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AIR TRAFFIC CONTROL

Status of FAA's Modernization Program

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Chairman
The Honorable Frank R. Lautenberg
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
United States Senate

The Honorable Frank R. Wolf
Chairman
The Honorable Ronald D. Coleman
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
House of Representatives

This is the sixth annual report requested by your subcommittees on the status of the Federal Aviation Administration's (FAA) efforts to modernize the air traffic control (ATC) system.[1] As with previous reports, this report provides information on the overall status of ATC's modernization, which currently includes 158 projects funded through the facilities and equipment (F&E) appropriation account. This information includes changes in total modernization costs, number of completed projects, and trends for unobligated funds. This report also provides detailed information on cost and schedule estimates for 15 major modernization projects, which account for over 40 percent of FAA's 1996 F&E budget request.[2] FAA is seeking $1.9 billion in this budget request, or 9 percent below its 1995 appropriation.

[1]FAA's modernization efforts began in 1981 under the National Airspace System Plan. Since 1990, these efforts have been continued and expanded under the Capital Investment Plan.

[2]Hereafter, the years referred to in this report are fiscal years, unless indicated otherwise.

In summary, for the ATC modernization program, we found the following:

-- FAA currently estimates that the total cost of modernization will be $37.3 billion from 1982 through 2003, a $1.5 billion decrease since last year. This $1.5 billion net decrease consists of $2.7 billion in increases for new and existing projects less $4.2 billion in reductions for other projects and budget items. However, FAA estimates that 18 of the current 158 projects in the Capital Investment Plan (CIP) will extend beyond 2003 and cost an additional $842 million beyond that time. Last year, no estimates were given beyond 2003.

-- FAA has completed 64 projects, including 10 in the past year; F&E costs for the 64 projects totaled $3.8 billion, or about 10 percent of the total estimated cost of modernization through 2003. These include a $363 million project completed last year to sustain and upgrade some current ATC computers and controller workstations and acquire 8 terminal radars. Although FAA intended to complete 16 projects in 1994, the agency did not complete 6 of these on schedule for various reasons, including software problems and site preparation delays. Also, FAA reduced its unobligated balance in the F&E account in 1994 from $1.78 billion to $1.28 billion.

-- The Congress has appropriated $19.8 billion of the $37.3 billion required to modernize ATC through 2003. FAA's December 1994 CIP financial plan indicates that the remaining $17.5 billion will be needed from 1996 to 2003. However, because of anticipated reductions in future F&E funding levels, FAA is currently reviewing whether this level of funding is realistic within these time frames. A recent FAA study indicates that the agency is likely to request $14.7 billion over the same time period, or $2.8 billion below the level in the CIP financial plan.[3] At this lower projected funding level, the agency will have to push costs for projects beyond 2003 or terminate existing projects.

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[3]Air Traffic Control Corporation Study: Financial Update, FAA (Feb. 7, 1995).

We also found the following for the 15 major projects we reviewed in detail:[4]

-- FAA made progress in fielding equipment for some of its projects. For example, this past year, FAA commissioned 11 of 38 operational surface detection radars to improve ground surveillance of aircraft. Previously, the agency had commissioned only one radar. Also, FAA commissioned the first 3 of 45 weather radars designed to detect wind shear. The radars mentioned above will assist in improving aircraft safety and operations in bad weather. FAA also successfully completed the demonstration and validation phase for a new system that will integrate several weather sensors to provide better information on weather hazards near airports.

-- In the past year, schedules for implementing systems at their first site slipped for five projects. These schedule delays were for 1 year or less. For example, first-site implementation for the new long-range primary surveillance radar was delayed 1 year--from September 1994 to September 1995--because testing revealed interface problems between the radar and other equipment. From the projects' inception, first-site implementation has been delayed for nine projects an average of 5 years. For six other projects, comparable schedule data were not available.

-- Last year, the total F&E cost for seven projects increased, while costs for two projects decreased, resulting in a net increase of $219 million. For example, a project to provide better information on weather hazards near airports increased $112 million--from $139 million to $251 million--because FAA now provides cost estimates for the entire project. Previously, only costs for the initial phase of the project were included. Also, a project that will provide a voice communications system for controllers increased by $46 million--from $1,407 million to $1,453 million--because of delays caused by the restructuring of the Advanced Automation System (AAS). Starting with

[4]These 15 projects are examined in detail because they are among the most important and expensive systems and/or equipment to be used in FAA's efforts to modernize ATC automation, communications, navigation, and surveillance. All but one of these projects are currently estimated to cost over $150 million.

each project's inception, seven projects' cost estimates have increased, while four have decreased. Four projects did not have comparable cost data.

-- FAA restructured AAS, the centerpiece of the ATC modernization program. Total cost estimates grew from $2.5 billion in 1983 to $7.6 billion last year, and the project slipped 8 years from the original schedule. As a result, AAS was restructured into three more manageable projects that are estimated to cost $6 billion. In general, FAA will receive less capability under the restructured projects.

-- FAA initiated additional actions to strengthen its control of the restructured AAS. For example, FAA submitted to the Congress a comprehensive automation plan--including projected time frames and funding levels. Despite these actions, whether these steps will lead to the project's success remains to be seen. As we testified in March 1995, the en-route automation system being developed as part of the restructured AAS continues to experience software stability problems.[5]

Section 1 of this report provides background information on the ATC system and FAA's efforts to modernize it. The section explains where 15 major projects emphasized in this report fit into the ATC modernization program. Section 2 discusses the status of the overall modernization efforts, emphasizing changes in cost estimates. Section 3 reviews in detail the changes during 1994 and 1995 in costs and schedules for 15 major projects. It also provides information on cost and schedule changes after a project's inception for many of these projects.

SCOPE AND METHODOLOGY

We conducted our review from November 1994 through April 1995, focusing on changes over the past year. We obtained the information on the overall costs of ATC's modernization as well as on appropriations and obligations from documents provided by representatives of FAA's Associate Administrator for Research and Acquisitions and Office of Financial Services. Cost, schedule, and performance information on individual systems came from project officials within the Research and Acquisition organization.

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[5]FAA Budget: Issues Related to the Fiscal Year 1996 Request (GAO/T-RCED/AIMD-95-131, Mar. 13, 1995).

We also obtained information from FAA's System Engineering and Integration Contractor.

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We provided a draft of this report for comment to the Office of the Secretary of Transportation; the Acting Chief Financial Officer, FAA Office of Financial Services; and FAA's Associate Administrator for Research and Acquisition. Commenting for the Department of Transportation and FAA, the Acting Chief Financial Officer generally agreed with the information presented in the report. Officials in the Office of Financial Services and the Research and Acquisition organization responsible for ATC modernization provided us with some revised funding estimates, implementation dates, and other information. We incorporated those changes into our report.

We are providing copies of this report to the Secretary of Transportation; the Administrator, FAA; and other interested parties. We will make copies available to others on request.

Please contact me on (202) 512-2834 if you or your staff have any questions. Major contributors to this report are listed in appendix II.

Kenneth M. Mead
Director, Transportation and
Telecommunication Issues

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ABBREVIATIONS

AAS	Advanced Automation System
ACCC	Area Control Computer Complex
ACF	Area Control Facility
ADAS	AWOS Data Acquisition System
ADL	Aeronautical Data Link
ADS	Automatic Dependent Surveillance
AERA	Automated En-Route Air Traffic Control
AFSS	Automated Flight Service Station
AMASS	Airport Movement Area Safety System
AOAS	Advanced Oceanic Automation System
ARSR	Air Route Surveillance Radar
ARTS	Automated Radar Terminal System
ARTCC	Air Route Traffic Control Center
ASDE	Airport Surface Detection Equipment
ASOS	Automated Surface Observing System
ASR	Airport Surveillance Radar
ATC	air traffic control
ATCBI	Air Traffic Control Beacon Interrogator
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATN	Aeronautical Telecommunications Network
AWOS	Aviation Weather Observing System
AWPG	Aviation Weather Products Generator
CASA	Controller-Automated Spacing Aid
CIP	Capital Investment Plan
CRDA	Converging Runway Display Aid
CTAS	Center/TRACON Automation System
DA	Descent Advisory
DLP	Data Link Processor
DOD	Department of Defense
DRR	Deployment Readiness Review
DSR	Display System Replacement
DT&E	Development Test and Evaluation
EARTS	En-Route Automated Radar Tracking System
EDP	Expedited Departure Path
FAA	Federal Aviation Administration
FAST	Final Approach Spacing Tool
FDIO	Flight Data Input Output
F&E	Facilities and Equipment
FSAS	Flight Service Automation System
GAO	General Accounting Office
GPS	Global Positioning System
GSA	General Services Administration
ISSS	Initial Sector Suite System
ITWS	Integrated Terminal Weather System
LLWAS	Low Level Windshear Alert System
MCF	Metroplex Control Facility
MLS	Microwave Landing System
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association

