AIR TRAFFIC CONTROL MODERNIZATION: FAA FACES CHALLENGES IN MANAGING ONGOING PROJECTS, SUSTAINING EXISTING FACILITIES, AND INTRODUCING NEW CAPABILITIES

Federal Aviation Administration

Report Number: AV-2008-049
Date Issued: April 14, 2008

Memorandum

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

Subject: ACTION: Air Traffic Control Modernization: FAA Faces Challenges in Managing Ongoing Projects, Sustaining Existing Facilities, and Introducing New Capabilities
Federal Aviation Administration
Report Number AV-2008-049

Date: April 14, 2008

From: Lou E. Dixon
Assistant Inspector General
for Aviation and Special Program Audits

Reply to Attn. of: JA-10

To: Acting Federal Aviation Administrator

This report provides the results of our review of the Federal Aviation Administration's (FAA) major acquisitions. At the request of the Chairman and Ranking Member of the House Committee on Transportation and Infrastructure, we updated our May 2005 status report[1] on FAA's major acquisitions and examined how projects are impacted by plans for the Next Generation Air Transportation System (NextGen). Our objectives were to examine (1) overall trends affecting FAA's Facilities and Equipment (F&E) or capital account, (2) recent changes in cost and schedule baselines of FAA's major acquisition programs, and (3) the effect of NextGen plans on existing projects.

Our review examined 18 projects valued at $17.5 billion[2] in capital costs. These projects include developing new automated controller tools, acquiring new technologies to prevent accidents on runways and taxiways, and modernizing FAA facilities that manage large segments of airspace over the Atlantic and Pacific oceans. We performed this audit in accordance with generally accepted Government Auditing Standards as prescribed by the Comptroller General of the United States. Exhibit A details the status of the 18 projects, and exhibit B lists

[1] OIG Report Number AV-2005-061, "Status of FAA's Major Acquisitions: Cost Growth and Schedule Delays Continue To Stall Air Traffic Modernization," May 26, 2005. OIG reports and testimonies are available on our website: www.oig.dot.gov.

[2] The $17.5 billion total for the 18 projects reviewed includes baselined, non-baselined, and technical refreshment cost estimates presented in FAA's Capital Investment Plan.

their cost and schedule variances. Exhibit C contains our review scope and methodology.

FAA's modernization effort and plans for NextGen are central issues in the debate about how best to finance FAA as the current tax structure expires. While there is controversy about various financing mechanisms, there is almost universal agreement by stakeholders that significant change is needed to meet the anticipated demand for air travel.

BACKGROUND

In the early 1980s, FAA initiated a multibillion-dollar effort to modernize the National Airspace System (NAS), which involved acquiring a vast network of radar, navigation, communications, information processing systems, and new air traffic control facilities. This modernization effort continues today and is now expected to cost $51.1 billion through fiscal year (FY) 2008.

In response to congressional direction, FAA created the Joint Planning and Development Office (JPDO) and tasked it with developing NextGen in the 2025 timeframe. NextGen is expected to significantly enhance capacity and boost productivity by shifting from the current ground-based system to a more aircraft-centered system that relies on satellites. In February 2007, we reported on the risks facing NextGen and the range of actions needed to successfully deliver new capabilities.[3]

FAA's air traffic control (ATC) modernization effort has a long history of cost growth, schedule delays, and unmet expectations that we have chronicled in numerous reports. In May 2005, we reported that 11 of the 16 projects we reviewed would experience a total cost growth of about $5.6 billion. Moreover, 9 of the 16 experienced schedule slips from 2 to 12 years. Problems are traceable to complex software development, overambitious plans, changing requirements, and poorly defined cost estimates. It will be important for FAA to avoid these problems as it moves forward with NextGen.

RESULTS IN BRIEF

FAA is at a crossroads with NAS modernization efforts and will be challenged to keep ongoing projects on track, maintain aging facilities, and develop and implement NextGen initiatives. FAA is essentially opening a new chapter in the history of ATC modernization with its plans for NextGen. The transition to

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

NextGen is one of the most complex, high-risk undertakings FAA has ever attempted.

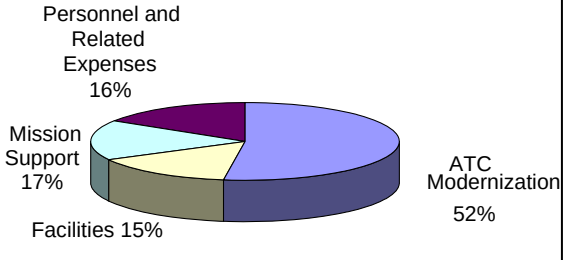
Overall, we found that FAA has done a better job of managing cost growth and schedule delays with its major acquisitions since we last reported. This is because FAA has taken a more incremental approach to investment decisions to modernize controller displays, radars, and communication equipment. However, some key projects that will serve as platforms for NextGen are still at risk of cost growth, schedule slips, or diminishing benefits. We also found that FAA's metrics for measuring progress with acquisitions have limitations that decision makers should be aware of when reviewing FAA's capital account.

Costs remain uncertain for NextGen, and FAA is still evaluating the best ways to obtain many NextGen capabilities, such as enhanced automation for boosting controller productivity and data link communications for controllers and pilots. FAA is also exploring what can be done in the near term. We note that over 30 existing capital projects will form platforms for NextGen, but FAA has not made significant changes to them. Our work shows that FAA will need to make several decisions between now and 2009 to determine how to achieve NextGen's capacity-enhancing capabilities.

FAA's capital account has focused on sustainment but is now being shaped by NextGen. Since 2005, FAA's capital account has remained steady at $2.5 billion annually and has mainly focused on sustaining the existing system. As we have previously reported, increasing operations costs (mostly salary-driven) have crowded out capital investments. As the capital account stayed relatively flat, FAA deferred, cancelled, or postponed decisions on projects. For example, FAA cancelled a $167 million data-link communications program for controllers and pilots because of cost concerns, impact on the operations account, and uncertainty about how quickly airspace users would equip with new avionics. FAA is now restarting a similar program for NextGen.

During the same period, FAA invested slightly over half of its capital account for air traffic control equipment. The remaining funds were for facilities, personnel costs, and support contracts. Figure 1 illustrates FAA's capital investments from FY 2003 through FY 2007.

Figure 1. FAA's Capital Account Percentages, FY 2003-FY 2007



Source: FAA

The overarching issue for the capital account now involves developing and introducing NextGen capabilities that can enhance capacity, boost controller

productivity, and reduce Agency operating costs. FAA plans call for the capital account to grow to an average of $3 billion per year, representing $15.4 billion for FY 2008 through 2012. A large portion of the increase is to fund NextGen projects, slated to cost $4.6 billion for that period.

A near-term challenge for FAA is maintaining its aging air traffic control facilities. FAA spends about $400 million annually on its facilities, or about 15 percent of its capital budget. Several events, such as the equipment failures in southern California that delayed hundreds of flights in 2006, have underscored the importance of maintaining these facilities. As of last year, FAA's en route operations reported a $120 million backlog in facility sustainment requirements, and FAA's terminal operations reported a $124 million backlog. We are currently reviewing the overall state of FAA's facilities and will issue our report later this year.

While FAA is taking a more incremental approach with its acquisitions, several major programs are facing significant cost and schedule risks or diminishing benefits. Overall, we are not seeing the significant cost growth and schedule slips with major acquisitions that have occurred in the past. When comparing revised baselines, only 2 of the 18 projects we reviewed experienced additional cost growth ($53 million, combined) and delays (5 years, combined) since our last report. However, from inception, 6 of the 18 programs have experienced cost growth of close to $4.7 billion and schedule delays of 1 to 12 years.[4]

One reason for this overall improvement is that FAA's approach focuses on "re-baselining" (i.e., making formal cost or schedule adjustments) or approving segments of major efforts. This involves reducing the number of systems procured or postponing investment decisions on remaining portions of the project. As a result, straightforward comparisons of many projects' original and revised cost and schedule baselines no longer represent all requirements. For example, FAA re-baselined the Airport Surveillance Radar (ASR-11) program in 2005 by breaking it into segments. The current, approved segment shows a slightly lower cost estimate ($697 million) for 66 systems by 2009 than the original *program* estimate of $743 million for 112 systems by 2005. FAA continues to postpone decisions on the second segment.

While this approach may reduce risk in the near term, it has left several programs with no clear end-state and less visibility into how much programs will cost. A case in point is terminal modernization. FAA's past terminal modernization

[4] Our analysis did not include the same programs reviewed in our previous modernization report, in which we reported $5.6 billion in cost growth. Several programs have since been re-baselined, resulting in lower cost estimates. For example, we reported in May 2005 that the Next Generation VHF Air/Ground Communication (NEXCOM) program cost estimate was $986.4 million; however, its current cost estimate is $324.7 million.

efforts focused on the Standard Terminal Automation Replacement System (STARS). In 2004, faced with cost growth of over $2 billion, FAA shifted to a phased approach and committed STARS to just 50 sites for an estimated cost of $1.46 billion instead of the original plan to deploy 172 sites for $940 million. FAA renamed the overall effort the Terminal Automation Modernization-Replacement initiative (TAMR).

In 2005, FAA approved modernizing five small sites and replacing aging displays at four large sites at a cost of $57 million. This leaves over 100 sites still in need of modernization. FAA's Capital Investment Plan (CIP)[5] now has separate line items for STARS and TAMR. Although firm requirements have not been established, over $3.5 billion is planned in the CIP for terminal modernization efforts.

Past problems with STARS leave FAA in a difficult position to transition to NextGen. Many NextGen capabilities for more flexible use of high-density airspace depend on enhanced controller displays and related equipment near airports. Key cost drivers will be (1) NextGen requirements, (2) the extent to which FAA consolidates its terminal facilities to keep pace with information sharing technology (this could be controversial as the size and location of FAA facilities directly affect system and workforce requirements), and (3) the need to replace or sustain legacy systems that have not been modernized.

Several projects, such as the FAA Telecommunications Infrastructure (FTI) and the Airport Surface Detection Equipment-Model X (ASDE-X) programs, have undergone significant changes but are still at risk of cost increases, schedule slips, or reduced benefits.

- **FTI** (replaces telecommunications networks with a single network to reduce operating costs): In April 2006, we reported[6] that FTI was unlikely to meet its December 2007 completion date; FAA has since extended the completion date by 1 year and increased acquisition costs by $8.6 million. To its credit, FAA has delivered 18,294 of 22,545 services as of January 31, 2008; however, expected cost savings have eroded. In 2005, the program office reported a reduced benefit estimate, from $820 million to $672 million. In August 2006, when FAA re-baselined FTI, we estimated cost savings decreased from $672 million to $434 million, when including previous investments in FTI. We will issue a report on FTI later this year that examines overall program costs and schedule risks and FAA's actions to address unscheduled outages during the FTI transition.

[5] The FAA's CIP is a 5-year plan that describes the NAS modernization projects planned for the next 5 years within anticipated levels of funding.

[6] OIG Report Number AV-2006-047, "FAA Telecommunications Infrastructure Program: FAA Needs To Take Steps To Improve Management Controls and Reduce Schedule Risks," April 27, 2006.

- **ASDE-X** (helps controllers track aircraft and vehicle movement at airports): FAA intended ASDE-X as a low-cost alternative to its legacy radar system for small- to medium-sized airports. In 2005, FAA increased ASDE-X costs by $44.6 million and extended the 2007 completion date by 4 years, refocusing the program on upgrading legacy radar at larger airports. Since the re-baseline, however, FAA has increased costs by $94 million for some ASDE-X activities and has only commissioned 12 of the 35 sites. Further, FAA has not resolved operational performance issues with key safety capabilities. In October 2007, we recommended that FAA develop realistic cost estimates for implementation and resolve operational performance issues before deploying ASDE-X safety capabilities at remaining airports.[7]

FAA's cost and schedule metrics are useful tools, but do not fully assess progress with major acquisitions. FAA reports in the FY 2007 Flight Plan and its most recent Performance and Accountability Report that 100 percent of its critical acquisitions were within 10 percent of budget estimates and 97 percent were on schedule for 2006. In FY 2006, FAA tracked about 29 projects, such as the acquisition of new radars. However, FAA's cost and schedule metrics have limitations that decision makers must understand to properly assess the overall status of FAA's acquisition portfolio.

- First, these metrics are "snapshots" in time and do not address changes in requirements, reductions in procured units, or shortfalls in performance. As noted earlier, there have been significant changes in requirements in terms of systems to be procured and deployment plans with respect to the ASR-11 and STARS/TAMR efforts.
- Second, FAA's budget metrics compare cost estimates taken during the current fiscal year using updated cost figures, not estimates from the original baseline. This is why the Wide Area Augmentation System (a satellite-based navigation system) is considered "on budget" even though costs have grown from $892 million to over $3 billion since 1998.
- Third, several schedule metrics focus on interim steps or task completion instead of whether systems meet operational performance goals. For example, ASDE-X metrics focused on the delivery of two systems instead of whether the systems entered service or operated as planned. There are no written standards for selecting or reporting program milestones, and FAA needs to develop criteria for program offices to improve milestone reporting.

Re-baselining a project is important to maintain reliable cost and schedule parameters and is consistent with Office of Management and Budget (OMB)

[7] OIG Report Number AV-2008-004, "FAA Needs To Improve ASDE-X Management Controls To Address Cost Growth, Schedule Delays, and Safety Risks," October 31, 2007.

guidance. However, comparisons of revised baselines—absent additional information—do not accurately depict a program's true cost parameters. To sufficiently measure progress with NextGen initiatives, FAA will need to explore a wider range of metrics that focus on promised capabilities and benefits from bundled procedures and multiple systems. FAA should focus on metrics associated with the goals of enhancing capacity, boosting productivity, and reducing Agency operating costs.

Much work remains to determine NextGen's impact on existing projects. FAA is currently exploring ways to accelerate elements of NextGen. FAA faces complex integration issues (linking new and legacy systems) and must manage interdependency among diverse projects. The pace of introducing new automation, more flexible airspace, and data-link communications will be governed by the pace of existing projects.

According to FAA, about 30 existing capital programs will serve as platforms for NextGen, some of which were designed and approved before the JPDO and NextGen concept of operations was established. For example, core NextGen initiatives, such as data link and flexible airspace, rely on software enhancements to the $2.1 billion En Route Automation Modernization program, or ERAM (new hardware and software for facilities that manage high-altitude traffic). However, since ERAM is planned for completion between 2009 and 2012, many NextGen capabilities are not planned for introduction until the 2012 to 2015 timeframe. ERAM software requirements related to NextGen are still uncertain, but costs are expected to be in the billions of dollars.

Over the next 2 years, over 23 critical decisions must be made about ongoing programs. These decisions affect major lines of the modernization effort with respect to *automation* (modernizing terminal and en route capabilities), *communications* (moving forward with data-link programs), *navigation* (deciding whether to retain or discontinue certain ground-based systems), and *surveillance* (using satellite-based and radar information with existing ATC systems).

These decisions and many others will depend heavily on the development of a comprehensive Enterprise Architecture (a technical roadmap) that lays out the vision of how the system will work and what changes will be required. The Enterprise Architecture must establish a transition path that identifies the role and evolution of current systems and how they will transition to NextGen.

FAA has made progress in developing the NextGen Enterprise Architecture, but planning documents lack details on requirements, particularly for automation, that could be used to develop reliable cost estimates. FAA must revise these documents to prioritize NextGen operational improvements and systems and

ensure that these priorities are reflected in NextGen planning documents and budget requests.

