative rolling, moving routes to avoid weather delays. Service would improve for travelers, and the airlines would avoid the substantial costs of delays, he said. Implementing RNP could also eventually lower the ATO's costs, another panelist said, since RNP does not require any ground equipment.

RNP technologies have been installed on larger aircraft for so long that some aircraft equipped with the technologies have already been retired to the desert, one panelist said. In addition, pilots have been trained to use the technologies, and the technologies are already being used in some other countries, including Canada, where a private airline company (West Jet) developed implementation procedures in collaboration with the Canadian ATC regulatory agency and the Canadian air traffic management organization.

As a first step toward obtaining FAA's approval of procedures for using RNP, a panelist said, the ATO could make policy announcements to set a tone and direction. These announcements would enlist the user community's support at little or no cost to the ATO, give the ATO an early success, and help tie customers to the ATO's mission. However, he also cautioned, it would be important for FAA to implement RNP in a way that did not "disenfranchise" general aviation interests and regional carriers whose aircraft are not already equipped with RNP technologies.

Two panelists expressed concerns about the government's approach to regulating the use of onboard navigation equipment and the associated procedures needed to implement RNP. According to one of these panelists, FAA has "the wrong conceptual framework" for developing regulations to implement new procedures. Its current approach is disproportionate, he said, because it establishes the same safety standards for aircraft of all sizes. "We can't keep treating airplanes that need 100 cubic miles of airspace the same from a cost and benefit point of view as airplanes that need a quarter cubic mile of airspace," he said. In his view, FAA needs to revise its approach to assessing and balancing risks. He maintained that the role of regulatory management on the evolution of the ATC system has been underestimated and called for significant investment in understanding risk management.

The other panelist who expressed concerns about the government's regulatory approach argued that navigational technology is evolving and shifting from ground-based to cockpit-based systems. He maintained that "you've got to get aircraft closer and closer together to be able to increase capacity," and said that the government should allow the ATO to change its policies on aircraft separation to permit "the technology that exists on airplanes today to do the job." He suggested that the private sector could assume the cost of capitalizing the equipment, but "the government's got to allow that technology to be used, and it hasn't."

Although one panelist emphasized the importance of conducting thorough technical evaluations of RNP to identify any roadblocks to its use, the panelists generally considered it a highly promising, low-cost option for the ATO to improve service. One panelist recommended that the ATO create incentives, such as the right to fly in preferred airspace, for users that equip their aircraft with RNP technologies, to lower the ATO's costs.

Contracting with the Private Sector to Provide Certain Air Traffic Services Could Demonstrate Efficiencies and Potential Cost Savings

Throughout the panel, panelists discussed an initiative that FAA has already begun—determining whether a private contractor or the federal government can provide automated flight service station services more efficiently.[20] OMB Circular A-76 directs federal agencies to (1) identify all activities performed by government personnel as either commercial or inherently governmental, (2) perform inherently governmental activities with government personnel, (3) use a competition to determine who should perform commercial activities, and (4) award a contract to the private sector if the outcome, or performance decision, of the competition is

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[20]FAA formally announced in December 2003 that its flight service stations met the criteria for competitive sourcing, and that it would conduct a competition under OMB's A-76 guidelines for an improved way to provide flight service operations. On February 1, 2005, FAA announced the selection of a team headed by Lockheed Martin to provide services now offered by the agency's network of 58 automated flight service stations across the United States. These services include weather briefing and flight planning services, which are used primarily by general aviation pilots. The total evaluated cost of the 5-year contract, with 5 additional option years, is $1.9 billion and represents estimated savings of $2.2 billion over the next 10 years.

determined in its favor.[21] The panelists, who generally assumed that the private sector could provide flight service station services and other air traffic services more efficiently than the government, suggested that if contracting for flight service station services proved to be effective, FAA could contract for other air traffic services, such as oceanic, night, en route, or airways facilities services. The A-76 process would then serve not only as a way of saving money but also as "a pilot program for how things could get done," one panelist said. In the view of another panelist, ongoing government oversight would ensure the safety of contracted operations, and "staged outsourcing" of the NAS's functions might build confidence in the private sector's ability to provide air traffic services safely and efficiently.