NWS	National Weather Service
NextGen	Next Generation FSAS
OAP	Oceanic Automation Program
OAS	Oceanic Automation System
OASIS	Operational Supportability and Implementation System
ODAPS	Oceanic Display and Planning System
ORD	Operational Readiness Demonstration
OSDS	Oceanic System Development and Support
OT&E	Operational Test and Evaluation
PAMRI	Peripheral Adapter Module Replacement Item
PAPI	Precision Approach Path Indicator
PCB&T	Personnel Compensation, Benefits, and Travel
PDC	Pre-Departure Clearance
PTR	program trouble report
RMMS	Remote Maintenance Monitoring System
STARS	Standard Terminal Automation Replacement System
TAAS	Terminal Advanced Automation System
TATCA	Terminal Air Traffic Control Automation
TCCC	Tower Control Computer Complex
TDLS	Tower Data Link Service
TDWR	Terminal Doppler Weather Radar
TMA	Traffic Management Advisor
TRACON	Terminal Radar Approach Control
TSSC	Technical Support Services Contract
VASI	Visual Approach Slope Indicators
VSCS	Voice Switching and Control System
WAAS	Wide Area Augmentation System
WARP	Weather and Radar Processor

SECTION 1

BACKGROUND ON THE U.S. AIR TRAFFIC CONTROL SYSTEM

The Federal Aviation Administration's (FAA) mission is to promote the safe, orderly, and expeditious flow of air traffic in the national airspace. To accomplish its mission, FAA provides services through its air traffic control (ATC) towers, terminal-area facilities, en-route centers, and flight service stations. Based on the National Airspace System (NAS) Plan, FAA's Capital Investment Plan (CIP) was established in December 1990 to improve and expand these services by capitalizing on new technologies and procedures.

FAA's air traffic controllers direct aircraft through the national airspace. FAA places its controllers primarily in three types of facilities: ATC towers, terminal-area facilities, and en-route centers. Most of FAA's CIP projects will modernize these three facilities. In addition, some projects will modernize flight service stations. We reviewed 15 major ATC modernization projects, which will modernize these four types of facilities. In some cases, these projects will modernize more than one type of facility. Table 1.1 depicts the air traffic services that will be modernized by these projects.

TOWERS

Tower controllers direct the movement of aircraft operating under visual flight rules on the ground and within the vicinity of the airport. These controllers provide ground control and local control services. Ground control gives taxiing instructions to aircraft and vehicles operating on an airport's runways and taxiways. Local control provides weather information and landing and takeoff clearances for arriving and departing aircraft, respectively. Tower controllers utilize various equipment, including landing and navigation aids, radars, and communications networks.

Of the 15 major projects addressed in section 3 of this report, 8 will modernize tower facilities. These include the Tower Automation project, which will integrate the monitor control systems, keyboards, and displays; the Terminal Doppler Weather Radar (TDWR), which controllers use to detect hazardous weather conditions; and Airport Surveillance Detection Equipment (ASDE-3), which provides controllers with information on aircraft and vehicles operating on the airport's runways and taxiways.

TERMINALS

Controllers in terminal-area facilities--known as Terminal Radar Approach Control (TRACON) facilities--direct aircraft in the airspace that extends from the point where the tower's control ends to about 50 miles from the airport. The facilities can be located at or outside an airport. Primary services provided by these facilities to aircraft operating under both instrument flight rules and visual flight rules include providing traffic advisories, traffic alerts, and weather information, and sequencing arrivals, departures, and through traffic.

Of the 15 major projects addressed in section 3, 7 will modernize terminal-area facilities. These include the Terminal Automation Program and, specifically, the Standard Terminal Automation Replacement System (STARS), which replaces the existing automated radar terminal system, and the Terminal Air Traffic Control Automation System (TATCA), which will assist controllers and managers in optimizing air traffic sequencing in terminal airspace.

EN-ROUTE CENTERS

Controllers in en-route centers--also known as Air Route Traffic Control Centers (ARTCC)--direct aircraft in air routes outside of terminal space. The primary role of the en-route center is to provide a safe, orderly, and expeditious traffic flow throughout the NAS. Services include separating aircraft operating under instrument flight rules, monitoring traffic flow and implementing traffic management initiatives, and issuing traffic and weather advisories. In the oceanic environment, the same general services are provided but with less efficiency owing to a lack of radar surveillance and direct communications between the pilot and controller.

Of the 15 projects addressed in section 3, 8 projects will modernize the en-route centers. Among other things, these projects will provide new equipment through the En-Route Automation Project, specifically, the Display System Replacement (DSR), which provides new en-route controller workstations, and the Wide Area Augmentation System (WAAS), which enhances the Department of Defense's (DOD) Global Positioning System (GPS)--a satellite-based system. In addition, the Oceanic Automation Program (OAP) comprises a series of projects to upgrade oceanic ATC. Figure 1.1 provides a general picture of how airspace is constructed and controlled.

FLIGHT SERVICES

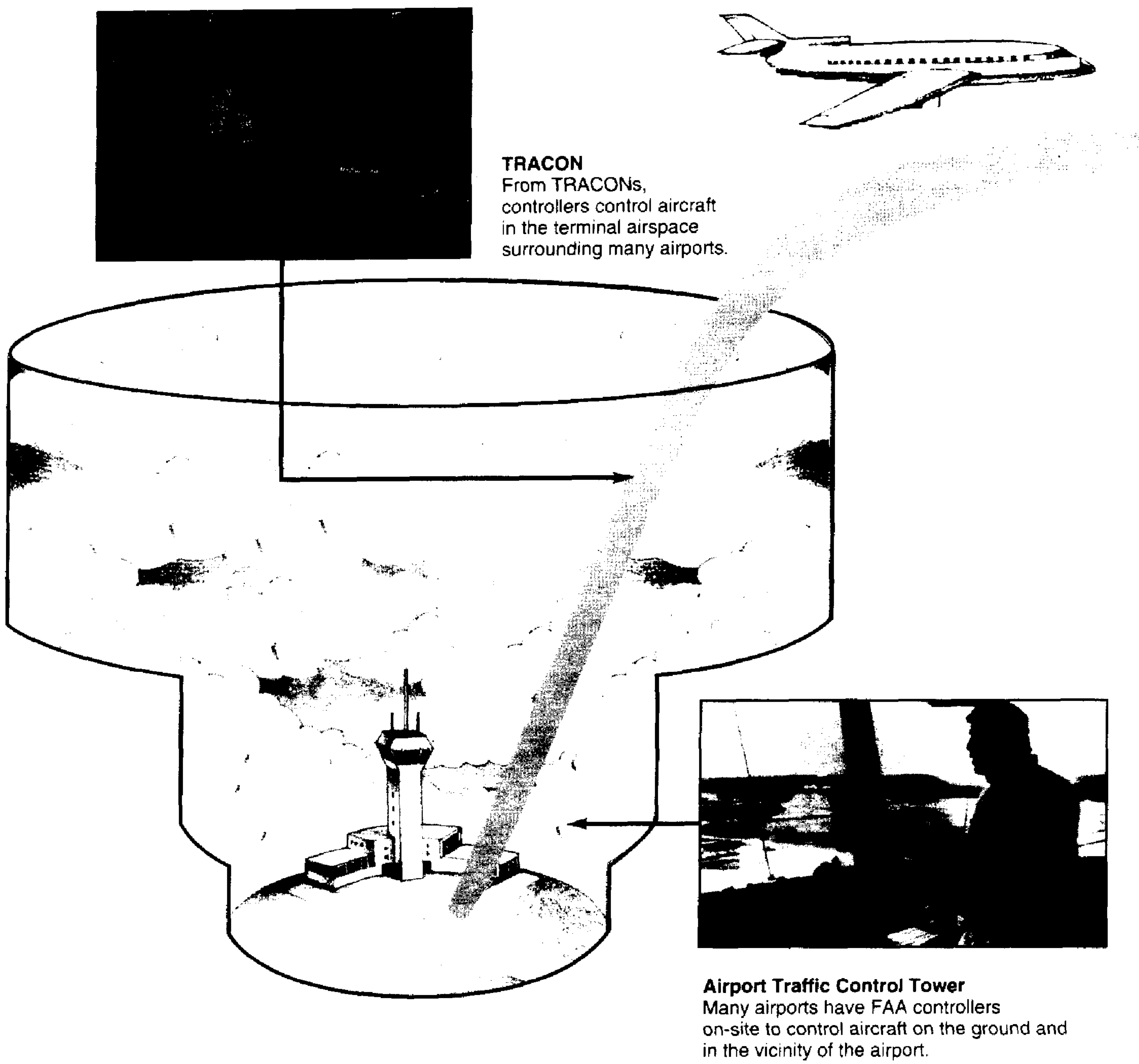
Flight Service Stations provide weather and flight plan services, primarily to general aviation pilots. Three major projects addressed in section 3 will modernize flight services. For example, the Flight Service Automation System (FSAS) will improve general aviation pilots' access to national aeronautical and weather information, simplify flight plan filing, and consolidate and automate other flight service station functions.