Along with refining the Enterprise Architecture, FAA must chart a clear transition course from the current NAS architecture to the vastly different NextGen environment. Our work shows that FAA needs to conduct a gap analysis between the current system and the NextGen architecture planned for the 2025 timeframe. This will help establish budget priorities, better define requirements, and refine transition plans. In addition, FAA needs to develop an interim architecture or "way-point" that is manageable and executable for what is expected of the NAS by 2015. Until these steps are taken, it will not be possible to determine technical requirements that translate into reliable cost and schedule estimates for existing or future acquisitions.

SUMMARY OF RECOMMENDATIONS

FAA faces challenges with completing existing projects, maintaining existing facilities, and developing NextGen without cost growth and schedule slips. In February 2007, we recommended that FAA review ongoing modernization projects to determine what cost and schedule adjustments would be required to better manage NextGen initiatives. We also recommended that FAA determine what skill sets would be required to manage and execute NextGen initiatives. FAA concurred with our recommendations and began actions to address our concerns.

At this time, we are recommending that FAA develop and track written criteria for selecting project milestones that are used to track Agency progress with major acquisitions; develop metrics for measuring NextGen progress that focus on enhancing capacity, boosting productivity, or reducing Agency operating costs; complete a gap analysis of the current NAS and planned NextGen enterprise architectures; and establish an interim architecture to establish priorities that will allow FAA to accurately determine costs and NextGen requirements. Our complete recommendations are listed on page 20.

SUMMARY OF AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

On February 1, 2008, we provided FAA with our draft report. We held an exit conference with FAA officials from the Air Traffic Organization and JPDO on February 21 to discuss our findings and recommendations. The officials generally concurred with all of our recommendations and noted that FAA has initiated efforts to accelerate elements of NextGen and develop new metrics to assess

progress with those elements. They also offered technical comments with respect to the Automatic Dependent Surveillance-Broadcast (ADS-B), ASDE-X, and FTI programs, and we have adjusted our report as appropriate. FAA's comments and our response are fully discussed on page 21.

ACTIONS REQUIRED

In accordance with DOT Order 8000.1C, we request that FAA formally respond to our recommendations within 30 calendar days. We are also requesting that FAA provide target completion dates in its response to each recommendation. FAA may propose alternative actions that it believes would resolve the issues presented in this report.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please contact me or Matthew E. Hampton, Deputy Assistant Inspector General for Aviation and Special Program Audits, at (202) 366-0500.

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TABLE OF CONTENTS

FINDINGS

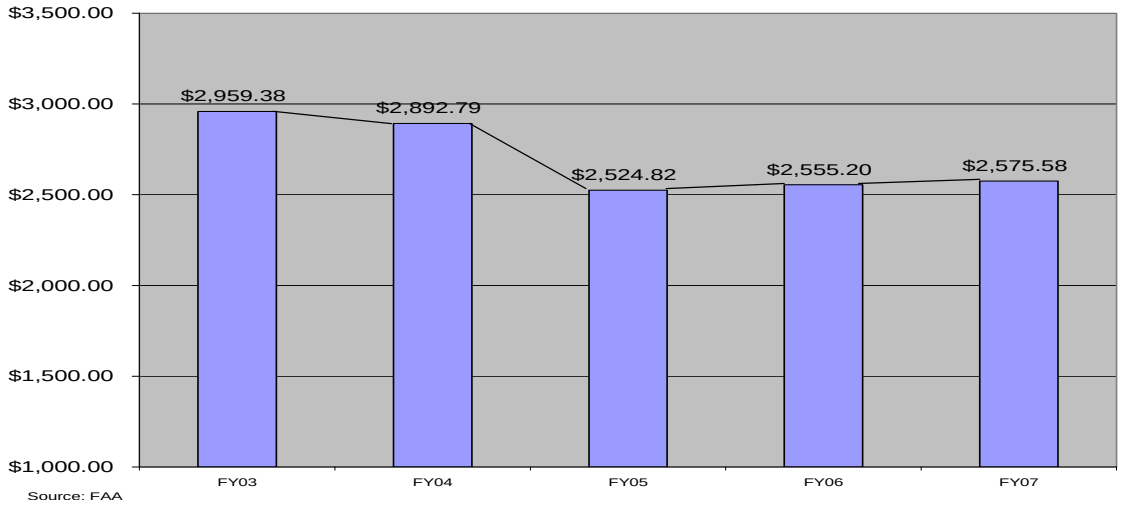
FAA's Capital Account Has Focused on Sustainment but Is Now Being Shaped by Efforts To Transition to NextGen

FAA's capital account has remained steady at $2.5 billion annually since 2005 and has mainly focused on sustaining the existing system. Also in recent years, FAA's operations budget has risen steadily, crowding out funds for major acquisitions. Looking forward, the capital budget for FY 2008 through 2012 is projected to be $15.4 billion, or an average of about $3.1 billion per year; about $4.6 billion of this amount is projected for NextGen efforts. FAA will face challenges as it must balance funding needs for NextGen initiatives with maintenance requirements for aging facilities.

Recent Capital Trends Focus on NAS Sustainment

From FY 2005 to FY 2007, FAA's capital account has stayed steady at about $2.5 billion, significantly below the $3.0 billion level authorized in the FY 2004 Vision 100 Century of Aviation Reauthorization Act.[8] During FY 2003 and FY 2004, the capital account averaged about $2.9 billion (see figure 2).

Figure 2. Agency F&E Enacted Funding, FY 2003 to FY 2007
(Totals in Millions)

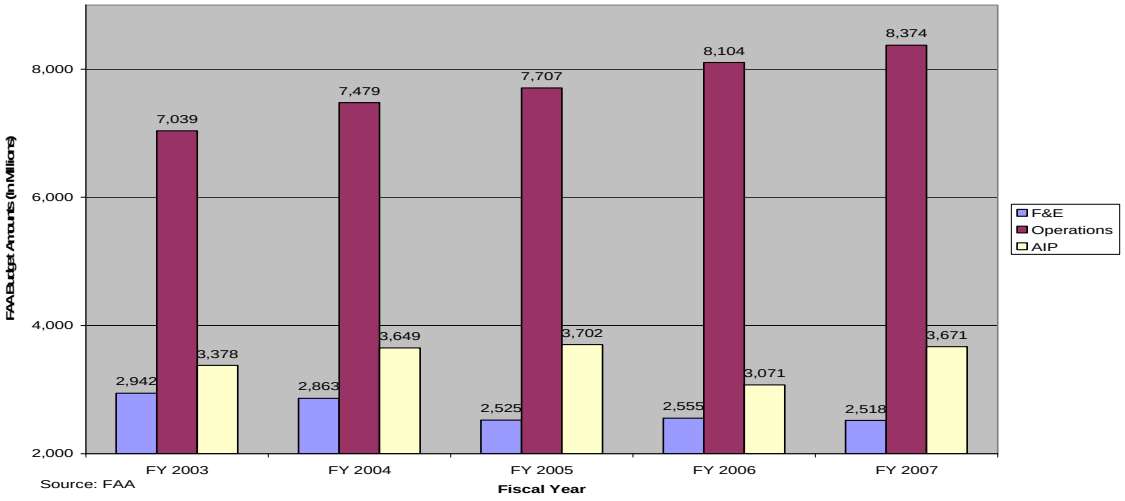


Over the last several years, increasing operating costs—mostly salary-driven—have crowded out funds for the capital account. From FY 2003 to FY 2007, funding for FAA's operations account rose almost 20 percent, while funding for

[8] Pub. L. No. 108-176 (2003).

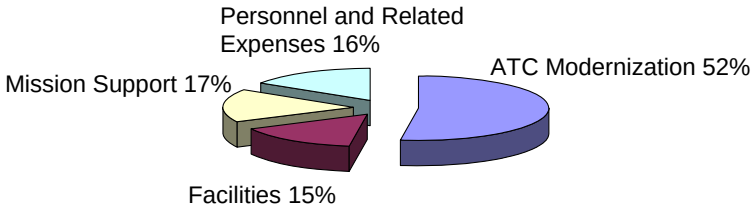
the capital account trended downward. Figure 3 illustrates funding levels for FAA's capital, operations, and airport improvement accounts.

Figure 3. Agency F&E, Operations, and Airport Improvement Actual Funding, FY 2003 to FY 2007
(Totals in Millions)



During the same period, FAA invested slightly over 50 percent of its capital account in modernizing air traffic control equipment; the remainder was used for personnel, mission support, and facilities (see figure 4).

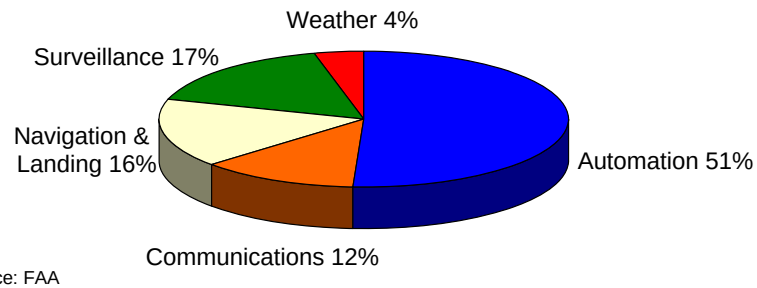
Figure 4. Breakout of FAA's Capital Account, FY 2003 to FY 2007



Source: FAA

Within the category of ATC modernization, investments can be grouped into five major lines of effort: automation, communications, navigation and landing, surveillance, and weather. Between FY 2003 and FY 2007, 51 percent of FAA's modernization funds went toward automation programs for controller displays and related components for terminal, en route, and oceanic systems. We note that FAA has spent about 40 to 50 percent of its modernization funds specifically on automation since the late 1990s. Figure 5 illustrates FAA investments among the major lines of effort.

Figure 5. Breakout of ATC Modernization Within FAA's Capital Budget, FY 2003 to FY 2007



Source: FAA

Several major programs are slated to reduce their capital expenditures between FY 2008 and FY 2012, including ASR-11, ASDE-X, ERAM, and FTI. While this could lead to lower annual capital requirements, program adjustments, in terms of requirements and costs needed to accommodate NextGen efforts, are still unknown.

FAA Has Deferred, Cancelled, and Postponed Several Acquisition Programs

Another trend that has affected the capital account during FY 2003 through FY 2007 is FAA's decision to defer or cancel several efforts. These include the following:

- *Local Area Augmentation System (LAAS)*—a satellite-based precision landing and approach system. In 2002, we reported on the risks facing LAAS and the need to reset expectations.[9] FAA placed the program into "research and development status" in FY 2004 to meet integrity requirements for Category I precision approaches[10] and stopped requesting funds for the program beginning in FY 2006. In 2008 or 2009, FAA will decide whether it will pursue LAAS.
- *Controller-Pilot Data Link Communications (CPDLC)*—a way for controllers and pilots to share information that is analogous to wireless e-mail. FAA began using CPDLC at the Miami Center in October 2002 and planned to deploy it to other facilities that manage high-altitude traffic for $167 million. In 2003, FAA cancelled the program due to concerns over user equipage, invalid cost estimates, and impact on the operations account. We reported on

[9] OIG Report Number AV-2003-006, "FAA Needs To Reset Expectations for LAAS Because Considerable Work Is Required Before It Can Be Deployed for Operational Use," December 16, 2002.
[10] CAT I precision approach has a 200-foot ceiling/decision height and visibility of a half-mile.

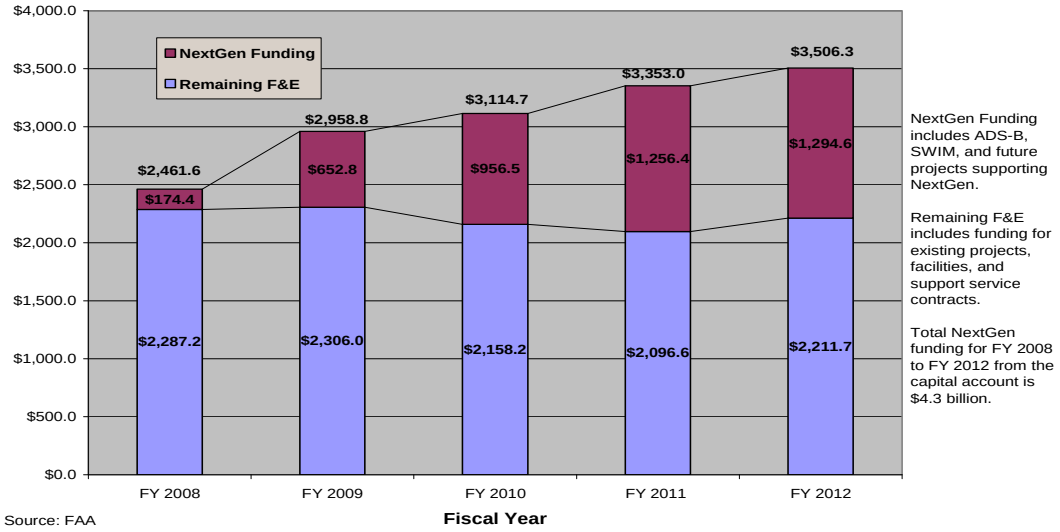
these issues in 2004.[11] We note that FAA is proposing a new data communication effort related to NextGen activities.

During the same period, FAA postponed decisions on future elements of several other programs, including terminal modernization, digital radars, and efforts to revamp voice and data communications in the NAS.

FAA's Capital Account Will Be Increasingly Shaped by Efforts To Transition to NextGen

FAA is planning for a significant increase in its capital budget to develop NextGen initiatives. FAA estimates show that the Agency will require $15.4 billion for capital projects from FY 2008 to FY 2012. This includes $4.6 billion for NextGen initiatives ($4.3 billion from the capital account and $300 million from the Research, Engineering, and Development [RE&D] account). Figure 6 illustrates FAA funding projections developed last year.

Figure 6. FAA Capital Funding Projections for FY 2008 to FY 2012 (Totals in Millions)



Source: FAA

In FY 2008, FAA requested funds in its capital budget for two prominent NextGen initiatives: ADS-B—a surveillance program—and System-Wide Information Management (SWIM)—an information architecture. FAA will spend $107.9 million on these programs in FY 2008. In addition, FAA requested funds for new NextGen initiatives, such as NextGen Data Communication

[11] OIG Report Number AV-2004-101, "Observations on FAA's Controller-Pilot Data Link Communications Program," September 30, 2004.

($7.4 million), NextGen Network Enabled Weather ($7 million), a new NAS Voice Switch ($3 million), and demonstration and infrastructure projects ($50 million).

The majority of funds for NextGen are for *developmental efforts*. In fact, $3.0 billion of the total $4.6 billion in projected NextGen funding will be dedicated to developmental efforts funded through the Engineering, Development, Test, and Evaluation portion of FAA's capital account starting in FY 2009. These efforts include providing the automation and communication links to allow trajectory-based operations, modifying procedures to improve airspace flexibility at high-density airports, and updating weather technology to sense and mitigate the impact of weather.

FAA Must Attend to Aging Facilities While Developing NextGen

A near-term challenge for FAA is maintaining its aging air traffic control facilities while concurrently focusing on NextGen efforts. Several events, such as the equipment failures in southern California that delayed hundreds of flights in 2006, have underscored the importance of maintaining existing facilities and related ground infrastructure. FAA has stated that its facilities are relatively old, on average, and have mechanical and electrical systems that are beyond their life expectancies or do not meet current operational requirements. FAA spent about $419 million in FY 2007 on facilities, or about 17 percent of its capital budget. Table 1 illustrates the average age of FAA's facilities as of FY 2007.

Table 1. Average Age of FAA Facilities

Type of Facilities	Average Age
Air Traffic Control Towers	29 years
Terminal Radar Approach Control Facilities	26 years
En Route Control Centers	43 years

Source: FAA

As of last year, FAA's air route traffic control centers have identified a $120 million backlog in facility sustainment requirements and, similarly, FAA's terminal operations have identified a $124 million backlog. We are currently reviewing the overall state of FAA's facilities and will issue a report later this year.