Obtaining Information on Other Countries' ATC Technologies and on International Technical Standards Could Help the ATO Save Costs

Obtaining information on technologies and procedures that other countries have already developed could help the ATO control costs, as well as help compensate for its lack of technical expertise, panelists noted. "We should be using and sharing" the technologies that have already been invented, one panelist said. According to his organization, the air navigation service business worldwide spends $3 billion to $4 billion a year on writing code for air traffic management software, and "at least half of that" is writing code for "something that's already been invented and…works just fine somewhere else."

Although this panelist's organization formerly maintained, as FAA has done, that it could not adapt other countries' systems to its own unique needs, it found, when faced with financial pressures, that it could buy technologies from other countries or enter into agreements with them and that it could do so at less cost than it could develop its own technologies. To facilitate information sharing and cost saving, the panelist suggested, benchmarks of the existing market would be useful, including information

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[21]Under President Clinton, air traffic services were defined as "inherently governmental," meaning that they could not be provided by the private sector. In June 2002, President Bush issued Executive Order 13264, which revised that definition and opened the way for FAA to contract with private companies for services on a test basis, as directed by OMB Circular A-76.

on the systems that are already running in countries, their performance, and their cost.[22]

Sharing information on technical standards with international organizations could also help the ATO avoid costly investments in technologies whose standards were incompatible with those of other countries. A shared vision is crucial for a globally based air traffic system, one panelist said. If every country or continent had its own technical standards—a North American switch, a European switch, a South American switch, and an Australian switch, for example—an international system could not function effectively.[23]

The following provides additional information from the ATO's COO and from previous GAO reports and work in progress on how FAA is addressing some of the funding shortfalls and features of the federal budget process that panelists identified as affecting ATC modernization:

The ATO's COO believes that good financial management means linking FAA's capital and operating budgets. Previously, FAA developed separate capital (Facilities and Equipment) and operating (Operations) budgets. But the ATO recognizes that capital expenditures directly affect operating costs over time, and therefore the two budgets must be developed together. Creating this linkage is important for the ATO to respond to concerns expressed by its owners and customers as well as to address internal issues, such as training, staffing, pay disparities, and infrastructure. Using the Strategic Management Process to drive budget decisions will help to ensure the establishment and maintenance of a linkage between the capital and operating budgets.

According to the ATO's COO, it will be at least 2 years before the ATO has completed the basic management processes needed to use the new

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[22]EUROCONTROL has been collecting and reporting performance data from its members since 1998, and the International Air Transport Association is calling on the Civil Air Navigation Services Organization (CANSO) to develop performance benchmarks for its members. CANSO represents the interests of air navigation service providers (organizations that provide ATC services) and technology suppliers of goods and services to the industry worldwide.

[23]FAA has ceased funding the ground station component of one modernization program (NEXCOM), in part because it is reevaluating its approach for modernizing the air-to-ground communications. FAA will move forward with replacing older radios, which is the least complex element of the NEXCOM effort.

financial management systems it has been putting in place. As steps toward that goal, the ATO expects everyone to learn the difference between cost and cash flow and get a better handle on unit costs as better cost accounting data become available. To gain a more complete understanding of its costs, FAA is revising its cost accounting practices and changing from a cash flow to a total cost business model for the ATO, and the ATO is developing management training in cost accounting and budgeting. Moreover, FAA plans to finish putting a new cost accounting system in place by 2006 that will allow it to assign, track, and better control costs.

In the fall of 2004, FAA updated its cost estimates in light of OMB's revenue projections for the next 4 years and arrived at a cumulative shortfall for the period of $5 billion for the operating budget and $3.2 billion for the capital budget. According to FAA, a business plan that the ATO was preparing at that time will show, when completed, how large a funding gap the ATO faces and how far it will have to go to address that gap. Whatever the exact size of the gap may be, FAA says that it is prepared to identify and eliminate redundancies in the NAS and to review its long-term ATC modernization priorities.