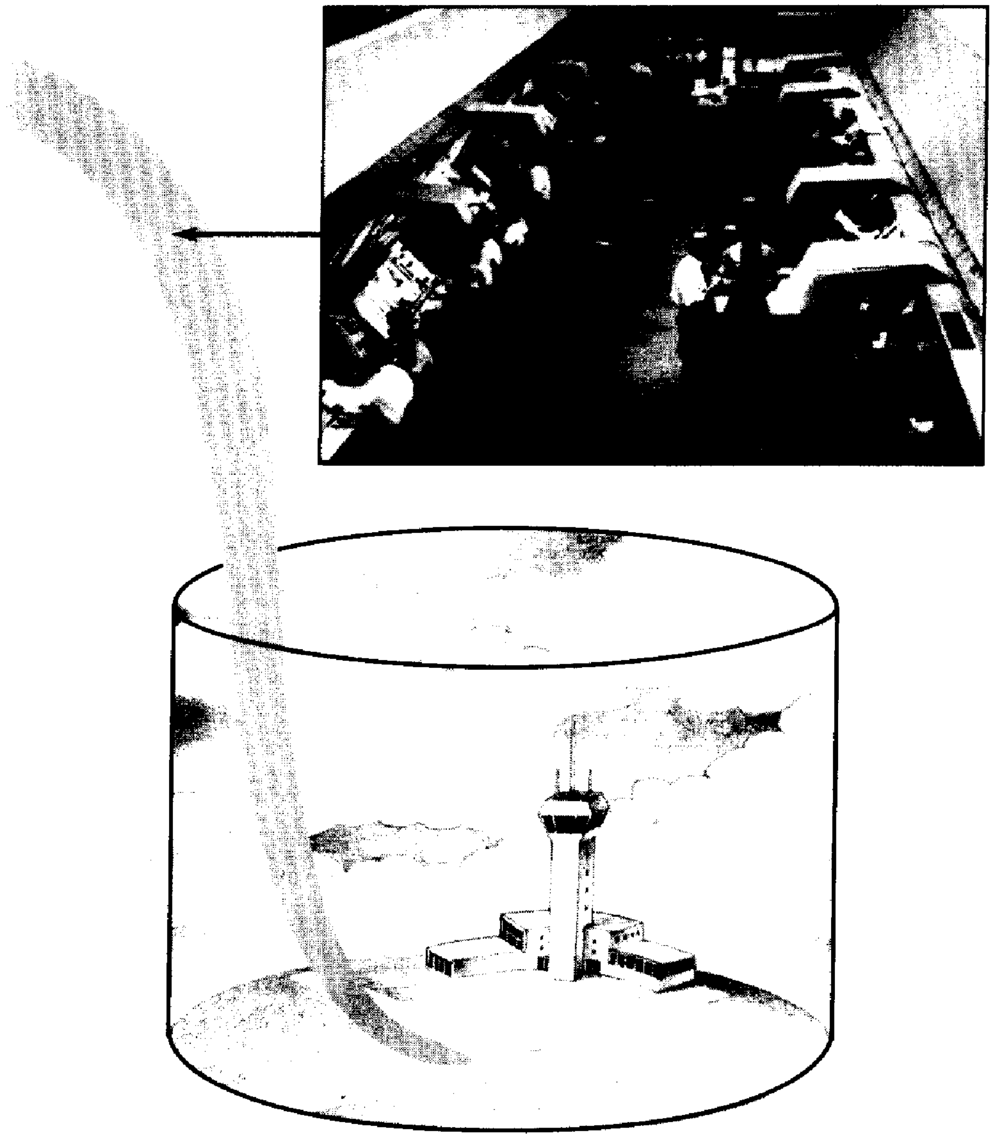
Table 1.1: Air Traffic Services That Will Be Modernized by 15 Major ATC Projects

	Service areas			
Project's title	Flight service stations	Towers	Terminals	En-route centers
Air Traffic Systems Development Program				
En-Route Automation				X
Terminal Automation			X	
Tower Automation		X		
Aeronautical Data Link (ADL)		X	X	X
Air Route Surveillance Radar-4 (ARSR-4)				X
Airport Surface Detection Equipment-3 (ASDE-3)		X		
Automated Weather Observing System (AWOS)	X	X		X
Flight Service Automation System (FSAS)	X			
Integrated Terminal Weather System (ITWS)		X	X	
Mode Select (Mode S)		X	X	X
Oceanic Automation Program (OAP)	X			X
Terminal Air Traffic Control Automation (TATCA)			X	
Terminal Doppler Weather Radar (TDWR)		X	X	
Voice Switching and Control System (VSCS)				X
Wide Area Augmentation System (WAAS)		X	X	X

Note: "X" denotes service areas where projects are utilized.

Figure 1.1: Three Main Types of Airspace and Their Associated ATC Facilities





En-Route Center
From en-route centers, controllers assume control of aircraft leaving TRACON airspace. They maintain control until aircraft enter airspace controlled by a TRACON or other en-route center.

Source: FAA.

SECTION 2

INFORMATION ON THE OVERALL STATUS OF MODERNIZATION

FAA's NAS Plan--which comprised 80 projects--was established in 1981 to modernize the ATC system.[1] Redefined and expanded in December 1990 as the CIP, the modernization program now includes 158 active projects funded through the Facilities and Equipment (F&E) appropriation account. Currently, the program is estimated to cost $37.3 billion through 2003. FAA is seeking $1.9 billion to fund this account in 1996, a 9-percent decrease below the 1995 appropriation. This section discusses the status of FAA's overall ATC modernization program, including the costs projected for the projects in FAA's December 1994 CIP financial plan, the factors affecting these costs, and other issues related to modernization.

TOTAL ESTIMATED COST OF MODERNIZATION THROUGH 2003 STANDS AT $37.3 BILLION

FAA's total estimated costs for ATC's modernization have decreased. In its December 1994 financial plan, FAA estimated that the cost of the modernization program for 1982 through 2003 will total $37.3 billion. Last year, the agency's estimate for the same time period was $38.8 billion. Of the current estimate, $19.8 billion was appropriated from 1982 through 1995. The financial plan projects that $17.5 billion will be needed from 1996 through 2003. However, because of anticipated funding reductions in future year F&E funding levels, FAA is currently reviewing the projects' funding levels. A recent FAA study indicates that the agency plans to request $14.7 billion over the same time period.[2] At this lower projected funding level, the agency will have to push costs for some projects beyond 2003 or terminate some existing projects.

FAA has also forecasted that the costs for some of the existing CIP projects may extend past 2003. For example, FAA estimates that 18 of the current 158 projects in the CIP will extend beyond 2003 and cost an additional $842 million beyond that time. Last year, no estimates were given for funding beyond 2003.

The $1.5 billion net decrease in the estimated cost of modernization[3] since last year consists of $2.7 billion in

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[1]Unless indicated otherwise, the years referred to in this report are fiscal years.

[2]Air Traffic Control Corporation Study: Financial Update, FAA (Feb. 7, 1995).