FAA Has Done a Better Job of Managing Acquisitions, but Several Programs Face Cost and Schedule Risks or Diminishing Benefits

Overall, we are not seeing the significant cost growth and schedule slips with FAA major acquisitions that occurred in the past. This is because FAA has taken a more incremental approach to managing major acquisitions. When comparing revised baselines, only 2 of the 18 projects we reviewed have experienced additional cost growth ($53 million) and delays (5 years) since our last report in 2005. However, from program inception, six programs have experienced cost growth of close to $4.7 billion and schedule delays of 1 to 12 years (see exhibit B). While FAA's incremental approach may reduce risk and make programs more manageable in the near term, it has left several programs with no clear end-state and less visibility into how much they will cost.

FAA's Incremental Approach to Major Acquisitions Involves Re-Baselining Several Efforts

One reason for the overall improvement in curbing cost growth is that FAA's approach focuses on approving segments of major acquisitions that can be completed within 5 years and deferring decisions on complicated portions of the acquisition. This is FAA's effort to correct past mistakes and maintain better control of acquisition efforts.

FAA has "re-baselined" (i.e., made formal cost or schedule adjustments) five major efforts since our 2005 report, including projects to prevent runway accidents and revamp Agency communications and ground-based radars. We found that two projects experienced cost and schedule adjustments without program segmentation, and their progress remains comparable to the original baseline (see table 2).

Table 2. FAA Program Re-Baselines With Some Cost Growth and Schedule Delays

System	Status and Key Issues
ASDE-X	In September 2005, FAA increased ASDE-X costs from $505.2 million to $549.8 million and extended the completion date from 2007 to 2011.
FTI	In August 2006, FAA increased its acquisition costs to develop the FTI network by $8.6 million (from $310.2 million to $318.8 million) and extended the completion date from December 2007 to December 2008.

Source: FAA's ASDE-X and FTI baseline documents

The three remaining re-baselining decisions involved an incremental approach that resulted in FAA reducing the number of systems procured or postponing

investment decisions. As a result, straightforward comparisons of original and revised cost and schedule baselines are no longer meaningful for these projects and do not fully represent all program requirements (see table 3).

Table 3. FAA Program Re-Baselines With Modifications and Deferrals

System	Status and Key Issues
STARS/TAMR	The current STARS program is a segment of the ongoing terminal modernization effort and is not analogous to the original STARS program. In June 2005, FAA estimated that the cost of STARS would be $2.7 billion and that it would be deployed at 50 sites by FY 2008 (later adjusted to 47 sites). This is very different from FAA's original estimate of 172 sites for $940.2 million by 2005. The FAA also decided on deploying TAMR (Phase 2) at nine sites and scheduled completion by mid-2008. FAA continues to defer decisions on additional phases, affecting more than 100 sites.
ASR-11	The current ASR-11 program is a segment of the original program. FAA originally estimated that the ASR-11 radar program would cost $743 million and be installed at 112 sites by 2005. Subsequent decisions increased program costs to $1.0 billion and extended the deployment schedule to 2013. In September 2005, FAA broke the program into segments. The currently approved segment (involving 66 systems) is estimated to cost $697 million and scheduled for completion by 2009. FAA continues to postpone decisions for the second segment.
NEXCOM	The NEXCOM program has a long and complicated history. For example, in May 1998, FAA proposed that NEXCOM would involve three segments—the first segment (for multi-mode digital radios and interface units) was approved for $407 million with other segments to follow. In May 2000, FAA divided segment 1 into a multi-mode digital radio segment (1a) and a ground infrastructure segment for digital communications (1b). FAA approved the radio segment for $318.4 million but did not approve the ground infrastructure segment, which was slated to cost $667.0 million. In December 2005, FAA increased the cost of NEXCOM segment 1a from $318.4 million to $324.7 million and delayed final implementation from FY 2010 to FY 2013. FAA has since deferred decisions on all remaining segments.

Source: FAA

FAA's Incremental Approach May Reduce Risk but Provides Less Visibility Into Programs' True Costs and Completion Dates

While FAA's incremental approach may help reduce risk and the potential for cost growth in the near term, it has left several programs with no clear end-state. As a result, it is unclear how much these programs will ultimately cost or how long they will take to complete.

Terminal Modernization and Replacement of Aging Controller Displays: In 2004, faced with cost growth of over $2 billion for STARS, FAA rethought its terminal modernization approach and shifted to a phased process, committing STARS to just 50 sites at an estimated cost of $1.46 billion instead of the original

plan to deploy 172 sites for $940 million. FAA renamed this effort the Terminal Automation Modernization-Replacement initiative.

In 2005, FAA approved modernizing displays through the TAMR program (referred to as TAMR Phase 2) by replacing legacy equipment at five additional small sites and installing modernized equipment to replace aging displays at four large, complex facilities at a cost of $57 million by 2008. However, this leaves over 100 sites still in need of modernization. Although FAA has not decided how it will modernize these sites, its FY 2008 budget submission indicates that this effort could cost over $1 billion. As outlined in the Agency's CIP, over $3.5 billion is planned for terminal modernization efforts.

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

FAA Faces Challenges With Key NextGen Programs That Have Recently Received Initial Cost and Schedule Baselines

Of the 18 programs we reviewed, 3 have established their initial baselines since we last reported on ATC modernization in May 2005. FAA is approving these programs, which are essential to the NextGen transition, using an incremental approach. Current cost estimates in the Agency's CIP projections bear limited relationship to the programs' approved cost baselines; therefore, it is unknown at this point how much these three programs will ultimately cost.

ADS-B: This program provides a satellite-based technology that allows aircraft to broadcast their position to ground systems, air traffic control, and other aircraft. In August 2007, FAA awarded a service-based contract for the ADS-B ground infrastructure worth $1.8 billion if all options are exercised. As we have stated in recent testimony,[12] FAA is pursuing a phased (or segmented) approach to implementing ADS-B. FAA estimates that ADS-B will cost about $1.6 billion in capital costs alone for initial segments of its implementation through 2014, which include the completion of a nationwide ground system for receiving and broadcasting ADS-B signals.

- In segment 1 (planned to occur between now and 2011), FAA plans to complete implementation in Alaska, provide services in the Gulf of Mexico,

[12] OIG Testimony Number CC-2007-100, "Challenges Facing the Implementation of FAA's Automatic Dependent Surveillance-Broadcast Program," October 17, 2007.

initiate broadcast service on the east coast, and continue efforts to develop air-to-air applications with United Parcel Service at Louisville International Airport.

- In segment 2 (planned to occur between 2009 and 2014), FAA plans to issue a final rule for mandating ADS-B usage by 2020, complete the ground infrastructure, and integrate ADS-B with existing FAA automation systems.

FAA must address several challenges linked to ADS-B usage. These include: (1) gaining stakeholder acceptance and aircraft equipage, (2) addressing broadcast frequency congestion concerns, (3) integrating with existing systems, (4) implementing procedures for separating aircraft, and (5) assessing potential security vulnerabilities in managing air traffic.

Air Traffic Management (ATM): This program provides FAA with hardware and software tools to manage air traffic, expand system capacity, and reduce the impact of bad weather system-wide. FAA baselined ATM for $454 million in August 2005 and scheduled its deployment for FY 2011. ATM is baselined for two initial segments with plans for additional segments.

Although the ATM effort has not experienced cost increases or schedule delays, we are concerned about risks and what will ultimately be delivered since FAA and the contractor significantly underestimated the size and complexity of software development. Since then, FAA has modified the contract and adjusted the scope of the work. Not withstanding FAA's efforts to adjust the contract, we note that underestimating software development has led to significant problems with other modernization projects.

The challenges FAA faces with ATM include: (1) developing complex software and integrating ATM with other NAS systems and (2) determining cost and schedule decisions on the additional segments, which are unknown at this time.

SWIM: This program provides FAA with a web-based architecture that allows information sharing among airspace users. FAA expects to spend $22.9 million on this program in FY 2008. FAA baselined the first 2 years of segment 1 (planned to occur between FY 2009 and 2010) for $96.6 million. The latest CIP cost estimate for initial SWIM segments is $285 million.

Current challenges include the work to determine requirements and interfaces with other FAA systems, including ERAM and ATM. SWIM will require integration with other Federal agencies' operations to realize NextGen benefits and develop a robust cyber security strategy and design. While FAA has begun initial efforts, it still needs to establish the architecture, strategy, and design. Additional SWIM segments have yet to be determined, and the cost to fully implement SWIM is unknown.

Findings

Current FAA Acquisition Programs That Have Undergone Baseline Changes Are Still at Risk of Not Attaining Expected Benefits

Our analysis shows that several programs require significant attention and oversight because of their size, diminishing benefits, potential costs and schedule problems, or importance to the NextGen transition. These projects have undergone baseline changes but are still at risk of not attaining expected benefits.

FTI: FTI is intended to replace seven FAA-owned and -leased telecommunications networks with a single network to provide FAA with services through 2017 and reduce operating costs. In FY 2007, Congress appropriated $28 million in F&E funds to FAA for this program. In FY 2008, FAA expects to spend $8.5 million for FTI efforts. Unlike most acquisitions, however, the vast majority of FTI is funded out of the operations account as opposed to the F&E account.

For FY 2008, FAA estimates it will need $210 million to support FTI operations and another $91 million to extend legacy network operations while continuing the FTI transition. The costliest legacy network FTI will replace is the Leased Interfacility National Airspace System Communications System (LINCS), with over $600 million spent for operations from 2002 to 2007. In April 2007, FAA completed negotiations to extend LINCS until April 2008 for a $92 million ceiling price, with three 6-month options. FTI program officials told us they do not intend to extend the contract for LINCS legacy network beyond April 2008. This will help control telecommunication costs.

In April 2006, we reported that FTI was unlikely to meet its December 2007 transition completion date and recommended that FAA improve FTI management controls and develop a realistic master schedule. FAA agreed and tasked the MITRE Corporation with conducting an independent assessment of the FTI master schedule. The assessment identified several risks associated with FAA meeting its transition deadline. Consequently, in August 2006, FAA's Joint Resource Council approved a second re-baseline of FTI's cost and schedule goals, which extended the completion date to December 2008 and increased the overall cost by over $100 million (from $3.3 billion to $3.4 billion). FAA also reduced the total number of NAS services to be transitioned to FTI from 25,294 to 20,033.

Since we last reported, FAA has made significant progress with the FTI transition and has delivered 18,294 services (as of January 31, 2008). However, it is important to note that shifting requirements, eroding cost benefits, and risks to air traffic operations during the transition have impacted the FTI program.

We note that FAA will not replace all networks as originally planned. FAA has decided not to replace digital equipment that supports long-range radars or

switching equipment that supports flight data for high-altitude communications, as originally envisioned by the FTI program office. As a result, FAA will have to maintain this existing equipment much longer than expected. The cost of doing so and the impact on potential FTI benefits remain uncertain. Additionally, even though the last baseline significantly reduced the number of services planned for transition, this number has since climbed to 22,545. FAA attributes the increase to "emerging requirements."[13] Further, the master schedule does not yet include requirements for moving forward with NextGen efforts. We recognize that these requirements will have to be addressed through adjustments to the FTI program or another effort.

FAA's main goal for FTI was to reduce Agency operating costs. Yet, we found that costs for FTI remain uncertain since FAA still has not validated cost and benefit estimates as agreed after our 2006 report. Although FAA reduced the number of services planned, the overall program cost estimate grew by over $100 million through 2017. As costs escalate, cost savings have eroded. In 2006, when FAA re-baselined FTI, we estimated that cost savings decreased from $672 million to $434 million, when including sunk costs (i.e., previous investments in FTI). Further, FAA did not achieve any FTI cost savings for FY 2007. Until FAA independently validates FTI cost and benefit information, the cost effectiveness of the investment in FTI will remain questionable.

Finally, because of recurring outages and customer service problems, many FTI services are not meeting availability requirements—9 percent of accepted FTI services in December 2007, as reported by the FTI program office. The contractor also reported that many of these were not being restored to service within contractual timeframes after outages.

Unscheduled outages of both primary and back-up services have led to flight delays. For example, in Chicago on May 23, 2007, improperly configured FTI equipment caused the loss of all radar service, forcing air traffic controllers to implement a local ground stop and triggering 72 flight delays. We will be reporting on the FTI program again later this year.

ASDE-X: ASDE-X is FAA's latest effort designed to help controllers identify aircraft and vehicle positions on the airport surface, with the ultimate goal of reducing the risks of accidents on runways. It is planned to improve airport safety by operating in all-weather and low-visibility conditions (e.g., fog, rain, and snow) when controllers cannot see surface movement on ramps, runways, and taxiways. In FY 2007, Congress appropriated $70.6 million to FAA for the ASDE-X program. In FY 2008, FAA expects to spend $40.6 million for ASDE-X efforts.

[13] These are requirements for new services, such as FS-21.

ASDE-X was initially designed to provide FAA with a low-cost alternative to its ASDE-3 radar systems for small- to medium-sized airports, but it has evolved into a different program. In September 2005, FAA made a major change to the scope of the program, increasing ASDE-X costs from $505.2 million to $549.8 million and extending the completion date from 2007 to 2011. FAA now plans to upgrade ASDE-3 systems with ASDE-X capabilities at 25 large airports and install the system at 10 other airports that have no existing surface surveillance technology. FAA concluded this would yield the greatest return on its investment and maximize safety benefits by deploying ASDE-X capabilities to airports with larger traffic counts or more complex operations.

We are concerned about further cost increases, schedule delays, and operational performance problems with this important program.

- Since the 2005 re-baseline, FAA has increased the cost to acquire and install some ASDE-X activities by $94 million. To stay within the revised baseline, FAA offset this cost by decreasing planned expenditures for seven other program activities, such as construction for later deployment sites.
- We are also concerned that the ASDE-X schedule is not realistic. When we reported in October 2007, FAA had commissioned 11 of the 35 ASDE-X sites; however, only 6 of the 11 had all the planned capabilities commissioned for operational use. We note that in April 2008, FAA commissioned the 12th ASDE-X system for operational use. FAA officials told us that all ASDE-X systems have been purchased with spares and test equipment to support each site and that site prep has begun. They also noted that each airport presents unique challenges that must be addressed. We maintain that FAA should not declare ASDE-X as commissioned for operational use until all planned capabilities are fully implemented.
- FAA needs to resolve operational performance issues associated with key ASDE-X safety capabilities. For example, while FAA has commissioned the first ASDE-X system that can alert controllers of potential collisions on intersecting runways or converging taxiways, under certain circumstances, the system does not generate timely alerts for controllers to take appropriate action. Additionally, ASDE-X is susceptible to dropping targets during heavy precipitation. FAA has made progress in addressing these problems. FAA will need to fully test ASDE-X safety capabilities to ensure the system can meet the unique needs of each airport scheduled to receive ASDE-X.

Because of these issues, the program is at risk of not meeting its goals to deliver all 35 ASDE-X systems by 2011. In October 2007, we recommended that FAA develop realistic cost estimates for all activities required to complete ASDE-X implementation and resolve operational performance issues identified during

system testing before deploying key ASDE-X safety capabilities at remaining airports. FAA concurred with our recommendations and agreed to take appropriate action to address our concerns. We will continue to monitor FAA efforts to deploy ASDE-X and implement much-needed safety capabilities.

Advanced Technologies and Oceanic Procedures (ATOP): This program is FAA's $548 million effort to modernize how controllers manage oceanic flights. FAA now has ATOP in use at Oakland, California; New York, New York; and Anchorage, Alaska. In FY 2007, Congress appropriated $30.9 million to FAA for the ATOP program. In FY 2008, FAA expects to spend $52.8 million for ATOP.