FAA has already taken some steps to control the costs of ATC modernization. For example, it has adopted the phased approach to implementing new ATC systems that it used under Free Flight Phase 1, called "build a little, test a little." This approach relies on the early and ongoing investment of stakeholders, who review the progress of new projects regularly and identify critical omissions and "no go" items that would prevent a system from operating as intended. Reviews of three projects with cost, schedule, and performance issues that our reports had identified—the Local Area Augmentation System, Controller-Pilot Data Link Communications, and Next-Generation Air-to-Ground Communications System—led FAA to reduce the funding for them in FAA's fiscal year 2005 budget request. The ATO says it plans to continue this phased approach to acquiring new systems.

FAA developed a Roadmap for Performance-Based Navigation, which it published in July 2003, but the ATO is having difficulty finding the $10 million in its operations budget that it needs to chart RNP procedures. Airspace redesign using RNAV is occurring in phases, and its implementation will depend on those owners and operators who have fully equipped aircraft and are sufficiently trained. To encourage progress, FAA is implementing procedures that provide benefits for those

*customers that do equip. Now, during the first phase, FAA is
implementing the redesign at very high altitudes. In January 2005, FAA
doubled the airspace routes between 29,000 feet and 41,000 feet by
spacing aircraft 1,000 feet apart instead of 2,000 feet. The procedure,
invisible to passengers, is called Reduced Vertical Separation Minimum
and is expected to save airlines $400 million in fuel costs during the first
year. As technology allows, FAA says, more flight altitude levels will be
added. Currently, FAA is implementing a number of improvements to
airspace and procedures using RNP. In addition, according to FAA, five
airports are developing RNP-based procedures in partnership with
airlines that favor RNP.*

Panelists Suggested Structural Changes to Improve the ATO's Chances of Success over Time

While recognizing that the ATO could make some progress in addressing its
cultural, technical, and budgetary challenges under its current authorities,
the panelists generally agreed that structural changes would increase the
ATO's chances of success. These changes, which would give the ATO a
more predictable source of funding and greater decision-making authority,
would generally require legislative action and take time to implement. To
give the ATO a more predictable source of funding, panelists suggested that
it be authorized to establish and manage user fees, rather than rely on
appropriated tax receipts, and that it be allowed to issue revenue bonds
backed by these fees. To give the ATO greater decision-making authority,
panelists proposed restructuring it to streamline and strengthen its
management and provide its managers with the tools needed to address its
challenges. These changes would allow the ATO to implement a "sensible"
capital investment program; hire the technical expertise it needs; achieve
cost efficiencies; and offer better, more responsive service. Additionally,
panelists said, restructuring could resolve the conflict of interest inherent
in FAA's dual responsibility as the regulator and the operator of air traffic
services.

Some Panelists Considered the Steps Taken to Create a Performance-Based Air Traffic Organization Insufficient for Its Success

When Congress authorized the ATO's creation and generally implemented the Mineta Commission's[24] organizational recommendations without implementing its funding recommendations, it produced an anomaly—that is, an organization charged with becoming performance-based but deprived of the means to transform itself, according to one panelist. Other panelists also portrayed the ATO as an organization that is charged with operating like a business but is not provided with the management tools available to a business. In their view, the ATO's chances for success are limited because the COO is being asked to turn the organization around without being given the tools to do so. One panelist, who said he was skeptical about the ATO's ability to act like a business when it is not really one, suggested that it was only at the margins that the creators of the ATO had replicated a business. According to him, the ATO is still largely a government organization and therefore remains subject to most governmental constraints.

Panelists Said a User Fee System Would Give the ATO a More Predictable Source of Funding and Link Air Traffic Services with Demand

Replacing airline ticket taxes with a user fee and allowing the ATO, rather than Congress, to manage the collected fees is a step that many panelists considered essential for the ATO's success. While recognizing that such a fee would be controversial, since the costs for most users would likely increase, the panelists maintained that it would produce a more predictable, reliable funding stream than the annual appropriations process.