[3]For the purposes of this report, the "cost of modernization" means all F&E appropriations from 1982 through 2003 for projects in FAA's financial plan. This plan contains funding primarily for projects

increases for new and existing projects less $4.2 billion in reductions for other projects and budget items. Table 2.1 shows the elements comprising the net decrease.

The decrease in costs represents the difference between FAA's financial plans for November 1993 and December 1994. In last year's report, we compared FAA's estimates through 2001. This year, since FAA's estimates for both plans extend through 2003, we have been able to analyze costs through that year. Because of efforts to reduce FAA's funding levels, FAA is currently reviewing project funding profiles and yearly total F&E costs, which may result in major changes to the December 1994 financial plan.

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in the CIP but also for personnel compensation, benefits, and travel; for Technical Support Services Contract activities; and for some projects whose costs have been estimated by FAA but which have not yet been added formally to the CIP.

Table 2.1: Elements Comprising the Decrease in the Estimated Cost of Modernization Through 2003--A Comparison of the Financial Plans of the 1993 and 1994 CIPs

Dollars in billions

Cost category	Cost
Reductions	
Reduction in cost estimates of projects that were in the financial plan of the 1993 Capital Investment Plan (CIP)	-$4.1
Reduction in costs for personnel and technical support services that are not allocated to specific projects	-0.1
Subtotal of reductions	**-4.2**
Additions	
Increase in estimated costs of ongoing or planned projects that were in the financial plan for 1993	+2.5
Five new projects that were in the financial plan of the 1994 CIP	+0.2
Subtotal of additions	**+2.7**
Total (net change)	**-$1.5**

TEN PROJECTS WERE COMPLETED IN 1994

One way to measure FAA's progress in modernizing the ATC system is to identify the number of projects that have been completed. FAA has fully implemented 64 projects since the NAS Plan was established in 1981--including 10 in the past year. These 64 completed projects cost $3.8 billion, or approximately 10 percent of the total estimated cost of modernization through 2003. Of the 64 projects that were completed through calendar year 1994, 5 were considered Level I major acquisitions--that is, a project whose total cost is $150 million or more.

The 10 projects that were completed in calendar year 1994 cost $842.4 million, or about 22 percent of the value of all projects completed to date. Although FAA intended to complete 16 projects in 1994, the agency did not complete 6 of these on schedule for various reasons, including software problems and site preparation delays. One of the 10 completed projects--Interim Support Plan, a project to sustain and upgrade current ATC operations--cost $363 million. Appendix I shows the cost and completion date of the 64 projects that have been completed.

THE ESTIMATED COST OF MANY PROJECTS DECREASED SINCE LAST YEAR

Cost changes in existing projects--those that were in the financial plans of both the 1993 and 1994 CIPs--have also had a significant effect on the overall estimated cost of modernization. When the 1993 and 1994 plans are compared, cost decreases of projects that were in both plans totaled $4.1 billion through 2003, while cost increases totaled $2.5 billion. The estimated cost of 68 F&E projects through 2003 decreased during the last year because of termination, reduction, merges with other projects, or deferral of funding beyond 2003. The cost of 24 of these projects decreased by $50 million or more. Many of the projects with the largest decreases and deferrals beyond 2003 were for ATC infrastructure, such as the modernization of towers and TRACONs.

The estimated costs of 40 F&E projects through 2003 increased during the last year; the funding for 12 of these projects increased by $50 million or more. Table 2.2 shows the 10 projects with the largest dollar decreases in expected costs since last year, and table 2.3 shows the 10 projects with the largest dollar increases. We limited our lists to the 10 projects' accounts and therefore did not include the $127 million reduction in Personnel Compensation, Benefits, and Travel and Technical Support Services Contract costs noted in table 2.1.

Table 2.2: The 10 Projects Whose Total Estimated Costs Through 2003 Have Decreased the Most Since Last Year

Dollars in millions

Project's name and CIP number	F&E estimate through 2003 (Nov. 1993)	F&E estimate through 2003 (Dec. 1994)	Change through 2003
Microwave Landing System (MLS)--Phase I (24-07)[a]	$740.7	335.4	-$405.3
Airport Traffic Control Tower (ATCT)/Terminal radar Approach Control (TRACON) Modernization (42-13)[b]	709.7	370.6	- 339.1
Airport Surveillance Radar (ASR)-11 (34-13)[c]	977.4	733.2	- 244.2
Department of Defense (DOD)/Federal Aviation Administration (FAA) Air Traffic Control (ATC) Facility Transfer/Modernization 32-27)[d]	400.3	189.8	- 210.5
Modernize and Improve FAA Buildings and Equipment Sustained Support (46-08)[e]	396.5	195.6	- 200.9
Sustain Air Route Traffic Control Center (ARTCC)/Area Control Facilities (46-09)[f]	548.2	352.8	- 195.4
Surveillance System Enhancements (34-20)[g]	180.0	0	- 180.0
Upgrade Low-Level Windshear Alert System (LLWAS)to Expanded Network Configuration (43-12)[h]	198.0	21.2	- 176.8
Power System Sustained Support (46-07)[i]	295.2	135.8	- 159.4
Replace Visual Approach Slope Indicators (VASI) with Precision Approach Path Indicators (PAPI)(44-09)[j]	183.0	29.0	- 154.0

Note: Costs are current through 2003.

[a]Project was terminated because the GPS, enhanced by augmentation systems being developed by FAA, is expected to support all types of precision approaches.

[b]Funding was reduced or deferred until after 2003 for modernization of towers and TRACONs including terminal facilities, equipment, and space needs because of funding constraints.

[c]Funding was reduced because of a revised acquisition strategy. Nondevelopmental items will be used rather than customized items.

approaches. (For further details, see discussion of WAAS in sec. 3.)

[c]Cost increase does not reflect restructured AAS project. 1993 F&E cost estimate reflects terminal controllers' displays and related technical field support costs that were moved to STARS (62-25) in 1994. (See sec. 3 on Air Traffic Systems Development for further details on AAS.)

[d]See section 3 on ITWS for further details.

[e]Reflects updated estimate from Key Decision Point-3; however, project was recommended for cancellation by FAA.

[f]Project was expanded to include replacement of two B-727 research and development aircraft.

[g]Project now reflects funding profile for complete program. System enables an ASR to detect low-altitude windshear and microbursts in various regional climates.

[h]Project incorporates Maintenance Control Center Enhancement (46-04) into program.

[i]Project transfers post 1995 funding ($54.2 million) from Central Weather Processor (23-02), parts of which are now integrated in WARP.

FIVE PROJECTS ADD $232 MILLION TO THE COST OF FAA'S FINANCIAL PLAN OF THE 1994 CIP

Our review of FAA's financial plan of the 1994 CIP identified five new projects estimated to cost $232 million through 2003.[4] The number of new projects formally added to the CIP has greatly decreased over the past year, reversing an upward trend over the previous 2 years--5 in 1991, 12 in 1992, and 17 in 1993. Funding constraints were the main reason for this decrease. In table 2.4, we list the five new projects added to the financial plan of the 1994 CIP.

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[4]One of these projects, the Cabin Safety Research facility, has not yet been added formally to the CIP.

Table 2.4: The Five New Projects Added to the Financial Plan of the 1994 CIP

Dollars in millions

Project's name and CIP number	Estimated F&E cost
ASDE-X (64-14)[a]	$87.8
Modernization of National Airspace System (NAS) Switch System (45-22)[b]	66.3
New Austin Airport (32-25)[c]	64.9
Integrated Network Management System (46-32)[d]	7.8
Cabin Safety Research Facility (5X-XX)[e]	5.5

Note: Costs are current through 2003.

[a]This project is expected to provide surface surveillance and safety conflict alerting at incursion-prone airports (1) with a high percentage of general aviation operations, where capacity is not constrained, and (2) where complex runway/taxi configurations exist. Surveillance at these airports will be provided at a lower cost than that for ASDE-3 by use of commercial off-the-shelf alternatives. Conditional approval is pending additional information. Funding is planned for 1998-2001. (See sec. 3 for further information on ASDE-3.)

[b]This project is planned to convert FAA's voice telecommunications switch interfaces from analog to digital as much as is possible to increase efficiency, improve availability and restoration time, and improve capacity. Approval by FAA's Acquisition Review Committee is pending. Funding is planned for 1997-2001.