FAA has experienced problems with this program that could impede its ability to serve as a platform for NextGen capabilities. These include existing and potential communication problems, which have limited some ATOP benefits, and large contract cost increases.

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

  According to controllers, these incidents represented potentially hazardous safety conditions that must be resolved. The larger separation distances required between aircraft flying across oceans than for those in domestic airspace have allowed controllers to manage these problems. However, benefits from the new automation system, such as reduced separation, have not been fully realized.

- While communication issues have been resolved, problems still persist with controllers receiving erroneous position reports. FAA is now in the position of introducing ATOP software enhancements while concurrently correcting new problems identified by controllers.

- Finally, because FAA severely underestimated critical work areas in the original contract, it is planning to increase the contract cost by $90 million. This would increase the contract value from $306 million to $396 million—a 29 percent increase. Since the contract was awarded in 2001, its value has increased from $217 million to $396 million. FAA officials stated the cost increase can be accommodated within the current baseline.

While FAA May Meet Cost and Schedule Goals, Its Metrics Do Not Fully Assess Progress With Major Acquisitions

In its FY 2007 Flight Plan and most recent Performance and Accountability Report, FAA reported that for FY 2006, 100 percent of its critical acquisitions were within 10 percent of budget estimates and 97 percent were on schedule. In FY 2006, FAA tracked 29 acquisitions, including the acquisition of new radars. However, FAA's cost and schedule metrics, which measure progress with acquisitions, have limitations that decision makers must understand to properly assess the overall status of FAA's acquisition portfolio.

FAA's Cost and Schedule Metrics for Acquisition Programs Are Useful but Have Limitations

While FAA cost and schedule performance metrics are worthwhile tools for Agency management and oversight of major acquisitions—a step we called for several years ago[14]—these metrics have limitations that could hinder decision makers' visibility into the true status of major acquisitions. FAA's cost and performance metrics do not fully represent the status of its modernization efforts for the following reasons:

- First, FAA's cost and schedule metrics are "snapshots" in time. They are not designed to address changes in requirements, reductions in procured units, or shortfalls in performance that occur over time. For example, while FAA has reduced quantities to be delivered in the ASR-11 and STARS/TAMR program, its cost and schedule metrics do not take these changes into account.
- Second, FAA's budget metrics compare cost estimates taken during the fiscal year using updated, "re-baselined" cost figures—not estimates from the original baseline. This is why the Wide Area Augmentation System (a satellite-based navigation system) is considered "on budget" even though costs have grown from $892 million to over $3 billion since 1998.

  We recognize that re-baselining a project is important to maintain realistic cost and schedule parameters and is consistent with OMB guidance and the Agency's own Acquisition Management System. The revised baselines are used for justifying budgets and making investment decisions, i.e., ensuring that major acquisitions are still cost beneficial. We note that if OMB agrees to the new baseline, and Congress funds the acquisition, OMB allows FAA to measure deviations from the new baseline.

  However, OMB guidance states that *all reporting on the project or program must also show deviations from the original baseline.* FAA's current

[14] OIG Report Number AV-2003-045, "Status of FAA's Major Acquisitions," June 26, 2003.

comparisons of revised program baselines—absent additional information—fail to provide an accurate picture of a program's true cost parameters.

- Finally, FAA's schedule metrics used for assessing progress with several programs in 2006 were generally reasonable but focused on interim steps or the completion of tasks instead of whether systems met operational performance goals. For example, ASDE-X metrics focused on delivery of two systems instead of whether systems entered service or met operational performance expectations. We found that there are no written criteria for selecting or reporting the milestones. Table 4 provides information on some of the metrics used for measuring progress with acquisitions in FY 2006.

Table 4. FAA Schedule Metrics Used in FY 2006

Program	Metric	Planned Date	Actual Date
ASDE-X	Deliver two systems	February 2006	February 2006
STARS	Deliver to one site	February 2006	January 2006
ATM	Conduct detailed design review	August 2006	March 2006
Precision Runway Monitor	Complete factory acceptance testing for Atlanta	April 2006	April 2006
Wide Area Augmentation System	Complete initial installation of two reference stations	September 2006	May 2006

Source: FAA ATO-Finance Capital Expenditures Program Office

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

Much Work Remains for FAA To Determine NextGen's Impact on Existing Projects

In February 2007, we recommended that FAA examine existing projects to determine if they were still needed and, if so, what adjustments would be required. FAA concurred and has begun this assessment. To date, however, FAA has not made major adjustments to modernization projects. FAA faces complex challenges with linking new and legacy systems and managing interdependences among diverse projects. As FAA planning documents show, the pace of introducing new automation, more flexible airspace, and data-link communications will depend on the pace of existing projects. The success and costs of these efforts will also be driven by an effective strategy for realigning air

traffic control facilities with NextGen plans—a controversial issue with workforce implications. FAA must continue to refine the NextGen Enterprise Architecture and establish a transition path that clearly identifies the role of current systems and requirements for the shift to NextGen.

Key Projects Serve as Platforms for NextGen Capabilities

According to FAA, approximately 30 existing capital programs will serve as platforms for NextGen. These include ERAM (new hardware and software for facilities that manage high-altitude traffic) and ATM (new tools for FAA to manage the impact of bad weather). These programs were designed and approved before the establishment of the JPDO and the NextGen concept of operations. As a result, FAA faces complex integration challenges (see table 5).

Table 5. Key NextGen Platforms

System	Status and Key Issues
Terminal Modernization: STARS and Common Automated Radar Terminal System (Common ARTS): Delivers controller workstations that process surveillance data and display it on-screen to manage air traffic in the terminal environment.	FAA envisions relying on automation to boost controller productivity in the future terminal environment. Problems with terminal modernization—with STARS in particular—leave FAA in a difficult position to transition to NextGen. NextGen requirements are uncertain and need to be defined sooner rather than later.
ERAM: Replaces the Host computer hardware and software (including the Host back-up system) and associated support infrastructure at 20 en route centers.	With an estimated cost of $2.1 billion, ERAM is one of the largest, most complex acquisitions in FAA's modernization portfolio. Several new capabilities (e.g., dynamic airspace management and data link) depend on future enhancements to ERAM that have yet to be defined or priced.
ATM: Modernizes the hardware and software used to manage the flow of air traffic.	FAA has identified ATM as an important effort for aircraft trajectory operations throughout the NAS. ATM is designed to support traffic management specialists and coordinators in managing air traffic flow. FAA will have to decide whether some new functions of the system will reside within ATM or ERAM.

Source: FAA

The $2.1 billion ERAM program is a linchpin for the NextGen system. Because ERAM is expected to serve as a foundation for NextGen, any program cost increases or schedule delays will affect the pace of introducing new capabilities.

Essentially, FAA is waiting to complete ERAM between 2009 and 2012 before introducing NextGen-related capabilities. This is why many NextGen capabilities (such as data link) are planned for completion as late as 2012 to 2015. Further, many of these with respect to new automated capabilities and more flexible airspace are planned in future software enhancements. FAA planning documents we reviewed show as many as nine future software releases for ERAM (beyond the three currently approved). The requirements and costs for the ERAM software enhancements are uncertain but expected to be in the billions of dollars.

Findings

Critical Decisions on Existing Projects That Affect NextGen Are Needed in the Short Term

Over the next 2 years, over 23 critical decisions must be made about ongoing programs. These decisions affect major lines of the modernization effort with respect to automation, communications, navigation, and surveillance.

- Automation: FAA will approve a limited number of "candidate capabilities" and enhancements for the second major ERAM software release. In FY 2008, FAA will identify the requirements and cost parameters for new capabilities based on ERAM; these capabilities are planned for the 2012 to 2018 timeframe. FAA will also have to address what changes are needed to modernize its terminal facilities and whether or not it will pursue a "common automation platform" for terminal and en route environments in the future.
- Communications: Between FY 2008 and FY 2009, FAA plans to decide how to move forward with data communications and when to restart a data-link communications program for controllers and pilots. Costs remain uncertain, and FAA faces a myriad of complex questions about its overall technical approach, implementation plans, and rulemaking initiative timelines.
- Navigation: In FY 2008, FAA intends to decide how much of the existing ground-based navigation system will be retained. Specifically, FAA will consider how best to move forward with the next generation precision and approach landing system and whether to pursue LAAS—which has been in research and development status since FY 2004.
- Surveillance: As part of the effort to move forward with ADS-B, FAA must decide how to best incorporate "fusion" into existing air traffic control automation systems. Fusion in this context is defined as taking all surveillance data available for an aircraft and using the best data or combination of data to determine aircraft position and intent. Industry groups have asked FAA to accelerate its work on fusion.

A Key Cost Driver Will Be the Extent to Which FAA Realigns Air Traffic Control Facilities

A key aspect of these decisions will be the extent to which FAA consolidates or realigns air traffic control facilities as a result of modern information-sharing technology. FAA points out that flexible ground communication networks do not require facilities to be near the traffic they manage. FAA often cites its aging facilities and the related expense of maintaining such a large number of facilities to justify consolidating the air traffic control system into a small number of facilities. FAA currently operates 21 en route centers, over 200 terminal facilities,

and 9,000 unstaffed facilities. The size and location of FAA facilities directly affect system requirements and costs and have workforce implications.

Because of the controversial nature of the issue, some have advocated a base closure commission to help FAA and Congress make decisions on FAA facilities. FAA's reauthorization proposal called for a "Realignment and Consolidation of Aviation Facilities Commission" to conduct an independent review and make recommendations to the President. The House and Senate reauthorization proposals for FAA (H.R. 2881 and S. 1300) also recognized the issue of consolidation and the need for further examination. While there are some technical prerequisites (such as a new voice switch), how to best realign or consolidate FAA facilities is a policy issue for Congress.

Decisions on Transitioning to NextGen Depend Heavily on an Enterprise Architecture, Which Currently Lacks Important Details

These decisions and many others will depend heavily on the development of a comprehensive Enterprise Architecture[15] that outlines the vision of how the system will work and how necessary changes will be accomplished. The Enterprise Architecture must establish a transition plan that identifies the role and evolution of current systems and how they will transition to NextGen. A central element will be outlining a path to develop both existing and proposed automation systems.

To date, FAA has made progress in developing NextGen's Enterprise Architecture, which is planned for implementation by 2025. FAA has also progressed towards technical roadmaps for the automation, communications, navigation, and surveillance lines of effort. In addition, FAA has decided to rely on the Operational Evolution Partnership (OEP), the Agency's blueprint for enhancing capacity, to help manage and implement NextGen initiatives.

However, planning documents we reviewed lacked detail regarding requirements, particularly for automation, that could be used to develop reliable cost estimates and schedules. These documents describe a general path for over 60 decisions that must be made over the next 18 years. An October 2007 MITRE Corporation assessment[16] of the Enterprise Architecture highlighted several areas that need improvement, including unresolved technical issues and gaps between the Enterprise Architecture and the NextGen concept of operations. MITRE noted

[15] An enterprise architecture is a blueprint that links core programs and systems to an agency's mission. This includes the transition from the "as-is" to the "to-be" environment.

[16] "Observations, Results, and Recommendations, NextGen v2.0 Assessment," Center for Advanced Aviation Systems Development, MITRE Corporation, October 15, 2007.

that, in most cases, information in the NextGen Enterprise Architecture remained at too high of a level to be effective.

At this point, it is difficult for FAA to determine what to invest in first to move forward with NextGen. FAA needs to identify the highest priority operational improvements (high-density airports; high-altitude, trajectory-based operations; or networked facilities) and systems for NextGen from the large number of possibilities in various planning documents. These priorities should then be reflected in NextGen planning documents and budget requests.

In addition, the Enterprise Architecture does not detail how FAA will complete the transition between the present NAS and the future NextGen architectures, which are considerably different. Understanding this gap is important because one industry analysis suggests that FAA could face a $50 billion software development effort with NextGen. Until FAA completes a gap analysis, it will not be possible to determine technical requirements that translate into reliable cost and schedule estimates for major acquisitions. Efforts are underway to reconcile differences between the current and NextGen enterprise architectures, but more work is required.

Because of the significant differences between the current system and the NextGen architecture and concept of operations, some FAA and industry officials believe FAA should develop an interim architecture or "way-point" for the 2015 timeframe that is consistent with plans in the OEP. This would help bridge the gap between current systems and plans for the future. It also would help FAA determine reasonable goals, establish priorities, fully identify adjustments to existing projects, refine requirements for new systems, and obtain an understanding of complex transition issues.

As we have previously noted, FAA faces enormously complex integration challenges with NextGen. FAA officials commented that the interim architecture should serve as the basis for an integrated program plan that establishes an executable acquisition plan for NextGen though 2017. This plan should go beyond what is envisioned in the OEP and include detailed cost, schedule, requirements, acquisition strategies, risk management, and the supporting organizational structures to execute the integrated program.

Congress has recognized the importance of the NextGen architecture and the transition plan for existing modernization efforts to future systems. In the House proposal for reauthorizing FAA, the Agency is directed to have the National Research Council review the NextGen architecture. This review is expected to examine, among other things, the technical activities that will be needed to transition current and planned modernization efforts to the future system. We

believe that such an assessment is important to reduce risk with developing and implementing NextGen capabilities.

RECOMMENDATIONS

FAA faces challenges with completing existing projects, maintaining existing programs, and developing NextGen without cost growth and schedule slips. We have made numerous recommendations over the years to strengthen FAA's management of major acquisitions. In February 2007, we recommended that FAA review ongoing modernization projects to determine what cost and schedule adjustments would be required to better manage NextGen efforts. We also recommended that FAA determine what skill sets would be required to manage and execute NextGen initiatives. FAA concurred with our recommendations and began actions to address our concerns. At this time, we are recommending the following actions to FAA:

1. Develop written criteria for the selection of milestone metrics that are used for tracking progress with major acquisitions and reported in Agency plans and reports.

2. Develop and report on a new set of metrics for measuring progress with NextGen initiatives that focus on the delivery of a new capability with respect to enhancing capacity, boosting productivity, or reducing Agency operating costs.

3. Complete a gap analysis of the NAS enterprise architecture that closely examines current systems (the "as is") and the planned NextGen enterprise architecture (the "to be") and develop and establish priorities.

4. Once the gap analysis is completed, develop an interim architecture that details what can be accomplished in the 2015 timeframe that will allow FAA to more accurately determine costs and other factors required for NextGen.

5. Use the interim architecture as the basis for an integrated program plan that establishes an executable program for the NextGen capabilities. This effort should include detailed cost, schedule, requirements, acquisition strategies, risk management, and the supporting organizational structures to execute the integrated program.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

On February 1, 2008, we provided FAA with our draft report. We held an exit conference with FAA officials from the Air Traffic Organization and JPDO on February 21 to discuss our findings and recommendations. The officials generally concurred with all of our recommendations, including the need to develop written criteria for selecting milestones used to track progress with major acquisitions, establish metrics for measuring progress with NextGen initiatives, and develop an interim architecture for NextGen.

FAA officials noted that FAA has initiated efforts to accelerate elements of NextGen and develop new metrics to progress with those elements. They also emphasized that the purpose of NextGen is not only to modernize but also to fundamentally transform how air traffic is managed. Finally, the officials offered technical comments with respect to the ADS-B, ASDE-X, and FTI programs. We discussed these issues with them and have adjusted our report as appropriate.