A user fee system would link air traffic services directly with demand, panelists pointed out. Under the annual appropriations process, they noted, Congress comes between the ATO and the airlines that use its services. The ATO lacks a direct link with the users because Congress appropriates the revenue from them—the airline ticket taxes that are deposited into the Aviation Trust Fund—and the ATO is required to spend the funds as Congress directs. Not having a direct financial link between the ATO and the users can create inefficiencies, panelists said: The users lack incentives to monitor the ATO's spending and may not insist on cost control, while the ATO lacks incentives to consult the users and may invest in technologies that the users do not want. A user fee makes the ties between the funding source and the users "much more transparent," according to one panelist,

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[24]The Mineta Commission, formally authorized as the National Civil Aviation Review Commission, recommended in 1997 that FAA's air traffic system be restructured as a performance-based organization, subject to independent oversight, and be given leasing and borrowing authority.

and helps preclude spending for "gold-plated things that don't affect the true performance of the system and drive the costs up completely unnecessarily." Without a direct connection to the users and their mission, another panelist said, "evolution takes very unintended and very undesirable paths over long periods of time." As long as the customers are not directly paying the bills and providing the resources, still another panelist maintained, "it's going to be very hard to bring about real change" and make the ATO "a customer-driven, customer-servicing organization. The ones who pay the bills are the ones you respond to and serve," he concluded.

While panelists generally favored a user fee system, they cautioned care in proposing and implementing one. As one panelist said, the fee question, once raised, would be all-consuming and would require the expenditure of political capital. In his view, it was critical that the ATO wait to achieve some successes before seeking a user fee system. Another panelist called for figuring out "not only what problem we're solving, but what problems we might be likely to create," and noted that the government would have to consider what it was incentivizing through user fees. For example, if the fee was based on weight, he said, it might "incentivize even smaller planes and more planes," thereby increasing demands on the ATC system's capacity. Another issue that would have to be worked out, is how the common costs of air traffic services (e.g., the costs of activities in the ATC system operated by the Department of the Air Force) should be allocated—whether users should pay only for the incremental costs of the services they use, as most users would argue, or whether some cross-subsidies should continue. Another panelist pointed out that implementing a user fee alone would not guarantee efficiency, because the air traffic services provider could simply raise the fee when costs increased and the users would have to pay, since the service is a monopoly. Some method of controlling costs would have to be built into the system, he said.

Most panelists correctly assumed that legislation would be required to institute a user fee system. Specifically, a user fee system could be implemented in a government or a public-private type of air traffic services organization. However, one panelist cautioned, it would be "fatal" to implement the fee in any way that did not make the ATO financially independent of Congress. Once the airlines and general aviation users started to pay a fee to finance the ATO, then the ATO should be held accountable to them, he said, and "FAA should not be getting approval from government to spend its budget."

Panelists Said Borrowing Authority Would Provide the Funding for Efficient Capital Investment

Revenue bonding based on a new user fee stream would create an "alternative to capital starvation," one panelist said. Even if the user fee stream initially produced no more revenue than the airlines are now paying in aviation-related taxes, he said, the ATO could reap a "transition dividend" during the first 5 or 10 years after the bonds are issued, limiting its annual outlays to the debt service on the bonds. To facilitate the airlines' recovery, he suggested, the ATO could cut what the airlines pay and "still have a robust modernization program being financed by the revenue bonds." He characterized this strategy as "money that's lying on the sidewalk waiting to be picked up" and saw it as an opportunity to buy some new equipment in bulk and get it installed before it becomes obsolete. Such a "sensible" approach would not be possible with annual appropriations, he said.

Further Organizational Restructuring Could Streamline and Strengthen the ATO's Management

Panelists maintained that the ATO's organizational placement, combined with its dependence on Congress for funding, limits the COO's ability to make decisions and take actions. The COO is not a Chief Executive Officer, as one of the panelists observed. Instead, he reports to his "owners"—who include the FAA Administrator and the DOT Secretary, who in turn receive direction from the administration (the President and OMB Director) and Congress.