[c]This project will establish a new airport at the former Bergstrom Air Force Base, thus replacing the existing Robert Mueller Airport, which will be closed and converted to other purposes by the city of Austin, Texas. Approval by FAA's Acquisition Review Committee was granted in July 1994. Funding is planned for 1994-99.

[d]This project will establish telecommunications network control centers to consolidate the management and operation of FAA's telecommunications network. The Integrated Network Management System will automate the detection, isolation, and resolution of network problems before they affect end users' services. Funding is planned for 1996-97.

[d]Funding was reduced or deferred until after 2003 for approach control services formerly provided by DOD because of funding constraints. Project is still in early planning. Funding decisions will be made when project is further defined.

[e]Funding was reduced or deferred until after 2003 because of overall funding constraints.

[f]Funding for rehabilitation or replacement of various components of original ARTCC facilities as they become obsolete and require refurbishment was reduced or deferred until after 2003 because of funding constraints.

[g]Funding was terminated because capabilities can be addressed by Mode S project. (See sec. 3 on Mode S for further details.)

[h]Project was restructured to upgrade LLWAS-2 systems only because windshear requirements can be met in a more cost-effective manner by the ASR Weather Systems Processor, which enables an ASR radar to detect low-altitude windshear and microbursts in various regional climates.

[i]Funding was reduced or deferred until after 2003 for continued replacement of main and standby electrical power and grounding because of funding constraints.

[j]Funding was reduced to replace only 170 systems at international runways to meet the International Civil Aviation Organization's requirements.

Table 2.3: The 10 Projects Whose Total Estimated Costs Through 2003 Have Increased the Most Since Last Year

Dollars in millions

Project's name and CIP number	F&E estimate through 2003 (Nov. 1993)	F&E estimate through 2003 (Dec. 1994)	Change through 2003
Standard Terminal Automation Replacement System (STARS) (62-25)[a]	$412.8	$933.2	$520.4
Augmentation for Global Positioning System (GPS) (64-05)[b]	50.7	507.9	457.2
Advanced Automation System (AAS)(21-12)[c]	4703.4	5054.4	351.0
ITWS (63-21)[d]	138.9	250.7	111.8
Aviation Weather Products Generator (AWPG) (63-22)[e]	142.4	251.5	109.1
Aircraft Fleet Modernization (56-11)[f]	262.4	358.6	96.2
ASR Weather Systems Processor (64-13)[g]	3.0	73.6	70.6
Sustain Remote Maintenance Monitoring System (RMMS) (46-01)[h]	42.4	113.4	71.0
OAP (61-23)[d]	169.1	236.5	67.4
Weather and Radar Processor (WARP) (43-02)[i]	17.4	84.4	67.0

Note: Costs are current through 2003.

[a]1994 F&E estimate reflects terminal controllers' displays and related technical field support costs no longer funded under restructured AAS project. Also, requirements were expanded to include interfaces with TATCA, ITWS, ADL, and Traffic Flow Management.

[b]Reflects addition of WAAS (not previously in F&E). System enhances GPS to support en-route navigation and precision

[e]This project will construct a facility to allow FAA to perform research concerning an emergency evacuation of passenger-carrying aircraft; experiments must be able to be conducted in controlled situations without regard to weather and daylight conditions. Approval by FAA's Acquisition Review Committee was granted in May 1994. The project was not formally added to the CIP. Funding is planned for 1996-97.

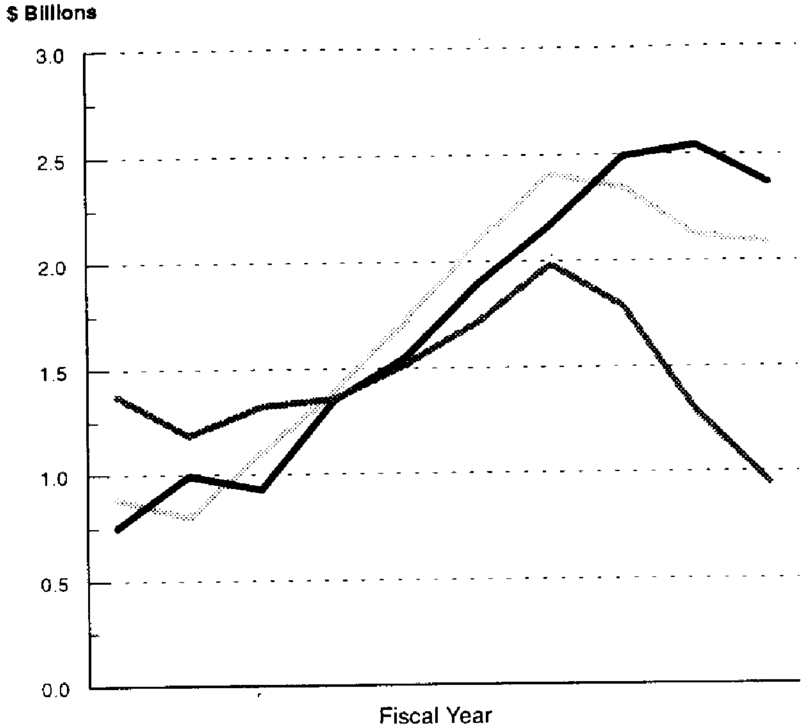
APPROPRIATIONS AND UNOBLIGATED F&E BALANCE DECREASED, WHILE FIRST-YEAR OBLIGATIONS LEVELED OFF IN 1994

FAA's F&E appropriations decreased in 1995. As indicated in figure 2.1, after increasing significantly since 1987, appropriations have decreased since 1993. One measure of the progress in modernizing the ATC system is the amount of F&E funding that FAA has obligated. Obligations involve awarding contracts, placing orders, and receiving services. In the past, the Congress has considered FAA's rising unobligated balance to be a sign of problems and an indication of weaknesses in financial and program management. FAA has been able to reverse the rise of unobligated balances in recent years.

FAA's unobligated F&E balance dropped by 28 percent during 1994, from $1.78 billion to $1.28 billion. As figure 2.1 shows, this decline in the unobligated balance occurred for the second straight year after a steady rise during the preceding 5 years. Last year, FAA predicted that during 1994, the unobligated balance would decline to $1.1 billion. Obligations for 1994 exceeded those for 1993 by $50 million, bringing total obligations for 1994 to $2.5 billion.

Figure 2.1 also shows FAA's projections that the unobligated balance will continue to decline during 1995 to $947 million, a decrease of $338 million--the lowest unobligated balance since 1984, when it stood at $1.1 billion. The agency expects obligations to also decline from $2.5 billion in 1994 to $2.4 billion by the end of 1995. FAA's Budget Office noted that one major factor leading to the decrease in unobligated funds is that the Congress limited the span of F&E appropriations to 3 years beginning in 1992. Both the 5-year 1990 appropriation and the 3-year 1992 appropriation expired at the end of 1994. In addition, the 5-year 1991 appropriation and the 3-year 1993 appropriation will both expire at the end of 1995. Another factor leading to the decline in unobligated funds is that $113.7 million of prior year unobligated balances was rescinded in 1993 and 1994.

Figure 2.1: FAA's F&E Appropriations, Obligations, and Unobligated Balances for 1986-95