EXHIBIT A. STATUS OF FAA'S MAJOR ACQUISITIONS (AS OF SEPTEMBER 2007)

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Advanced Technologies and Oceanic Procedures (ATOP): Modernizes FAA facilities that are responsible for managing large segments of airspace over the Atlantic and Pacific Oceans. FAA plans call for an integrated system for flight data processing, detecting conflicts between aircraft, data link, and surveillance capabilities. **Contractor:** **Lockheed/Martin** **Responsible Service Unit:** **En Route & Oceanic Services**	$548.2 million	$548.2 million	Start: 2004 Finish: 2006	Start: 2004 Finish: 2006	ATOP is now operational at Oakland, New York, and Anchorage Air Route Traffic Control Centers that manage oceanic traffic. We note that ATOP is expected to help demonstrate NextGen automation capabilities. Because FAA severely underestimated critical work areas in the original contract, it is currently planning to increase the contract cost by $90 million. This would increase the contract value from $306 million to $396 million—a 29 percent increase. FAA officials have stated that the cost increase can be accommodated within the current baseline. FAA controllers have raised legitimate concerns about recurring failures (loss of data-link communication with aircraft and aircraft position jumps) with ATOP. These problems represent potentially hazardous safety conditions and directly limit promised capacity and productivity benefits, such as reduced separation. Over the past year, FAA has addressed problems with ATOP while deploying new capabilities; it will continue to do so going forward.

ATOP is a key NextGen initiative for demonstrating new automation capabilities.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Air Traffic Control Beacon Interrogator-6 (ATCBI-6): A ground-based system that interrogates transponders, receives and processes replies from transponders, determines the range and direction to/from aircraft, and forwards the information to appropriate air traffic control automation systems. Replies from aircraft provide transponder identification and altitude data, which are displayed on the controller's screen. **Contractor: Raytheon** **Responsible Service Unit: En Route & Oceanic Services**	$281.8 million	$282.9 million	Start: 2000 Finish: 2004	Start: 2002 Finish: 2009	FAA has installed 112 out of 130 operational ATCBI-6 systems and 6 out of 7 support systems. Of the operational systems, 88 are commissioned. However, the program is requesting, in an upcoming JRC review, to extend the deployment schedule to May 2010. A number of factors have contributed to the need for rebaselining, including prior reductions in funding and an increased number of systems being deployed due to agency cost share agreements, congressional earmarks, and other government programs. However, due to implementation efficiencies, the new cost baseline will be reduced to $251.7 million.
Air Traffic Management (ATM): Consists of: Traffic Flow Management - Modernization and Collaborative Air Traffic Management Technologies (CATMT). TFM-M modernizes the infrastructure that serves as the automation backbone for the nationwide	$454.3 million	$454.3 million	Start: 2007 Finish: 2011 (Up to Work Package #1. Additional segments are to be determined.)	Start: 2007 Finish: 2011 (Up to Work Package #1. Additional segments are to be determined.)	ATM is an important effort to address capacity in both the short and long term. It is an important tool in reducing the impact of bad weather throughout the National Airspace System. Although the ATM effort has not experienced cost increases or schedule delays, we are concerned about risks and what will ultimately be delivered. Our concerns are based on the

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
traffic management units that assist in the strategic planning and management of air traffic. CATMT (Work Package #1) provides new decision support tools to deliver additional user benefits and increase the effective capacity of the NAS. **Contractor: Computer Sciences Corporation (TFM-M) Volpe NTSC, and various others (CATMT)** **Responsible Service Unit: Systems Operations**		**ATM is a key platform for NextGen initiatives.** ATM efforts will have to be integrated with automation and communication programs.			fact the FAA and the contractor significantly underestimated the size and complexity of TFM-M software development. FAA has modified the contract and adjusted the scope of the work. The current risks for ATM focus on developing complex software and integrating the ATM with other NAS systems.
Airport Surface Detection Equipment-X (ASDE-X): ASDE-X provides surveillance equipment and conflict alerting safety logic to prevent runway incursions at a large number of airports. Implementation of these systems will improve controller situational awareness of the airport movement area. **Contractor: Sensis Corp.**	$424.3 million	$549.8 million (Includes $77 million in technical refresh costs.)	Start: 2003 Finish: 2007	Start: 2003 Finish: 2011	ASDE-X is an important technology to prevent accidents on airport runways and taxiways. FAA last re-baselined ASDE-X in September 2005, increasing costs from $505.2 million to $549.8 million and extended the deployment completion date from 2007 to 2011. ASDE-X was initially envisioned to provide a low-cost alternative system for small- to medium-sized airports similar to FAA's ASDE-3 radar system, but has evolved into a different program. FAA made a significant change to the program in September 2005 and not only intends to upgrade ASDE-3 systems with ASDE-X capabilities at 25 large airports but also will

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Responsible Service Unit: Terminal Services					install the system at 10 other airports that currently lack any surface surveillance technology. We remain concerned about the possibility of further increases and schedule slips, and when operational performance issues with key safety features will be resolved.
Airport Surveillance Radar (ASR-11): Replaces aging ASR-7 and ASR-8 analog radars at small terminal facilities with digital radar. ASR-11 can be used by Common ARTS and STARS. This is a joint effort with the Department of Defense. **Contractor: Raytheon** **Responsible Service Unit: Terminal Services**	$743.3 million	$696.5 million	Start: 2000 Finish: 2005	Start: 2003 Finish: 2009	The ASR-11 program has undergone significant changes since our last report. In 2005, FAA re-baselined the effort to address cost and schedule issues. FAA now plans to deploy only 66 of the 112 originally planned systems. This accounts for the slight reduction in the costs associated with the ASR-11 program. FAA also extended the deployment schedule by 4 years. Surveillance architecture consists of the following basic elements: radar systems, beacon systems, and Automatic Dependent Surveillance – Broadcast (ADS-B). In September 2006, FAA decided to continue to limit the ASR-11 baseline to 66 systems and wait until the ADS-B investment decision before re-evaluating the business case for replacing the remaining legacy radars. In February 2007, the ADS-B program office proposed to retain primary radars as part of its backup strategy, therefore the ASR-11 program decided to go forward with its re-evaluation.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
					No baseline changes were required for ASR-11 based upon the ADS-B backup strategies. Any delays in implementing ADS-B will force FAA to rethink its investments in ground-based radar technology.
Automatic Dependent Surveillance-Broadcast (ADS-B) NAS-Wide Implementation: ADS-B is a technology that relies on GPS to broadcast the positions of properly equipped aircraft and surface vehicles. Formerly funded under the *Safe Flight 21 Initiative*, ADS-B is expected to provide air-to-air and air-to-ground surveillance capability throughout the NAS. **Contractor(s):** **ITT Corp.** **Responsible Service Unit:** **En Route & Oceanic Services**	$1.66 billion (Segments 1 and 2)	$1.66 billion (Segments 1 and 2)	Start: 2007 Finish: 2013 (Additional segments are to be determined.)	Start: 2007 Finish: 2013 (Additional segments are to be determined.)	ADS-B is a cornerstone technology for NextGen and has considerable potential for enhancing safety and boosting capacity. In June 2006, FAA approved the first 2 years of ADS-B which involves development, validation of services, and limited deployment. FAA awarded a $1.8 billion service contract for ADS-B in August 2007 to build the ground infrastructure. With this type of contract, the Government will not own the ground infrastructure but will pay for ADS-B services. Initially, FAA is focusing on "ADS-B OUT" as a replacement for or adjunct to current radar. However, most benefits are expected with "ADS-B IN," which will display traffic information in the cockpit. This will facilitate self-separation. Realizing the full range of ADS-B benefits will depend on mitigating risk in a number of areas, including airspace users equipping with new avionics. FAA intends to rely on a rulemaking initiative to spur aircraft equipage. Other risks

ADS-B is a key NextGen initiative. Airspace users must equip to obtain benefits and FAA intends to rely on rulemaking initiative to spur equipage.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
					involve addressing broadcast frequency congestion concerns, implementing procedures for separating aircraft, and assessing security vulnerabilities in managing air traffic.
Collaborative Decision Making (CDM): Part of Air Traffic Management (ATM), CDM allows information exchange and consultation with airline operation centers to determine the most acceptable strategies to reduce delays. **Contractors: Volpe NTSC, Metron Aviation, Northrup-Grumman** **Responsible Service Unit: System Operations**	$75.9 million	$56.4 million	Start: 2002 Finish: 2005	Start: 2002 Finish: see Air Traffic Management (ATM)	The CDM effort was part of the Free Flight Phase I and II initiatives. It introduced information exchange systems between the FAA and airline operations centers. *In August 2005, the CDM program became part of the Collaborative Air Traffic Management Technologies within the Air Traffic Management line of effort.* CATMT will encompass the same type of software enhancements that were formerly provided by CDM.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Controller-Pilot Data Link Communications (CPDLC): Designed to provide a digital data communications capability for ATC operations that will be an enhancement to existing air/ground voice communications. **Responsible Service Unit: En Route & Oceanic Services**	$166.7 million (Builds 1 and 1A)	$118 million (Amount expended) **Data Link Communications are a key NextGen initiative** for reducing voice communications and enhancing controller productivity.	Start: 2003 Finish: 2005	Start: N/A Finish: N/A	FAA has long considered an effective controller-pilot data link essential for enhancing capacity. FAA cancelled its most recent CPDLC effort (a limited deployment) in April 2003 because of concerns about airspace user equipage and increased costs. We documented FAA's reasons in our September 2004 report. Data link communications are a key element in NextGen to enhance capacity and boost productivity. FAA is planning to restart this effort as part of a NextGen initiative and has scheduled an initial investment decision for FY 2008.
En Route Automation Modernization (ERAM): Replaces the Host computer hardware and software, including the Host backup system, and associated support infrastructure, at 20 En Route Centers. **Contractors: Lockheed/Martin (prime), and Raytheon (subcontractor)** **Responsible Service Unit: En Route & Oceanic**	$2.154 billion	$2.142 billion **ERAM is a key platform for NextGen** Automation efforts that will provide for greater controller productivity.	Start: 2009 Finish: 2010	Start: 2009 Finish: 2010	ERAM is currently on budget and on schedule and is meeting performance milestones. The next major milestone is Government Acceptance, which is planned for October 2007, 6 months earlier than planned. ERAM is currently managing several significant risks dealing with system complexity and software development, training and transition issues, and operational acceptance. The ERAM program will provide a modern and slightly more capable replacement for the existing Host computer system. An expanded ERAM is being envisioned as the primary

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Services					automation system for NextGen to provide flight data, trajectory-based services for high and low altitude air traffic. The follow-on ERAM program will include additional software releases and hardware upgrades that will provide the new capabilities envisioned for NextGen. These upgrades are currently undefined and likely will require billions of dollars to develop and field. Cost increases or schedule slips to the existing ERAM program would have a cascading impact on other capital programs and could directly affect the pace of the overall transition to NextGen.
FAA Telecommunications Infrastructure (FTI): FTI is designed to phase out older telecommunications systems and replace them with one provider responsible for operating and maintaining FAA telecommunications infrastructure. **Contractor:** **Harris Corporation** **Responsible Service Unit:** **Technical Operations**	$205.5 million	$318.8 million	Start: 2002 Finish: 2007	Start: 2002 Finish: 2008	FTI is a key telecommunications program that FAA expects to significantly reduce Agency operating costs. FAA re-baselined FTI in August 2006, extending the transition end date by 12 months to December 2008. FAA extended the schedule to address a number of risks associated with completing the FTI transition by December 2007. FAA continues to face challenges in implementing FTI. FAA has a backlog of more than 1,000 FTI services, but considers the remaining work manageable. The program's

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
					estimated benefit associated with savings is eroding. By the end of FY 2006, we estimated that the benefit, in terms of estimated cost savings, had dropped from the original estimate of $820 million to $434 million. Finally, FAA must ensure FTI diversity requirements are met to reduce the risks of unscheduled system outages.
Integrated Terminal Weather System (ITWS): Acquires and integrates weather data from multiple sensors, and provides traffic management units with a graphic display of weather information that needs no meteorological interpretation. This includes (1) a display of terminal winds aloft and (2) a 20-minute prediction of convective weather. **Contractor: Raytheon** **Responsible Service Unit: Terminal Services**	$276.1 million	$286.1 million ITWS is an enabling technology for NextGen.	Start: 2002 Finish: 2003	Start: 2003 Finish: 2009	FAA has installed 17 of 22 operational ITWS systems and four support systems. Of the operational systems, 15 are commissioned. In May 2004, FAA decided to defer 12 systems to allow the incorporation of the Terminal Convective Weather Forecast (TCWF) while remaining within funding levels. FAA completed the development of TCWF enhancement in April 2006 and has retrofitted 9 of 11 ITWS that were installed prior to TCWF development. In an upcoming JRC review, FAA plans to make a deployment decision regarding the 12 systems, which may extend the schedule baseline and increase operation and maintenance costs; however, cost and schedule baselines are still being validated.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Local Area Augmentation System (LAAS): LAAS is a precision approach and landing system that is expected to boost airport arrival rates under all weather conditions. It provides the augmentation needed at 160 airports to make GPS fully usable for Categories I, II, and III precision approaches at selected airports. **Contractor: Honeywell** **Responsible Service Unit: Technical Operations**	$530.1 million	$719.5 million (Includes $111.1 million for technical refresh)	Start: 2002 Finish: to be determined	Start: N/A Finish: N/A	FAA has deferred making decisions about how to move forward with LAAS until the 2008/2009 timeframe and the effort has been in a research and development mode since 2004. Consequently, firm cost and schedule baselines do not exist. FAA intends to continue the development activities to complete a design capable of achieving expected performance parameters. FAA is planning a cooperative agreement with Department of Defense to achieve Category III performance with the Department of Defense system, the Joint Precision Approach and Landing System (JPALS). Also, FAA is cooperating with Air Services Australia to develop the LAAS integrity design. Although decisions for LAAS have been postponed, we note that in its Capital Investment Plan, the FAA is allocating about $400 million for LAAS for FY 2012 and beyond.

Airspace users must equip to obtain benefits.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Next Generation VHF Air/Ground Communications (NEXCOM): Replaces and modernizes the aging and obsolete national airspace system (NAS) air-to-ground analog radio communications infrastructure and will address the impending shortage of communication frequency spectrum. **Contractor: ITT** **Responsible Service Unit: Technical Operations**	$406.0 million (Segment 1 only)	$324.7 billion (Segment 1a only. The total estimate outlined in FAA CIP for all segments is $1.26 billion.)	Start: 2002 Finish: 2008 (Key site)	Start: 2004 Finish: 2013 (Segment 1a only)	NEXCOM was originally envisioned as program to revamp voice and data communications in the National Airspace System. *It is now essentially a radio replacement program.* In March 2004, FAA deferred major elements of NEXCOM. In December 2005, NEXCOM was re-baselined only for the purchase and installation of multimode digital radios in the analog mode (segment 1a) in en-route facilities. FAA has requested funding to complete an investment analysis and initiate an acquisition to replace radios in terminal and flight service facilities. According to FAA, efforts to modernize communications by providing data communications capabilities will be funded through the new NextGen Data Communications program. FAA faces a myriad of complex decisions about requirements, technical approaches, and ways to transition new communication systems.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Standard Terminal Automation Replacement System (STARS) - Terminal Automation Modernization/ Replacement Program (TAMR) Phase I: Replaces controller and maintenance workstations with color displays, processors, and computer software at terminal air traffic control facilities. **Contractor: Raytheon** **Responsible Service Unit: Terminal Services**	$940.2 million	$2.719 billion (Includes $585 million for technical refresh.)	Start: 1998 Finish: 2005	Start: 2002 Finish: to be determined	The STARS program (now referred to as TAMR Phase I) has a long history of cost increases and schedule slips. It is no longer the program that FAA originally envisioned. In 2004, faced with cost growth in excess of $2 billion for STARS, FAA rethought its terminal modernization strategy. The Agency committed to deploying STARS at 50 sites (later reduced to 47) at a cost of $1.46 billion as opposed to the original plan for 172 sites at a cost of $940 million. STARS is fully operational at 46 of the 47 sites. Norfolk—the 46th site—achieved Initial Operational Capability in June 2007. At the remaining site—Dayton—the hardware will be placed in storage awaiting facility construction completion. There is no current defined "end state" for terminal modernization, and past problems with STARS leaves FAA in a difficult position to begin transitioning to NextGen capabilities. Future costs will be shaped by (1) NextGen requirements, (2) the extent of FAA's terminal facilities consolidation, and (3) the need to replace or sustain existing (legacy) systems that have not yet been modernized.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
System-Wide Information Management (SWIM): SWIM will provide a NAS-wide information web to connect FAA systems to each other and enable interaction with members of the decision making community. To the extent practicable, SWIM will leverage existing systems and networks based on proven technologies in the operational and demonstration environment. **Contractor: To Be Determined** **Responsible Service Unit: Technical Operations**	$96.6 million (FAA CIP cost estimate: $285.0 million)	$96.6 million (FAA CIP cost estimate: $285.0 million)	Start: 2009 Finish: 2010 (FAA baselined the first 2 years of segment 1. Additional segments are to be determined.)	Start: 2009 Finish: 2010 (FAA baselined the first 2 years of segment 1. Additional segments are to be determined.)	SWIM is a key transformational program for the development of NextGen. FAA decided to baseline the first 2 years of segment 1 of the program (FY 2009-FY 2010) to allow assessment of commercial off-the-shelf products to satisfy SWIM requirements, design capabilities, and deploy selected capabilities. Much work remains to determine the requirements and interfaces with other FAA systems.