Because the ATO is embedded so deeply in the executive branch, the COO has no means of communicating directly with the congressional committees that authorize and fund the ATO. Congress originally tried to address this issue when, as part of the legislation creating the COO position, it created the Air Traffic Services Subcommittee to oversee the ATO and report independently to Congress on the ATO's performance.[25] However, the legislation did not authorize funds to support an independent staff for the subcommittee, and when the FAA Administrator requested funds, DOT denied the request, one panelist said, because the Deputy Secretary saw the subcommittee as performing a DOT function. Moreover, as another panelist noted, Congress eliminated the subcommittee's

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[25]As originally implemented, this committee, the Air Traffic Services Subcommittee, was similar to the board of public interest directors that the Mineta Commission recommended be established to oversee a performance-based air traffic services organization.

oversight authority,[26] making the subcommittee purely advisory. Consequently, he said, there is no oversight group that is expected to provide constructive criticism of FAA, and FAA does not get "the kind of constructive advice that you might hope for." According to a third panelist, Europe's Performance Review Commission provides such constructive advice for EUROCONTROL, the European air traffic management organization. The commission serves as a panel of independent advisers and costs about $2.5 million a year, he said, and "it's well worth the investment."

According to several panelists, the ATO's COO lacks the management tools that would be available to a private-sector CEO. His ability to plan modernization projects, set program priorities, and implement new technologies is constrained because the FAA Administrator, DOT Secretary, and OMB Director can revise his budget request and Congress can make further changes in the ATO's budget. In addition, the 20-year vision of the Joint Planning and Development Office (JPDO)[27] is at odds with the ATO, according to one panelist, because it looks forward to the ATC system of 2025, rather than helping the ATO address its immediate funding needs. Other panelists observed that the controllers' union influences management's decisions.

The COO lacks key financial data needed to determine, analyze, and manage the ATO's costs. When he was "parachuted" into the ATO, as one panelist put it, he did not have the numbers he needed to know where the ATO stood because FAA did not maintain basic information on the costs and value of existing systems, reducing the ATO's potential to be data driven. As a result, he spent most of his first year overseeing the implementation of a cost accounting system and collecting other key data.

Finally, the COO's ability to manage the ATC workforce is limited. Civil service rules give the ATO's employees powers and rights that they would not have in a private organization, and management's ability to influence

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[26]Congress eliminated the subcommittee's oversight responsibilities when it reauthorized FAA in December 2003.

[27]This office coordinates an air transportation system planning initiative that involves the Departments of Transportation, Commerce, Defense, and Homeland Security; the National Aeronautics and Space Administration; and the Office of Science and Technology Policy and other experts from the public and private sectors. The office reports to a Senior Policy Committee chaired by the Secretary of Transportation.

their performance is constrained because their terms of employment and compensation are based largely on negotiated agreements rather than on performance. In addition, salary caps limit FAA's ability to pay for technical expertise.

Restructuring Could Resolve the Conflict of Interest Inherent in FAA's Dual Role as the Regulator and the Operator of Air Traffic Services

As one panelist observed at the end of the panel, the ATO's creation did not address the structural conflict of interest that exists because FAA is both the regulator and the operator of air traffic services. "We didn't have arms length regulation of air traffic control in FAA," he said, "and the ATO didn't do anything to accomplish that." Another panelist noted that when his country restructured its air traffic organization, it immediately eliminated the same structural conflict of interest, and "overnight" the regulator became more effective and the operator's safety performance "significantly improved." According to the first panelist, other countries that have reorganized their air traffic organizations have also instituted arms' length regulation if they did not have it already. "We remain one of the few places that somehow thinks that self-regulation is a good idea, in spite of sort of overwhelming evidence in lots of arenas that it's not a very good idea," he said.

The following is additional information from the ATO's COO and from previous GAO reports and work in progress that indicates how FAA is addressing some of the structural changes that panelists proposed to improve the ATO's success over time:

In addition to the business plan that the ATO is developing to guide and improve its operations and financial management, FAA has worked to develop three longer term planning documents. First, it has published its Flight Plan for 2005 through 2009, a multiyear strategic effort that sets a 5-year course for FAA in the areas of safety, capacity, international leadership, and organizational excellence. Second, it has developed a rolling 10-year effort, called the Operational Evolution Plan (OEP), through which FAA plans to increase the capacity of the NAS by one-third. Finally, FAA is participating in a multiagency effort, sponsored by the JPDO, to develop a national plan for aviation in 2025 and beyond. Both the OEP and the JPDO's plan are designed to meet the Flight Plan's commitment to help the NAS flow smoothly and meet future needs. According to FAA, the Vice President of the Operations Planning Service Unit in the ATO is also the Director of the JPDO, helping to ensure integration of near-term and long-term planning.