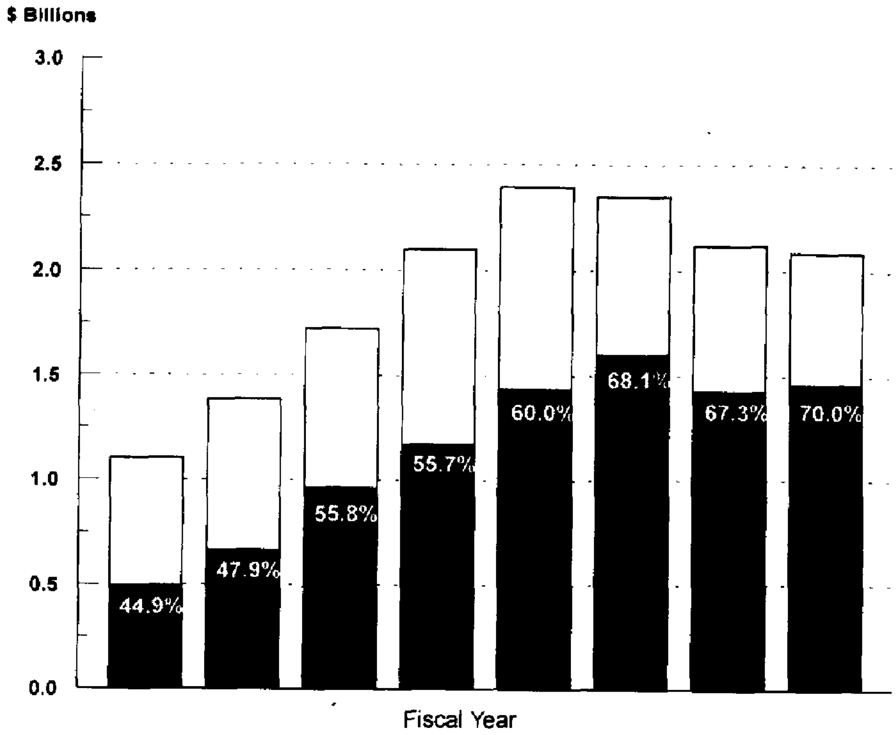
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995[a]
F&E Appropriation	0.9	0.8	1.1	1.4	1.7	2.1	2.4	2.4	2.1	2.1
FY Obligations	0.8	1.0	0.9	1.3	1.6	1.9	2.2	2.5	2.5	2.4
Unobligated Balance	1.4	1.2	1.3	1.4	1.5	1.7	2.0	1.8	1.3	0.9

[a]Figures for the 1995 obligation and unobligated balances are FAA's estimates.

Source: GAO's analysis of FAA's data.

Although the unobligated F&E appropriation declined, the percentage of annual appropriations that are obligated in their first year (also known as "first-year obligations") leveled off in 1994. The rate of first-year obligations decreased slightly from 68 percent in 1993 to 67 percent in 1994. FAA's Budget Office noted that a large increase occurred during 1992 and 1993 because the Congress limited the F&E appropriation to cover a 3-year period instead of a 5-year period. An FAA budget official stated that in the future, first-year obligations should remain around 70 percent. Figure 2.2 shows the first-year obligation rates since 1988.

Figure 2.2: F&E Appropriations and Percentage of First-Year Obligations



	1988	1989	1990	1991	1992	1993	1994	1995*
Obligated ■	0.50	0.66	0.96	1.17	1.44	1.60	1.43	1.46
Not Obligated □	0.61	0.72	0.76	0.93	0.96	0.75	0.69	0.63

Note: Percentage figures indicate the percentage of appropriations obligated in the first year of the appropriation cycle.

*The figure for first-year obligations for 1995 is FAA's estimate.

Source: GAO's analysis of data from FAA's Budget Office.

SECTION 3

INFORMATION ON THE STATUS OF 15 MAJOR PROJECTS

This section provides detailed information on changes in the costs and schedules for 15 of FAA's major acquisitions.[1] Costs for the 15 major projects represent more than 40 percent of FAA's 1996 F&E budget request. FAA is seeking $1.9 billion in this budget request--a 9-percent decrease below the 1995 appropriation. FAA has estimated that these projects represent about $11.1 billion in F&E appropriations over their lifetime.

Over the past year, the net estimated F&E cost of 11 of 15 major projects increased by $219 million. Seven of these projects increased by a total of $233 million. This increase was led by a $111.8 million increase in the cost of the Integrated Terminal Weather System (ITWS) because FAA added cost estimates for the entire project. Previously, only costs for the initial phase were included. The Voice Switching and Control System (VSCS) increased by $45.9 million because it will take more time to field the system with the DSR, a new component of the restructured AAS. Two projects decreased by a total of $14 million; this decrease was led by a $10.4 million decrease in the overall cost of FSAS. This was due in large part to a reduction of costs for the Operational Supportability and Implementation System (OASIS), an FSAS subproject designed to replace original equipment. Two projects did not change in cost, and four projects--WAAS and the En-Route, Terminal and Tower automation projects of the restructured AAS--did not have comparable cost data for the previous year.

The unobligated balance for 12 of the 15 projects in fiscal year 1994 totaled $230 million, accounting for 18 percent of the total F&E unobligated balance. Three projects had no unobligated balances.

Over the past year, first-site implementation[2] was delayed for

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[1]Five projects--Aeronautical Data Link, Integrated Terminal Weather System, OAP, TATCA, and WAAS--have been added to this report because of their importance to improving the ATC system. AAS has been restructured into three projects. A discussion of four projects previously reported on--Microwave Landing System, Airport Surveillance Radar-9, Radar Microwave Link, and Weather and Radar Processor--has been deleted from this report because of their termination or completion in 1995 or because they were not funded in 1995.

[2]"Implementation" is equivalent to "operational readiness demonstration." Implementation signifies that a system has been fielded and that the personnel who will use and maintain it are satisfied that it is ready for operation. Usually, commissioning

1 year or less for 5 of 15 projects. Of the remaining 10 projects, 3 had no schedule delays and 7 did not have established milestones in 1994 for comparison purposes. At the time we issued our report last year, first-site implementation was scheduled for Air Route Surveillance Radar-4 (ARSR-4) and TDWR during 1994. While this milestone was met months late for TDWR, ARSR-4 did not reach first-site implementation this past year.

Technical problems and site identification and preparation problems have caused both first- and last-site implementation schedule delays. In particular, technical problems have led to delays in ARSR-4, ASDE-3, VSCS, and Mode S. Site preparation problems continue to delay ASDE-3 and TDWR.

Table 3.1 provides summaries of the 15 major projects including the projects' (1) description and anticipated benefits, (2) cost and schedule changes, and (3) key progress and problems.

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soon follows implementation.

Table 3.1. Summary of Costs, Schedules, and Key Issues for 15 Major Projects

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1994	1995	Change
En-Route Automation Terminal Automation Tower Automation	- Replaces hardware, software, and controllers' workstations at en-route, terminal, and airport tower ATC facilities. - Replaces aging equipment, increases controllers' productivity, and accommodates projected growth in air traffic through the use of modern equipment and advanced software functions.	$7,634.2	$5,991.0	N/A[a] [a]Costs reflect items not previously part of AAS.
ADL	- Digital communications system that provides a variety of weather and ATC information between ground and airborne automation systems. - Improves two-way air-to-ground communications and contributes to the system's safety and capacity by enhancing accessibility to information, relieving congested voice frequencies, and reducing workloads.	221.3	221.3	None
ARSR-4	- Provides for long-range surveillance radar, en-route navigation, air defense, and drug interdiction. - Decreases costs by replacing older radars that have become difficult to maintain and reducing number of site operators required.	403.2	399.7	(3.5)
ASDE-3	- Enables tower controllers to monitor ground movement of aircraft and other vehicles during periods of low visibility and darkness. - Increases surface safety and capacity by replacing aging and less reliable radar equipment.	223.8	247.3	23.5

2-year comparison of first- and last-site implementation schedules	Key progress and problem issues
1994 1995 Change	
First-site: 10/96[b] 09/98[c] N/A **Last-site:** [d] 12/03[d] N/A[d] [b]Implementation date for ISSS. [c]Implementation date for DSR based on FAA's staying with Loral Corporation. [d]Implementation date for STARS. Schedule was not established in 1994.	- AAS restructured into three areas in June 1994 . - FAA conducted negotiations with Loral while also preparing for a new competitive procurement for restructured en-route system--Display System Replacement (DSR)-- as a contingency plan. In April 1995, FAA decided to stay with Loral. - Contract award for STARS planned for July 1996 through rapid procurement, contractor selection, and system development and deployment. - Contract modified for TCCC in April 1995.
First-site: 11/94 07/95 +8 months[d] **Last-site:** 02/98 05/99 +15 months[e] [d]Dates for Tower Data Link Services. [e]Dates for en-route data link.	- The total estimated cost remained at $221.3 million; however, FAA will have to approve additional funding for the program if plans for additional components such as a terminal data link and an oceanic data link are approved. - The en-route data link has been delayed because of changes to application software requirements, delays in the Mode S program, changing international routing protocols, and host data link specification changes.
First-site: 09/94 09/95 +1 year **Last-site:** 09/96 06/97 +9 months	- First-site implementation slipped by 1 year to September 1995 because of requests for changes in the design of the system under the contract, and interface problems with other ATC systems. - Last-site implementation slipped by 9 months to November 1996 because of interface problems with other ATC systems. Because of these problems, FAA will only allow eight ARSR-4s to be shipped until these problems are resolved.
First-site: 11/93 11/93 None **Last-site:** 11/95 11/99 +4 years	- ASDE-3 has been commissioned at 12 sites. Last-site implementation has been delayed 4 years to November 1999 because of systems added to the project, contract definitizing, and site selection and preparation problems. - The cadmium dust problem has been resolved. Multipath problems causing false targets continue.