SWIM is a key NextGen initiative that will provide the basis for net-centric communications.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Terminal Automation Modernization/Replacement Program (TAMR) – Phase II Modernizes the automation systems that provide air traffic controllers with the information needed to safely and efficiently control air traffic in the terminal environment. **Contractor: Raytheon (primary), Lockheed Martin (subcontractor)** **Responsible Service Unit: Terminal Services**	$139.5 million (Includes $82.9 million for technical refresh)	$139.5 million (Includes $82.9 million for technical refresh. The current estimate for Phase III, while not approved, is $654 million.)	Start: 2007 Finish: 2008	Start: 2007 Finish: 2008	FAA is also funding ongoing terminal modernization through a follow-on effort called TAMR Phase II. This effort has its own baseline and funding profile in the FAA's Capital Investment Plan. In June 2005, FAA approved modernizing five small sites with STARS and replacing aging displays at four large, complex sites (Chicago, IL; Denver, CO; St. Louis, MO; and Minneapolis, MN) at a cost of $57 million. These sites are particularly critical to the NAS. However, this leaves over 100 small sites that are still in need of modernization. *The most urgent concern facing terminal modernization is how quickly FAA can replace aging displays at the four critical sites*. FAA chose not to compete this work based on a joint proposal from two contractors and instead decided to modify the current STARS contract to include the work. Although this was expected to expedite replacement of the aging displays, the time spent revising the contract caused FAA to lose the time advantage from forgoing competition. As a result, the aging displays will not be replaced until 2008.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Traffic Management Advisor (TMA): TMA is an automated decision-support system that allows air traffic controllers to sequence aircraft in a way that that reduces airspace congestion and optimizes airport arrival capacity. **Contractor: Computer Sciences Corporation** **Responsible Service Unit: En Route & Oceanic Services**	$135.5 million	$135.5 million	Start: 2003 Finish: 2006	Start: 2004 Finish: 2008	TMA was developed and implemented as part of the Free Flight Phase I and II initiatives. In May 2005, FAA established a specific baseline for TMA. TMA was deployed at six en route centers under Free Flight Phase I and at four additional en route centers under Free Flight Phase II. In June 2005, the FAA Administrator directed the delivery of TMA to seven en route centers and TMA is currently being deployed at these sites. This was done within the framework of the existing budget and the only impact is an extended final deployment schedule.
User Request Evaluation Tool (URET): URET is a decision support aid that automatically tells air traffic controllers of potential conflicts between aircraft and special-use airspace and introduces a conflict probe capability and electronic flight data processing. **Contractor: Lockheed-Martin** **Responsible Service Unit: En Route & Oceanic Services**	$285.3 million	$284.1. million	Start: 2003 Finish: 2006	Start: 2003 Finish: 2006	FAA developed and implemented URET as part of the Free Flight Phase I and II initiatives. In May 2005, FAA established a specific baseline for URET. URET is deployed and operational at all 20 en route centers. The program was completed within its cost and schedule baseline. URET is anticipated to be incorporated into the ERAM system in December 2010 as outlined in FAA planning documents.

TMA is a contributing technology for NextGen.

Program Name, Description, Purpose, and Contractor Name	Original Program Cost Estimate	Current Program Cost Estimate	Original Deployment Schedule	Current Deployment Schedule	Status and Key Issues Affecting Implementation
Wide Area Augmentation System (WAAS): Provides the augmentation needed to make the Global Positioning System (GPS) fully usable for en route, terminal, and non-precision approaches. **Contractor: Raytheon** **Responsible Service Unit: Technical Operations**	$892.4 million	$3.3 billion (Includes sunk costs)	Start: 1998 Finish: 2001 Airspace users must equip to obtain benefits.	Start: 2005 Finish: 2013	WAAS has a long history of cost growth and schedule slips. FAA last re-baselined WAAS in May 2004, increasing F&E costs from $2.9 billion to $3.3 billion. The first segment of the program provides precision approach capability and is baselined for completion by 2008. The second segment, which provides precision landing capability, is not currently baselined but is scheduled for completion by 2013. Risks to implementation include delays in completing the integration of two additional satellites and the rate of equipage of aircraft to use the system. FAA is currently developing hundreds of new WAAS approach procedures for airports each year, in part, to provide incentive for aircraft owners to equip and utilize the new instrument approach capabilities.

EXHIBIT B. COST AND SCHEDULE VARIANCES FOR EXISTING PROGRAMS

Program	Estimated Program Costs (in Millions)		Percent Cost Growth	Implementation Schedule		Schedule Delay
	Original	Current		Original	Current	
WAAS	$892.4	$3,339.6	274%	1998-2001	2003-2013	12 years
STARS *	$940.2	$2,719.2	189%	1998-2005	2002-TBD	2+ years
FTI	$205.5	$318.8	55%	2002-2007	2002-2008	1 year
LAAS	$530.1	$719.5	36%	2002-TBD	TBD-TBD	Deferred
ASDE-X	$424.3	$549.8	30%	2003-2007	2003-2011	4 years
ITWS	$276.1	$286.1	4%	2002-2003	2003-2009	6 years
ATCBI-6	$281.8	$282.9	N/A	2000-2004	2002-2009	5 years
CDM	$75.9	$56.4	N/A	2002-2005	2002-TBD	Merged with ATM
SWIM	$96.6	$96.6	N/A	2009-2010	2009-2010	N/A
TMA	$135.5	$135.5	N/A	2003-2006	2004-2008	2 years
TAMR *	$139.5	$139.5	N/A	2007-2008	2007-2008	N/A
URET	$285.3	$284.1	N/A	2003-2006	2003-2006	N/A
ATM	$454.3	$454.3	N/A	2007-2011	2007-2011	N/A
ATOP	$548.2	$548.2	N/A	2004-2006	2004-2006	N/A
CPDLC	$166.7	$118.0	N/A	2003-2005	N/A	Cancelled
NEXCOM	$406.0	$324.7	N/A	2002-2008	2004-2013	5 years
ASR-11	$743.3	$696.5	N/A	2000-2005	2003-2009	4 years
ADS-B	$1,656.5	$1,656.5	N/A	2007-2013	2007-2013	N/A
ERAM	$2,154.6	$2,141.9	N/A	2009-2010	2009-2010	N/A
Total	**$10,412.8**	**$14.868.1****				**1 year to 12 years**

Source: Varies, project-specific acquisition program baselines or FAA's Capital Investment Plan
N/A = Not applicable
TBD = To be determined

* For presentation purposes, STARS and TAMR are treated separately; however, these efforts are separate phases of the same program.

** Totals involve the current FAA-approved baseline cost estimate for the program and do not include non-baselined portion of the program or, in some cases, technical refresh cost estimates.

EXHIBIT C. OBJECTIVES, SCOPE, AND METHODOLOGY

At the request of the Chairman and Ranking Member of the House Committee on Transportation and Infrastructure, we updated our May 2005 status report on FAA's major acquisitions and examined how projects are affected by plans for the Next Generation Air Transportation System (NextGen). Our objectives were to examine (1) overall trends affecting FAA's Facilities and Equipment (F&E) or capital account, (2) recent changes in cost and schedule baselines of FAA's major acquisition programs, and (3) the effect of NextGen plans on existing projects.

We conducted this performance audit of 18 major FAA acquisitions from July 2006 to February 2008. These specific programs, valued at a total of $17.5 billion, were identified in the Agency's FY 2008-2012 National Airspace System Capital Investment Plan and subsequent updates, the latest of which was issued on September 2007. We selected the 18 programs for review based on their F&E cost estimate value—at $150 million or greater—or their significance to NextGen. We have included most of these programs in prior reports. We performed this review in accordance with Government Auditing Standards as prescribed by the Comptroller General of the United States and included such tests as we considered necessary to provide reasonable assurance of detecting abuse or illegal acts.

To identify trends affecting FAA's capital account, we reviewed past and current investment plans, budget submissions, and spending plans. We also examined various budget and planning documents that reflect FAA's capital investments with respect to support contracts, procurement of air traffic control systems, and existing buildings and facilities. We also reviewed FAA's planned investment portfolio for NextGen initiatives for the next 5 years, including plans for demonstration projects. In addition, we reviewed documents that projected FAA's needs for addressing facility maintenance and upgrading power distribution systems.

To address recent changes in cost and schedule baselines of FAA's major acquisitions, we updated the data from our 2005 report. We examined project status reports, OMB Form 300 exhibits, and decisions made by FAA's Joint Resources Council. We also updated status matrices for individual programs (see exhibit A). Upon completion, we forwarded the information to FAA for review and incorporated its comments where necessary. We decided not to track several projects from our last report because they were either essentially complete or reduced in scope. Moreover, we found it was difficult to make similar comparisons between original and current programs because FAA has segmented or deferred decisions that significantly modified programs with respect to cost,

schedule, and expected benefits. This makes it very difficult for decision makers to compare the current state of the programs with past assessments.

In examining the cost and schedule performance of FAA's major acquisitions, we also reviewed the reasonableness of FAA's metrics for measuring programs. These metrics are reported to the Congress and general public in FAA's Flight Plan and performance and accountability reports. To do so, we reviewed how metrics were established, reviewed, and reported since their inception. We also reviewed FAA's Flight Plan and Acquisition Management System policy and obtained data on the specific acquisition programs that FAA relied on to assess performance from 2003 through 2006. We discussed criteria used to select acquisitions and the strengths and weaknesses of acquisition metrics with FAA officials responsible for managing and reporting on them.

To determine how NextGen plans affect existing programs, we interviewed officials from FAA's Joint Planning and Development Office, which is responsible for developing a plan for NextGen. We also obtained plans and independent assessments for key NextGen documents, including the NextGen concept of operations, integrated work plan, and Enterprise Architecture (technical roadmap or blueprint). To gain an understanding of how NextGen capabilities will be introduced and the potential impact on existing projects, we reviewed FAA's Operational Evolution Partnership, which is intended to help manage NextGen efforts. In addition, we discussed the transition to NextGen and key cost drivers with FAA officials responsible for many key enabling technologies, including ERAM, data communications, and ADS-B.

EXHIBIT D. MAJOR CONTRIBUTORS TO THIS REPORT

THE FOLLOWING INDIVIDUALS CONTRIBUTED TO THIS REPORT.

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The following pages contain textual versions of the graphs and charts found in this document. These pages were not in the original document but have been added here to accommodate assistive technology.

Air Traffic Control Modernization: The Federal Aviation Administration Faces Challenges in Managing Ongoing Projects, Sustaining Existing Facilities, and Introducing New Capabilities

Section 508 Compliant Presentation

Figure 1. The Federal Aviation Administration's Capital Account Percentages, Fiscal Year 2003 to Fiscal Year 2007

Capital Account Item	Percentage
Air Traffic Control Modernization	52 percent
Facilities	15 percent
Personnel and Related Expenses	16 percent
Mission Support	17 percent

Source: Federal Aviation Administration

Figure 2. Agency Facilities and Equipment Enacted Funding, Fiscal Year 2003 to Fiscal Year 2007

Fiscal Year	Funding Level
2003	$2,959,380,000
2004	$2,892,790,000
2005	$2,524,820,000
2006	$2,555,200,000
2007	$2,575,580,000

Source: Federal Aviation Administration

Figure 3. Agency Facilities and Equipment, Operations, and Airport Improvement Actual Funding, Fiscal Year 2003 to Fiscal Year 2007

Figure 3, Item 1: Facilities and Equipment Account

- In fiscal year 2003, this account's actual funding level was $2,942,000,000.
- In fiscal year 2004, this account's actual funding level was $2,863,000,000.
- In fiscal year 2005, this account's actual funding level was $2,525,000,000.
- In fiscal year 2006, this account's actual funding level was $2,555,000,000.
- In fiscal year 2007, this account's actual funding level was $2,518,000,000.

Figure 3, Item 2: Operations Account

- In fiscal year 2003, this account's actual funding level was $7,039,000,000.
- In fiscal year 2004, this account's actual funding level was $7,479,000,000.
- In fiscal year 2005, this account's actual funding level was $7,707,000,000.
- In fiscal year 2006, this account's actual funding level was $8,104,000,000.
- In fiscal year 2007, this account's actual funding level was $8,374,000,000.

Figure 3, Item 3: Airport Improvement Account

- In fiscal year 2003, this account's actual funding level was $3,378,000,000.
- In fiscal year 2004, this account's actual funding level was $3,649,000,000.
- In fiscal year 2005, this account's actual funding level was $3,702,000,000.
- In fiscal year 2006, this account's actual funding level was $3,071,000,000.
- In fiscal year 2007, this account's actual funding level was $3,671,000,000.

Source: Federal Aviation Administration

Figure 4. Breakout of the Federal Aviation Administration's Capital Account, Fiscal Year 2003 to Fiscal Year 2007

Capital Account Item	Percentage
Air Traffic Control Modernization	52 percent
Facilities	15 percent
Personnel and Related Expenses	16 percent
Mission Support	17 percent

Source: Federal Aviation Administration

Figure 5. Breakout of Air Traffic Control Modernization Within the Federal Aviation Administration's Capital Budget, Fiscal Year 2003 to Fiscal Year 2007

Account Item	Percentage
Automation	51 percent
Communications	12 percent
Navigation and Landing	16 percent
Surveillance	17 percent
Weather	4 percent

Source: Federal Aviation Administration

Figure 6. The Federal Aviation Administration's Capital Funding Projections for Fiscal Year 2008 to Fiscal Year 2012

(Note: NextGen funding includes ADS-B, SWIM, and future projects supporting NextGen. Total NextGen funding for fiscal year 2008 to fiscal year 2012 from the capital account is $4.3 billion. Remaining Facilities and Equipment includes funding for existing projects, facilities, and support service contracts.)

- For fiscal year 2008, the NextGen funding projection is $174,400,000, and the remaining funds projected for Facilities and Equipment is $2,287,200,000. Total capital funding projection for fiscal year 2008: $2,461,600,000.

- For fiscal year 2009, the NextGen funding projection is $652,800,000, and the remaining funds projected for Facilities and Equipment is $2,306,000,000. Total capital funding projection for fiscal year 2009: $2,958,800,000.

- For fiscal year 2010, the NextGen funding projection is $956,500,000, and the remaining funds projected for Facilities and Equipment is $2,158,200,000. Total capital funding projection for fiscal year 2010: $3,114,700,000.