According to the ATO's COO, the restructuring of U.S. air traffic services that has taken place thus far, through the establishment of a performance-based air traffic organization, constitutes "the first building block" of the longer term effort to transform the aviation system envisioned in the JPDO's 20-year plan. According to the COO, this vision of the U.S. aviation system will incorporate both technologies and processes. However, he acknowledged that the ATO has not yet connected this long-term vision with the financial and other challenges it currently faces. He said that his goal is to establish an organization that can execute the long-term vision and manage not only its finances but also its future—an organization that can, in effect, ensure the viability of the long-term vision. Over time, he said, he plans to expand the OEP to include a strategy and the JPDO's long-term vision, thereby "tie[ing] the vision to the viability of the future." The OEP will then be "not just a set of projects," but a project plan with a vision and a strategy that goes out 20 years. But given the current budget constraints, he conceded, the path to that goal is not clear.

In March 2004, FAA created the Air Traffic Safety Oversight Service (AOV), under FAA's Office of Aviation Safety. This step established separate reporting relationships for the ATO, which is responsible for managing the ATC system, and for the AOV, which is responsible for ensuring the safety of changes to air traffic standards and procedures. The establishment of the AOV responds directly to a recommendation by the 1997 National Civil Aviation Review Commission that safety oversight of FAA's traffic function be provided by a separate part of the agency. Although both organizations remain within FAA, under the FAA Administrator, they are less closely joined than they were previously. Hence, this step is a positive move toward providing "arm's length" safety oversight, although it does not go as far as placing the two organizations in separate federal agencies or removing one of the agencies from the federal government altogether.

Concluding Observations

At our request, the panelists concluded the panel with their parting thoughts on the day's discussion, including any advice they had for FAA or for Congress. Overall, the panelists were united in their desire for the ATO to succeed, but they generally agreed that its opportunities for success were constrained within a government system. For many, the steps taken thus far to create a performance-based organization were insufficient, in large part because the ATO lacks control over its revenues and funding priorities, and the ATO still had a long way to go to achieve its goals.

Some panelists stressed the importance of progressing by small steps within the existing system, at least for the time being. Such small steps might include obtaining good performance and cost information, scoping programs in accordance with current budget projections, contracting out some air traffic services, and obtaining outside expertise from systems engineers and other technical and management experts. It was critical, one panelist said, for the ATO to "have some small early practical successes" to enlist the political support of the user community and help tie the customers to the ATO's mission.

Other panelists focused on the obstacles within the system that they believed would impede or prevent success. Among the obstacles they cited were the counterproductive incentives inherent in the budget process, the government's refusal to allow new air traffic technologies to be used, and opposition to organizational and technological change. It was important, one panelist said, to overcome this opposition by describing "the difference between how things are and how they might be." Descriptions of accomplishments elsewhere, together with actions to implement whatever safeguards and regulatory framework might be necessary, could perhaps make the argument for change "compelling," he said.

Still other panelists looked to the future, calling for international technical benchmarks to promote efficient development, business models that take into account operational trends (e.g., the growing market share of regional jets and low-fare airlines) and incentives to help users overcome cost barriers to acquiring new technologies. As one panelist said, "we have to target the future mix of real operations that we're really going to see, not build the world's most perfect system from 1956."

Despite their reservations about the ATO's potential for success as a government organization, the panelists generally agreed that stakeholders should not "allow the concept of privatization to be the enemy of moving forward with the ATO," as one panelist said, or "sacrifice the good for the better" in the words of another. Instead, taking a two-pronged approach—telling people "what's to be done now to get results" and telling them "that they have an obligation to build for the future"—would be the best way, in the view of most panelists, for the ATO to meet its immediate and longer term challenges.

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Staff Acknowledgments

In addition to the individual named above, Elizabeth Eisenstadt, Brandon Haller, Bert Japikse, Maren McAvoy, Beverly Norwood, and Richard Scott made key contributions to this special product.

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