3.1. Summary of Costs, Schedules, and Key Issues for 15 Major Projects (continued)

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1994	1995	Change
AWOS	- Obtains data such as wind velocity, temperatures, altimeter setting, cloud height, and visibility. - Processes and transmits weather data to pilots via a synthesized computer voice. - Improves safety at small, nontowered airports and reduces observation errors at larger airports.	$244.4	$255.3	$10.9
FSAS	- Improves pilots access to automated weather data and simplifies flight plan filing. - Increases flight service efficiency and mitigates cost of additional staff and facilities to meet demand for flight services.	550.9	540.5	(10.4)
ITWS	- Integrates data from terminal weather sensors such as TDWR and LLWAS to provide short-term automated weather information. - Improves predictions of short-term weather changes in easily understood graphical and textual form, enabling air traffic personnel to isolate terminal area weather hazards and improve flight safety.	138.9	250.7	111.8
Mode S	- Is a secondary surveillance radar that identifies, locates, and tracks aircraft by interrogating a device, called a transponder, on board the aircraft. Also provides a communication channel between the aircraft and ground facilities. - Improves safety by locating aircraft more accurately than current secondary surveillance radars and expands capacity.	438.2	450.9	12.7

2-year comparison of first- and last-site implementation schedules	Key progress and problem issues
1994 1995 Change	
First-site: 07/89 07/89 None **Last-site:** Indefinite 12/97 N/A	- Costs continue to grow for the overall AWOS project because of a renegotiated delivery schedule in response to a $10 million cut in 1994. - FAA has purchased all 200 AWOS units ordered so far. FAA has installed 189 units and commissioned 181. State environmental regulations caused last-site implementation to slip. - Automated Surface Observing System (ASOS) first-and last-site implementation schedule slipped because of technical problems and deficiencies, logistic problems, and restructuring of the project.
First-site: N/A 05/98 N/A[f] **Last-site:** N/A 05/01 N/A[f] [f] These are the dates for the OASIS/NextGen schedule. Last year, we used the schedule for FSAS Model 1 Full Capacity equipment.	- Model 1 Full Capacity equipment has been accepted at all and commissioned at 59 of the 61 Automated Flight Service Stations (AFSSs). The supportability of Model 1 Full Capacity equipment remains a concern. - FSAS costs decreased mainly because of an $8.2 million cost decrease in the OASIS project. FAA is rescoping the OASIS and NextGen projects. This effort has resulted in a 7-month schedule delay.
First-site: 09/99 03/00 +6 months **Last-site:** 09/00 06/01 +9 months	- ITWS costs increased to $250.7 million for the entire project, versus $138.9 million for initial operating capability only. - ITWS successfully completed demonstration and validation in August 1994. Because of algorithm development and other issues, first-site implementation has slipped about 6 months and last-site implementation has slipped about 9 months.
First-site: 03/94[g] 03/94[g] None **Last-site:** 12/96 12/96 None [g] Date for initial Mode S capability for terminal sites.	- Mode S costs increased by $12.7 million to fund system enhancements and continued software development, anticipated contractor claims, and additional site installation costs. - FAA has pushed back the schedule for many portions of the third phase of Mode S--the en-route Mode S systems. The estimated date for implementing the first en-route Mode S system was delayed by 1 year to December 1995. However, the December 1996 date for implementing the last site has not been changed.

Table 3.1. Summary of Costs, Schedules, and Key Issues for 15 major projects (continued)

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1994	1995	Change
OAP	- Combines into a common system, hardware and software packages from various systems under development to improve the automation of ATC over the oceans. - Improves traffic flow while promoting maximum fuel efficiency and minimal travel times.	$216.6	$236.5	$19.9
TATCA	- Provides controllers with several new automated tools to better sequence, space, and schedule time of arrival and departure of aircraft. - Addresses present-day needs for increased airport capacity through the introduction of new technology and automation aids.	138.0	138.0	None
TDWR	- Detects hazardous weather around airports, such as microbursts, gust fronts, wind shifts, and precipitation. - Promotes safety by providing alerts of hazardous weather conditions in terminal areas and of changing wind conditions that influence runway usage.	373.3	380.9	7.6
VSCS	- Replaces and improves voice ground-to-ground and air-to-ground communications at ATC facilities. - Increases controllers' efficiency in handling air traffic.	1,407.0	1,452.9	45.9
WAAS	- Enhances GPS, a satellite-based system that provides precise time and position information to aircraft. WAAS augments GPS' signals so that the system can satisfy civil air navigation requirements. - GPS, in conjunction with WAAS, will support all phases of flight.	No official cost estimates in 1994.	512.6	N/A

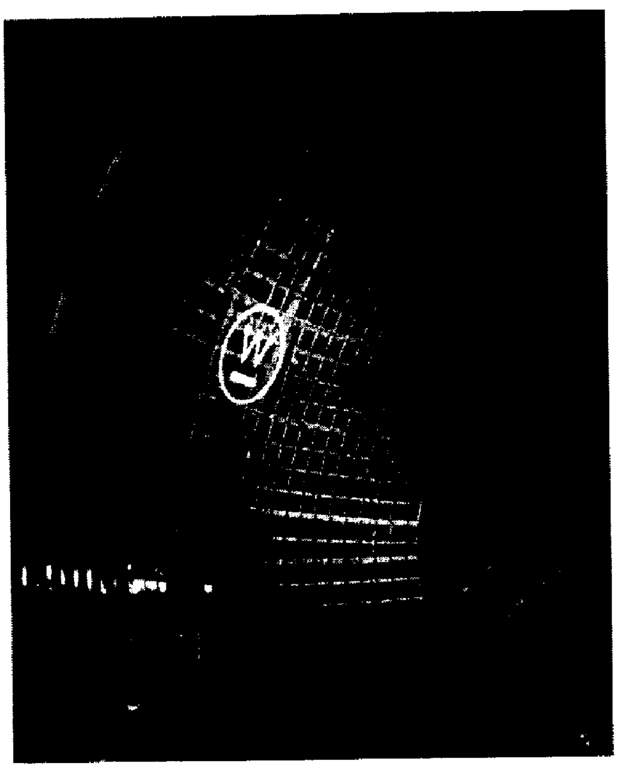
2-year comparison of first- and last-site implementation schedules			Key progress and problem issues
1994	1995	Change	
First-site:			- Oceanic ATC is designed to evolve from the current Oceanic Display and Planning System (ODAPS) into the Oceanic Automation System (OAS), and eventually into the Advanced Oceanic Automation System (AOAS).
Indefinite	Indefinite	N/A	
Last-site:			- The contract for the AOAS, known as the Oceanic System Development and Support (OSDS) contract, will be awarded in the summer of 1995.
Indefinite	Indefinite	N/A	
First-site:			- FAA is implementing one element of TATCA, field evaluating a second element, and researching the third and final element.
Indefinite	12/97	N/A	
Last-site:			- FAA plans to award the contract for the second TATCA element, the Center/TRACON Automation System (CTAS), in January 1997.
Indefinite	Indefinite	N/A	
First-site:			- Last-site implementation remains indefinite. TDWR has experienced schedule delays because of site availability and land acquisition problems.
04/94	07/94	+3 months	
Last-site:			- The estimated cost of TDWR increased by $7.6 million because of schedule delays. TDWR is planned for 47 locations. Sixteen have been delivered, 3 have been commissioned, and 1 used for training is fully operational.
Indefinite	Indefinite	N/A	
First-site:			- Project costs will increase by $45.9 million due to FAA's recent decision to cancel the ISSS segment of the AAS project and replace it with DSR.
04/95	06/95	+2 months	
Last-site:			- The projects schedule will slip because of continued software development problems found in testing. Moreover, FAA's recent AAS program decisions will reduce the number of needed VSCS production systems.
07/98	01/00	+18 months	
First-site:			- FAA is reviewing proposals submitted by different vendors.
[h]	09/97	N/A	
Last-site:			- FAA expects to award a contract to develop and implement WAAS by May 1995.
[h]	06/01	N/A	

[h]Schedules were not established in 1994.