- For fiscal year 2011, the NextGen funding projection is $1,256,400,000, and the remaining funds projected for Facilities and Equipment is $2,096,600,000. Total capital funding projection for fiscal year 2011: $3,353,000,000.

- For fiscal year 2012, the NextGen funding projection is $1,294,600,000, and the remaining funds projected for Facilities and Equipment is $2,211,700,000. Total capital funding projection for fiscal year 2012: $3,506,300,000.

Source: Federal Aviation Administration

Table 1. Average Age of Federal Aviation Administration Facilities

As of fiscal year 2007,

- The average age of air traffic control towers is 29 years.
- The average age of terminal radar approach control facilities is 26 years.
- The average age of en route control centers is 43 years.

Source: Federal Aviation Administration

Table 4. Federal Aviation Administration Schedule Metrics Used in Fiscal Year 2006

Table 4 shows metrics used for measuring progress with acquisitions in FY 2006.

Program	Metric	Planned Date	Actual Date
Airport Surface Detection Equipment, Model X (ASDE-X)	Progress measured by: delivery of two systems	Date planned for completion: February 2006	Metric actually completed in February 2006
Standard Terminal Automation Replacement System (STARS)	Progress measured by: delivery to one site	Date planned for completion: February 2006	Metric actually completed in January 2006
Air Traffic Management (ATM)	Progress measured by: Completion of detailed design review	Date planned for completion: August 2006	Metric actually completed in March 2006
Precision Runway Monitor	Progress measured by: Completion of factory acceptance testing for Atlanta	Date planned for completion: April 2006	Metric actually completed in April 2006
Wide Area Augmentation System (WAAS)	Progress measured by: Completion of initial installation of two reference stations	Date planned for completion: September 2006	Metric actually completed in May 2006

Source: the Federal Aviation Administration's Air Traffic Organization-Finance Capital Expenditures Program Office

Exhibit A. Status of Federal Aviation Administration (FAA) Major Acquisitions (as of September 2007)

Advanced Technologies and Oceanic Procedures (ATOP): Modernizes FAA facilities that are responsible for managing large segments of airspace over the Atlantic and Pacific Oceans. FAA plans call for an integrated system for flight data processing, detecting conflicts between aircraft, data link, and surveillance capabilities. **Contractor: Lockheed/Martin** **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $548.2 million	Current Program Cost Estimate: $548.2 million	Original Deployment Schedule: Start: 2004 Finish: 2006	Current Deployment Schedule: Start: 2004 Finish: 2006	ATOP is now operational at Oakland, New York, and Anchorage Air Route Traffic Control Centers that manage oceanic traffic. We note that ATOP is expected to help demonstrate NextGen automation capabilities. Because FAA severely underestimated critical work areas in the original contract, it is currently planning to increase the contract cost by $90 million. This would increase the contract value from $306 million to $396 million—a 29 percent increase. FAA officials have stated that the cost increase can be accommodated within the current baseline. FAA controllers have raised legitimate concerns about recurring failures (loss of data-link communication with aircraft and aircraft position jumps) with ATOP. These problems represent potentially hazardous safety conditions and directly limit promised capacity and productivity benefits, such as reduced separation. Over the past year, FAA has addressed problems with ATOP while deploying new capabilities; it will continue to do so going forward. **ATOP is a key NextGen initiative** for demonstrating new automation capabilities.
Air Traffic Control Beacon Interrogator-6 (ATCBI-6): A ground-based system that interrogates transponders, receives and processes replies from transponders, determines the range and direction to/from	Original Program Cost Estimate: $281.8 million	Current Program Cost Estimate: $282.9 million	Original Deployment date: Start: 2000 Finish: 2004	Current Deployment Schedule Start: 2002 Finish: 2009	FAA has installed 112 out of 130 operational ATCBI-6 systems and 6 out of 7 support systems. Of the operational systems, 88 are commissioned. However, the program is requesting, in an upcoming Joint Resource Council review, to extend the deployment schedule to May 2010.

aircraft, and forwards the information to appropriate air traffic control automation systems. Replies from aircraft provide transponder identification and altitude data, which are displayed on the controller's screen. **Contractor: Raytheon** **Responsible Service Unit: En Route & Oceanic Services**					A number of factors have contributed to the need for rebaselining, including prior reductions in funding and an increased number of systems being deployed due to agency cost share agreements, congressional earmarks, and other government programs. However, due to implementation efficiencies, the new cost baseline will be reduced to $251.7 million.
Air Traffic Management (ATM): Consists of: Traffic Flow Management - Modernization and Collaborative Air Traffic Management Technologies (CATMT). TFM-M modernizes the infrastructure that serves as the automation backbone for the nationwide traffic management units that assist in the strategic planning and management of air traffic. CATMT (Work Package #1) provides new decision support tools to deliver additional user benefits and increase the effective capacity of the NAS. **Contractor: Computer Sciences Corporation (TFM-M) Volpe NTSC, and various others (CATMT)**	Original Program Cost Estimate: $454.3 million	Current Program Cost Estimate: $454.3 million	Original Deployment Schedule: Start: 2007 Finish: 2011 (Up to Work Package #1. Additional segments are to be determined.)	Current Deployment Schedule: Start: 2007 Finish: 2011 (Up to Work Package #1. Additional segments are to be determined.)	ATM is an important effort to address capacity in both the short and long term. It is an important tool in reducing the impacts of bad weather throughout the National Airspace System. Although the ATM effort has not experienced cost increases or schedule delays, we are concerned about risks and what will ultimately be delivered. Our concerns are based on the fact the FAA and the contractor significantly underestimated the size and complexity of TFM-M software development. FAA has modified the contract and adjusted the scope of the work. The current risks for ATM focus on developing complex software and integrating the ATM with other NAS systems. **ATM is a key platform for NextGen initiatives.** ATM efforts will have to be integrated with automation and communication programs.

Responsible Service Unit: Systems Operations					
Airport Surface Detection Equipment-X (ASDE-X): ASDE-X provides surveillance equipment and conflict alerting safety logic to prevent runway incursions at a large number of airports. Implementation of these systems will improve controller situational awareness of the airport movement area. **Contractor: Sensis Corp.** **Responsible Service Unit: Terminal Services**	Original Program Cost Estimate: $424.3 million	Current Program Cost Estimate: $549.8 million (Includes $77 million in technical refresh costs.)	Original Deployment Schedule: Start: 2003 Finish: 2007	Current Deployment Schedule: Start: 2003 Finish: 2011	ASDE-X is an important technology to prevent accidents on airport runways and taxiways. FAA last re-baselined ASDE-X in September 2005, increasing costs from $505.2 million to $549.8 million and extended the deployment completion date from 2007 to 2011. ASDE-X was initially envisioned to provide a low-cost alternative system for small- to medium-sized airports similar to FAA's ASDE-3 radar system, but has evolved into a different program. FAA made a significant change to the program in September 2005 and not only intends to upgrade ASDE-3 systems with ASDE-X capabilities at 25 large airports but also will install the system at 10 other airports that currently lack any surface surveillance technology. We remain concerned about the possibility of further increases and schedule slips, and when operational performance issues with key safety features will be resolved.
Airport Surveillance Radar (ASR-11): Replaces aging ASR-7 and ASR-8 analog radars at small terminal facilities with digital radar. ASR-11 can be used by Common ARTS and STARS. This is a joint effort with the Department of Defense.	Original Program Cost Estimate: $743.3 million	Current Program Cost Estimate: $696.5 million	Original Deployment Schedule: Start: 2000 Finish: 2005	Current Deployment Schedule: Start: 2003 Finish: 2009	The ASR-11 program has undergone significant changes since our last report. In 2005, FAA re-baselined the effort to address cost and schedule issues. FAA now plans to deploy only 66 of the 112 originally planned systems. This accounts for the slight reduction in the costs associated with the ASR-11 program. FAA also extended the deployment schedule by 4 years.

Contractor: Raytheon **Responsible Service Unit: Terminal Services**					Surveillance architecture consists of the following basic elements: radar systems, beacon systems, and Automatic Dependent Surveillance – Broadcast (ADS-B). In September 2006, FAA decided to continue to limit the ASR-11 baseline to 66 systems and wait until the ADS-B investment decision before re-evaluating the business case for replacing the remaining legacy radars. In February 2007, the ADS-B program office proposed to retain primary radars as part of its backup strategy, therefore the ASR-11 program decided to go forward with its re-evaluation. No baseline changes were required for ASR-11 based upon the ADS-B backup strategies. Any delays in implementing ADS-B will force FAA to rethink its investments in ground-based radar technology.
Automatic Dependent Surveillance-Broadcast (ADS-B) NAS-Wide Implementation: ADS-B is a technology that relies on GPS to broadcast the positions of properly equipped aircraft and surface vehicles. Formerly funded under the *Safe Flight 21 Initiative*, ADS-B is expected to provide air-to-air and air-to-ground surveillance capability throughout the NAS. **Contractor(s):** **ITT Corp.** **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $1.66 billion (Segments 1 and 2)	Current Program Cost Estimate: $1.66 billion (Segments 1 and 2)	Original Deployment Schedule: Start: 2007 Finish: 2013 (Additional segments are to be determined.)	Current Deployment Schedule: Start: 2007 Finish: 2013 (Additional segments are to be determined.)	ADS-B is a cornerstone technology for NextGen and has considerable potential for enhancing safety and boosting capacity. In June 2006, FAA approved the first 2 years of ADS-B which involves development, validation of services, and limited deployment. FAA awarded a $1.8 billion service contract for ADS-B in August 2007 to build the ground infrastructure. With this type of contract, the Government will not own the ground infrastructure but will pay for ADS-B services. Initially, FAA is focusing on "ADS-B OUT" as a replacement for or adjunct to current radar. However, most benefits are expected with "ADS-B IN," which will display traffic information in the cockpit. This will facilitate self-separation.

					Realizing the full range of ADS-B benefits will depend on mitigating risk in a number of areas, including airspace users equipping with new avionics. FAA intends to rely on a rulemaking initiative to spur aircraft equipage. Other risks involve addressing broadcast frequency congestion concerns, implementing procedures for separating aircraft, and assessing security vulnerabilities in managing air traffic. **ADS-B is a key NextGen initiative**. Airspace users must equip to obtain benefits and FAA intends to rely on rulemaking initiative to spur equipage.
Collaborative Decision Making (CDM): Part of Air Traffic Management (ATM), CDM allows information exchange and consultation with airline operation centers to determine the most acceptable strategies to reduce delays. **Contractors: Volpe NTSC, Metron Aviation, Northrup-Grumman** **Responsible Service Unit: System Operations**	Original Program Cost Estimate: $75.9 million	Current Program Cost Estimate: $56.4 million	Original Deployment Schedule: Start: 2002 Finish: 2005	Current Deployment Schedule: Start: 2002 Finish: see Air Traffic Management (ATM)	The CDM effort was part of the Free Flight Phase I and II initiatives. It introduced information exchange systems between the FAA and airline operations centers. *In August 2005, the CDM program became part of the Collaborative Air Traffic Management Technologies within the Air Traffic Management line of effort.* CATMT will encompass the same type of software enhancements that were formerly provided by CDM.

Controller-Pilot Data Link Communications (CPDLC): Designed to provide a digital data communications capability for ATC operations that will be an enhancement to existing air/ground voice communications. **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $166.7 million (Builds 1 and 1A)	Current Program Cost Estimate: $118 million (Amount expended)	Original Deployment Schedule: Start: 2003 Finish: 2005	Current Deployment Schedule: Start: N/A Finish: N/A	FAA has long considered an effective controller-pilot data link essential for enhancing capacity. FAA cancelled its most recent CPDLC effort (a limited deployment) in April 2003 because of concerns about airspace user equipage and increased costs. We documented FAA's reasons in our September 2004 report. Data link communications are a key element in NextGen to enhance capacity and boost productivity. FAA is planning to restart this effort as part of a NextGen initiative and has scheduled an initial investment decision for FY 2008. **Data Link Communications are a key NextGen initiative** for reducing voice communications and enhancing controller productivity.
En Route Automation Modernization (ERAM): Replaces the Host computer hardware and software, including the Host backup system, and associated support infrastructure, at 20 En Route Centers. **Contractors: Lockheed/Martin (prime), and Raytheon (subcontractor)** **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $2.154 billion	Current Program Cost Estimate: $2.142 billion	Original Deployment Schedule: Start: 2009 Finish: 2010	Current Deployment Schedule: Start: 2009 Finish: 2010	ERAM is currently on budget and on schedule and is meeting performance milestones. The next major milestone is Government Acceptance, which is planned for October 2007, 6 months earlier than planned. ERAM is currently managing several significant risks dealing with system complexity and software development, training and transition issues, and operational acceptance. The ERAM program will provide a modern and slightly more capable replacement for the existing Host computer system. An expanded ERAM is being envisioned as the primary automation system for NextGen to provide flight data, trajectory-based services for high and low altitude air traffic. The follow-on ERAM program will include additional software releases and hardware upgrades that will

					provide the new capabilities envisioned for NextGen. These upgrades are currently undefined and likely will require billions of dollars to develop and field. Cost increases or schedule slips to the existing ERAM program would have a cascading impact on other capital programs and could directly affect the pace of the overall transition to NextGen. **ERAM is a key platform for NextGen** Automation efforts that will provide for greater controller productivity.
FAA Telecommunications Infrastructure (FTI): FTI is designed to phase out older telecommunications systems and replace them with one provider responsible for operating and maintaining FAA telecommunications infrastructure. **Contractor:** **Harris Corporation** **Responsible Service Unit:** **Technical Operations**	Original Program Cost Estimate: $205.5 million	Current Program Cost Estimate: $318.8 million	Original Deployment Schedule: Start: 2002 Finish: 2007	Current Deployment Schedule: Start: 2002 Finish: 2008	FTI is a key telecommunications program that FAA expects to significantly reduce Agency operating costs. FAA re-baselined FTI in August 2006, extending the transition end date by 12 months to December 2008. FAA extended the schedule to address a number of risks associated with completing the FTI transition by December 2007. FAA continues to face challenges in implementing FTI. FAA has a backlog of more than 1,000 FTI services, but considers the remaining work manageable. The program's estimated benefit associated with savings is eroding. By the end of FY 2006, we estimated that the benefit, in terms of estimated cost savings, had dropped from the original estimate of $820 million to $434 million. Finally, FAA must ensure FTI diversity requirements are met to reduce the risks of unscheduled system outages.

Integrated Terminal Weather System (ITWS): Acquires and integrates weather data from multiple sensors, and provides traffic management units with a graphic display of weather information that needs no meteorological interpretation. This includes (1) a display of terminal winds aloft and (2) a 20-minute prediction of convective weather. **Contractor: Raytheon** **Responsible Service Unit: Terminal Services**	Original Program Cost Estimate: $276.1 million	Current Program Cost Estimate: $286.1 million	Original Deployment Schedule: Start: 2002 Finish: 2003	Current Deployment Schedule: Start: 2003 Finish: 2009	FAA has installed 17 of 22 operational ITWS systems and four support systems. Of the operational systems, 15 are commissioned. In May 2004, FAA decided to defer 12 systems to allow the incorporation of the Terminal Convective Weather Forecast (TCWF) while remaining within funding levels. FAA completed the development of TCWF enhancement in April 2006 and has retrofitted 9 of 11 ITWS that were installed prior to TCWF development. In an upcoming Joint Resource Council review, FAA plans to make a deployment decision regarding the 12 systems, which may extend the schedule baseline and increase operation and maintenance costs; however, cost and schedule baselines are still being validated. ITWS is an enabling technology for NextGen.
Local Area Augmentation System (LAAS): LAAS is a precision approach and landing system that is expected to boost airport arrival rates under all weather conditions. It provides the augmentation needed at 160 airports to make GPS fully usable for Categories I, II, and III precision approaches at selected airports. **Contractor: Honeywell** **Responsible Service Unit: Technical Operations**	Original Program Cost Estimate: $530.1 million	Current Program Cost Estimate: $719.5 million (Includes $111.1 million for technical refresh)	Original Deployment Schedule: Start: 2002 Finish: to be determined	Current Deployment Schedule: Start: N/A Finish: N/A	FAA has deferred making decisions about how to move forward with LAAS until the 2008/2009 timeframe and the effort has been in a research and development mode since 2004. Consequently, firm cost and schedule baselines do not exist. FAA intends to continue the development activities to complete a design capable of achieving expected performance parameters. FAA is planning a cooperative agreement with Department of Defense to achieve Category III performance with the Department of Defense system, the Joint Precision Approach and Landing System (JPALS). Also, FAA is cooperating with Air Services Australia to develop the LAAS

					integrity design. Although decisions for LAAS have been postponed, we note that in its Capital Investment Plan, the FAA is allocating about $400 million for LAAS for FY 2012 and beyond. Airspace users must equip to obtain benefits.
Next Generation VHF Air/Ground Communications (NEXCOM): Replaces and modernizes the aging and obsolete national airspace system (NAS) air-to-ground analog radio communications infrastructure and will address the impending shortage of communication frequency spectrum. **Contractor: ITT** **Responsible Service Unit: Technical Operations**	Original Program Cost Estimate: $406.0 million (Segment 1 only)	Current Program Cost Estimate: $324.7 billion (Segment 1a only. The total estimate outlined in FAA CIP for all segments is $1.26 billion.)	Original Deployment Schedule: Start: 2002 Finish: 2008 (Key site)	Current Deployment Schedule: Start: 2004 Finish: 2013 (Segment 1a only)	NEXCOM was originally envisioned as program to revamp voice and data communications in the National Airspace System. *It is now essentially a radio replacement program.* In March 2004, FAA deferred major elements of NEXCOM. In December 2005, NEXCOM was re-baselined only for the purchase and installation of multimode digital radios in the analog mode (segment 1a) in en-route facilities. FAA has requested funding to complete an investment analysis and initiate an acquisition to replace radios in terminal and flight service facilities. According to FAA, efforts to modernize communications by providing data communications capabilities will be funded through the new NextGen Data Communications program. FAA faces a myriad of complex decisions about requirements, technical approaches, and ways to transition new communication systems.

Standard Terminal Automation Replacement System (STARS) - Terminal Automation Modernization/ Replacement Program (TAMR) Phase I: Replaces controller and maintenance workstations with color displays, processors, and computer software at terminal air traffic control facilities. **Contractor: Raytheon** **Responsible Service Unit: Terminal Services**	Original Program Cost Estimate: $940.2 million	Current Program Cost Estimate: $2.719 billion (Includes $585 million for technical refresh.)	Original Deployment Schedule: Start: 1998 Finish: 2005	Current Deployment Schedule: Start: 2002 Finish: to be determined	The STARS program (now referred to as TAMR Phase I) has a long history of cost increases and schedule slips. It is no longer the program that FAA originally envisioned. In 2004, faced with cost growth in excess of $2 billion for STARS, FAA rethought its terminal modernization strategy. The Agency committed to deploying STARS at 50 sites (later reduced to 47) at a cost of $1.46 billion as opposed to the original plan for 172 sites at a cost of $940 million. STARS is fully operational at 46 of the 47 sites. Norfolk—the 46th site—achieved Initial Operational Capability in June 2007. At the remaining site—Dayton—the hardware will be placed in storage awaiting facility construction completion. There is no current defined "end state" for terminal modernization, and past problems with STARS leaves FAA in a difficult position to begin transitioning to NextGen capabilities. Future costs will be shaped by (1) NextGen requirements, (2) the extent of FAA's terminal facilities consolidation, and (3) the need to replace or sustain existing (legacy) systems that have not yet been modernized.

System-Wide Information Management (SWIM): SWIM will provide a NAS-wide information web to connect FAA systems to each other and enable interaction with members of the decision making community. To the extent practicable, SWIM will leverage existing systems and networks based on proven technologies in the operational and demonstration environment. **Contractor: To Be Determined** **Responsible Service Unit: Technical Operations**	Original Program Cost Estimate: $96.6 million (FAA CIP cost estimate: $285.0 million)	Current Program Cost Estimate: $96.6 million (FAA CIP cost estimate: $285.0 million)	Original Deployment Schedule: Start: 2009 Finish: 2010 (FAA baselined the first 2 years of segment 1. Additional segments are to be determined.)	Current Deployment Schedule: Start: 2009 Finish: 2010 (FAA baselined the first 2 years of segment 1. Additional segments are to be determined.)	SWIM is a key transformational program for the development of NextGen. FAA decided to baseline the first 2 years of segment 1 of the program (FY 2009-FY 2010) to allow assessment of commercial off-the-shelf products to satisfy SWIM requirements, design capabilities, and deploy selected capabilities. Much work remains to determine the requirements and interfaces with other FAA systems. **SWIM is a key NextGen initiative** that will provide the basis for net-centric communications.

Terminal Automation Modernization/Replacement Program (TAMR) – Phase II Modernizes the automation systems that provide air traffic controllers with the information needed to safely and efficiently control air traffic in the terminal environment. **Contractor: Raytheon (primary), Lockheed Martin (subcontractor)** **Responsible Service Unit: Terminal Services**	Original Program Cost Estimate: $139.5 million (Includes $82.9 million for technical refresh)	Current Program Cost Estimate: $139.5 million (Includes $82.9 million for technical refresh. The current estimate for Phase III, while not approved, is $654 million.)	Original Deployment Schedule: Start: 2007 Finish: 2008	Current Deployment Schedule: Start: 2007 Finish: 2008	FAA is also funding ongoing terminal modernization through a follow-on effort called TAMR Phase II. This effort has its own baseline and funding profile in the FAA's Capital Investment Plan. In June 2005, FAA approved modernizing five small sites with STARS and replacing aging displays at four large, complex sites (Chicago, IL; Denver, CO; St. Louis, MO; and Minneapolis, MN) at a cost of $57 million. These sites are particularly critical to the NAS. However, this leaves over 100 small sites that are still in need of modernization. *The most urgent concern facing terminal modernization is how quickly FAA can replace aging displays at the four critical sites.* FAA chose not to compete this work based on a joint proposal from two contractors and instead decided to modify the current STARS contract to include the work. Although this was expected to expedite replacement of the aging displays, the time spent revising the contract caused FAA to lose the time advantage from forgoing competition. As a result, the aging displays will not be replaced until 2008.

Traffic Management Advisor (TMA): TMA is an automated decision-support system that allows air traffic controllers to sequence aircraft in a way that that reduces airspace congestion and optimizes airport arrival capacity. **Contractor: Computer Sciences Corporation** **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $135.5 million	Current Program Cost Estimate: $135.5 million	Original Deployment Schedule: Start: 2003 Finish: 2006	Current Deployment Schedule: Start: 2004 Finish: 2008	TMA was developed and implemented as part of the Free Flight Phase I and II initiatives. In May 2005, FAA established a specific baseline for TMA. TMA was deployed at six en route centers under Free Flight Phase I and at four additional en route centers under Free Flight Phase II. In June 2005, the FAA Administrator directed the delivery of TMA to seven en route centers and TMA is currently being deployed at these sites. This was done within the framework of the existing budget and the only impact is an extended final deployment schedule. TMA is a contributing technology for NextGen.
User Request Evaluation Tool (URET): URET is a decision support aid that automatically tells air traffic controllers of potential conflicts between aircraft and special-use airspace and introduces a conflict probe capability and electronic flight data processing. **Contractor: Lockheed-Martin** **Responsible Service Unit: En Route & Oceanic Services**	Original Program Cost Estimate: $285.3 million	Current Program Cost Estimate: $284.1. million	Original Deployment Schedule: Start: 2003 Finish: 2006	Current Deployment Schedule: Start: 2003 Finish: 2006	FAA developed and implemented URET as part of the Free Flight Phase I and II initiatives. In May 2005, FAA established a specific baseline for URET. URET is deployed and operational at all 20 en route centers. The program was completed within its cost and schedule baseline. URET is anticipated to be incorporated into the ERAM system in December 2010 as outlined in FAA planning documents.

Wide Area Augmentation System (WAAS): Provides the augmentation needed to make the Global Positioning System (GPS) fully usable for en route, terminal, and non-precision approaches. **Contractor: Raytheon** **Responsible Service Unit: Technical Operations**	Original Program Cost Estimate: $892.4 million	Current Program Cost Estimate: $3.3 billion (Includes sunk costs)	Original Deployment Schedule: Start: 1998 Finish: 2001	Current Deployment Schedule: Start: 2005 Finish: 2013	WAAS has a long history of cost growth and schedule slips. FAA last re-baselined WAAS in May 2004, increasing F&E costs from $2.9 billion to $3.3 billion. The first segment of the program provides precision approach capability and is baselined for completion by 2008. The second segment, which provides precision landing capability, is not currently baselined but is scheduled for completion by 2013. Risks to implementation include delays in completing the integration of two additional satellites and the rate of equipage of aircraft to use the system. FAA is currently developing hundreds of new WAAS approach procedures for airports each year, in part, to provide incentive for aircraft owners to equip and utilize the new instrument approach capabilities. Airspace users must equip to obtain benefits.

Exhibit B. Cost and Schedule Variances for Existing Programs

Note 1: For presentation purposes, STARS and TAMR are treated separately; however, these efforts are separate phases of the same program.

Note 2: Totals involve the current FAA-approved baseline cost estimate for the program and do not include non-baselined portion of the program or, in some cases, technical refresh cost estimates.

Wide Area Augmentation System (WAAS) program	Original Program Cost Estimate: $892.4 million	Current Program Cost Estimate: $3.3 billion	Percent Cost Growth: 274 percent	Original Deployment Schedule: Start: 1998 Finish: 2001	Current Deployment Schedule: Start: 2005 Finish: 2013	Schedule delay: 12 years
Standard Terminal Automation Replacement System program (STARS)	Original Program Cost Estimate: $940.2 million	Current Program Cost Estimate: $2.719 billion	Percent Cost Growth: 189 percent	Original Deployment Schedule: Start: 1998 Finish: 2005	Current Deployment Schedule: Start: 2002 Finish: to be determined	Schedule delay: over 2 years
FAA Telecommunications Infrastructure program (FTI)	Original Program Cost Estimate: $205.5 million	Current Program Cost Estimate: $318.8 million	Percent Cost Growth: 55 percent	Original Deployment Schedule: Start: 2002 Finish: 2007	Current Deployment Schedule: Start: 2002 Finish: 2008	Schedule delay: 1 year
Local Area Augmentation System program (LAAS)	Original Program Cost Estimate: $530.1 million	Current Program Cost Estimate: $719.5 million (Includes $111.1 million for technical refresh)	Percent Cost Growth: 36 percent	Original Deployment Schedule: Start: 2002 Finish: to be determined	Current Deployment Schedule: Start: to be determined Finish: to be determined	Schedule delay: Deferred
Airport Surface Detection Equipment-Model X program (ASDE-X)	Original Program Cost Estimate: $424.3 million	Current Program Cost Estimate: $549.8 million	Percent Cost Growth: 30 percent	Original Deployment Schedule: Start: 2003 Finish: 2007	Current Deployment Schedule: Start: 2003 Finish: 2011	Schedule delay: 4 years
Integrated Terminal Weather System program (ITWS)	Original Program Cost Estimate: $276.1 million	Current Program Cost Estimate: $286.1 million	Percent Cost Growth: 4 percent	Original Deployment Schedule: Start: 2002 Finish: 2003	Current Deployment Schedule: Start: 2003 Finish: 2009	Schedule delay: 6 years
Air Traffic Control Beacon Interrogator-6	Original Program	Current Program Cost	Percent Cost Growth: Not	Original Deployment	Current Deployment	Schedule delay: 5 years

program (ATCBI-6)	Cost Estimate: $281.8 million	Estimate: $282.9 million	applicable	date: Start: 2000 Finish: 2004	Schedule Start: 2002 Finish: 2009	
Collaborative Decision Making program (CDM)	Original Program Cost Estimate: $75.9 million	Current Program Cost Estimate: $56.4 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2002 Finish: 2005	Current Deployment Schedule: Start: 2002 Finish: to be determined	Schedule delay: Merged with ATM
System-Wide Information Management program (SWIM)	Original Program Cost Estimate: $96.6 million	Current Program Cost Estimate: $96.6 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2009 Finish: 2010	Current Deployment Schedule: Start: 2009 Finish: 2010	Schedule delay: not applicable
Traffic Management Advisor program (TMA)	Original Program Cost Estimate: $135.5 million	Current Program Cost Estimate: $135.5 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2003 Finish: 2006	Current Deployment Schedule: Start: 2004 Finish: 2008	Schedule delay: 2 years
Terminal Automation Modernization/Replacement Program (TAMR)	Original Program Cost Estimate: $139.5 million	Current Program Cost Estimate: $139.5 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2003 Finish: 2006	Current Deployment Schedule: Start: 2004 Finish: 2008	Schedule delay: not applicable
User Request Evaluation Tool program (URET)	Original Program Cost Estimate: $285.3 million	Current Program Cost Estimate: $284.1. million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2003 Finish: 2006	Current Deployment Schedule: Start: 2003 Finish: 2006	Schedule delay: Not applicable
Air Traffic Management program (ATM)	Original Program Cost Estimate: $454.3 million	Current Program Cost Estimate: $454.3 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2007 Finish: 2011	Current Deployment Schedule: Start: 2007 Finish: 2011	Schedule delay: Not applicable
Advanced Technologies and Oceanic Procedures program (ATOP)	Original Program Cost Estimate: $548.2 million	Current Program Cost Estimate: $548.2 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2004 Finish: 2006	Current Deployment Schedule: Start: 2004 Finish: 2006	Schedule delay: Not applicable

Controller-Pilot Data Link Communications program (CPDLC)	Original Program Cost Estimate: $166.7 million	Current Program Cost Estimate: $118 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2003 Finish: 2005	Current Deployment Schedule: Start: not applicable Finish: not applicable	Schedule delay: Cancelled
Next Generation VHF Air/Ground Communications program (NEXCOM)	Original Program Cost Estimate: $406.0 million	Current Program Cost Estimate: $324.7 billion	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2002 Finish: 2008	Current Deployment Schedule: Start: 2004 Finish: 2013	Schedule delay: 5 years
Airport Surveillance Radar program (ASR-11)	Original Program Cost Estimate: $743.3 million	Current Program Cost Estimate: $696.5 million	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2000 Finish: 2005	Current Deployment Schedule: Start: 2003 Finish: 2009	Schedule delay: 4 years
Automatic Dependent Surveillance-Broadcast program (ADS-B)	Original Program Cost Estimate: $1.66 billion	Current Program Cost Estimate: $1.66 billion	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2007 Finish: 2013	Current Deployment Schedule: Start: 2007 Finish: 2013	Schedule delay: Not applicable
En Route Automation Modernization program (ERAM)	Original Program Cost Estimate: $2.154 billion	Current Program Cost Estimate: $2.142 billion	Percent Cost Growth: Not applicable	Original Deployment Schedule: Start: 2009 Finish: 2010	Current Deployment Schedule: Start: 2009 Finish: 2010	Schedule delay: Not applicable

The total original estimated cost for these programs was $10,412,800,000.
The total current estimated cost for these programs is $14,868,100,000.
Schedule delays for these programs range from 1 year to 12 years.

Source: Varies, project-specific acquisition program baselines or FAA's Capital Investment Plan