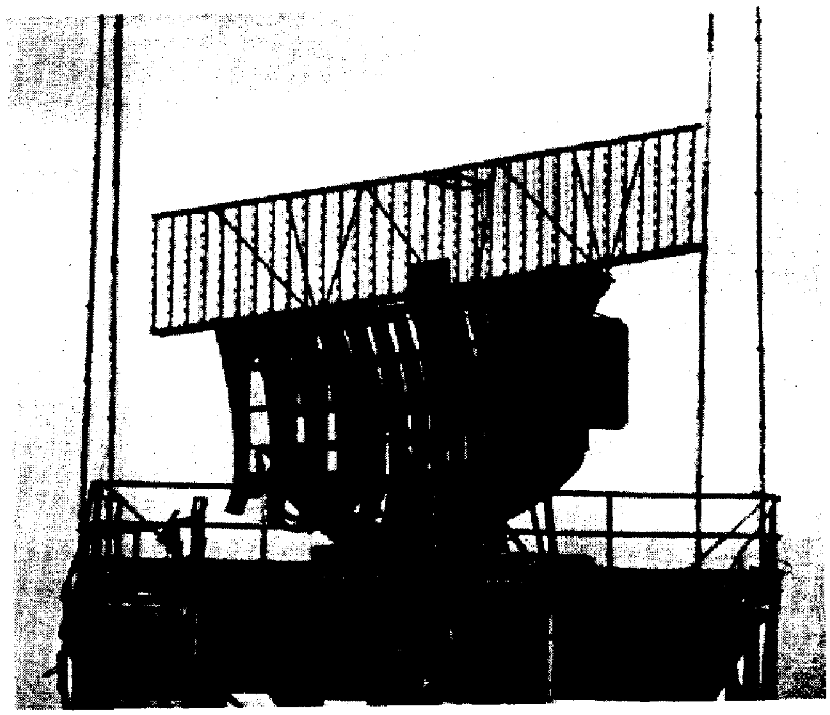
Figure 3.1: ATC Modernization Projects

Planned configuration of the Tower Control Computer Complex (TCCC).

TCCC controller workstation.

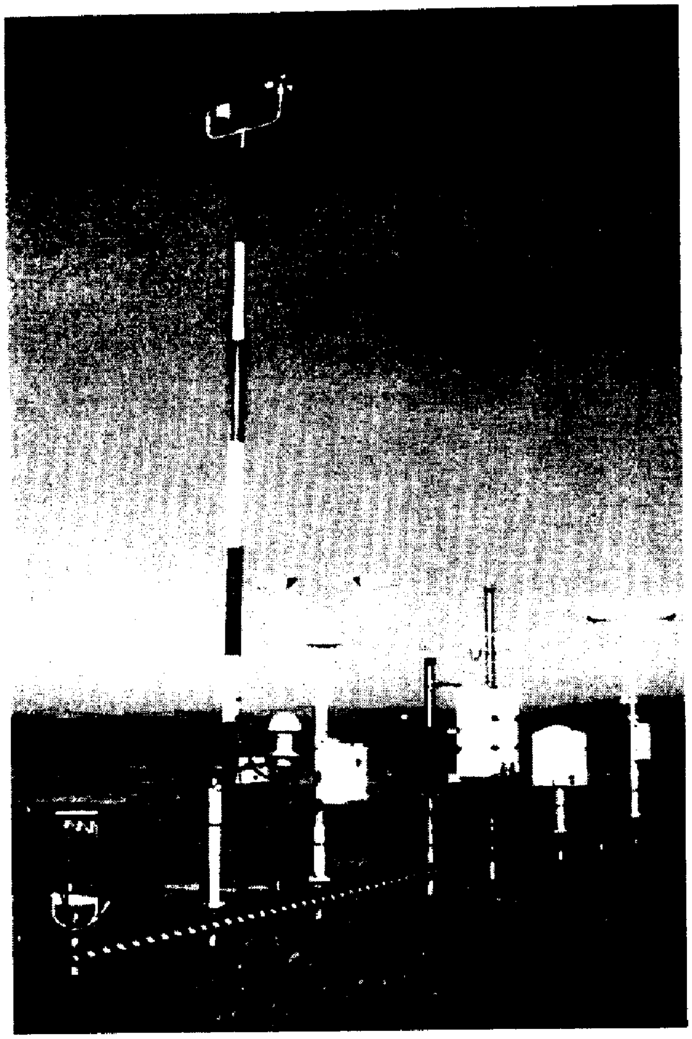


Air Route Surveillance Radar-4.



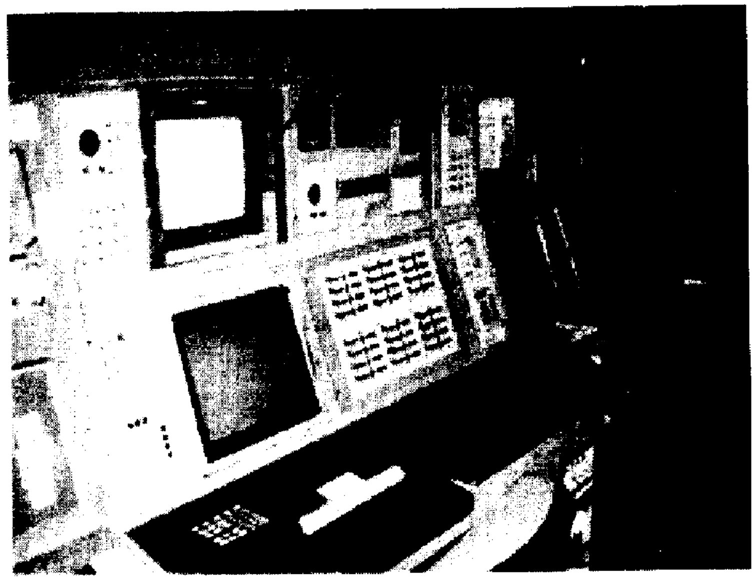
Mode S radar antenna mounted on Air Surveillance Radar-9.

Source: FAA.



Automated Surface Observing System.

Source: National Weather Service.



Current Flight Service Automation System.

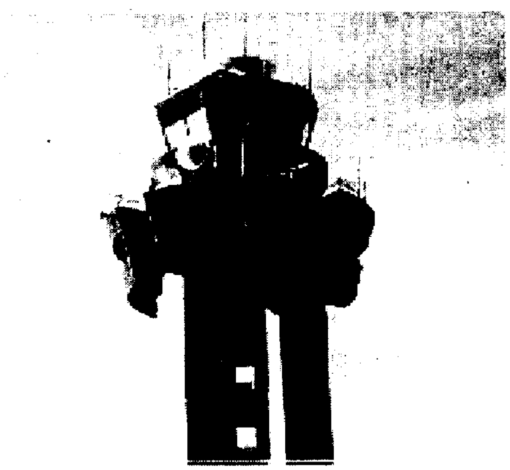
Terminal Air Traffic Control Automation's Converging Runway Display Aid.

Source: FAA.

Terminal Doppler Weather Radar.

Voice Switching and Control System display module.

Source: FAA.



Rotodome containing ASDE-3 radar on top of ATC tower.

CHANGES FROM ORIGINAL COST ESTIMATES FOR MAJOR ACQUISITIONS

We compared original and current cost estimates for 11 of the 15 major acquisitions. Starting with each project's inception, seven projects' cost estimates have increased while four have decreased. The En-Route, Terminal, Tower, and WAAS projects were not included because they do not have cost data comparable to previous years' data. Table 3.2 focuses on the changes in cost and the number of planned units.

Table 3.2: Changes in Cost for 11 Major Projects

Project	Date of original cost estimate	Original F&E costs	Original planned units	Current F&E costs	Current planned units
ADL	1991	247.0	24 DLPs/57 TDLS	221.3	24 DLPs/57 TDLS
ARSR-4	1983	425.8	48 radars	399.7	40 radars
ASDE-3	1983	83.2	21 radars	247.3	40 radars
AWOS	1983	160.7	700 units	255.3	737 units
FSAS	1983	305.1	61 stations	394.2[a]	61 stations
ITWS	1993	138.9	47 systems	250.7	37 systems
Mode S	1983	487.2	197 systems	450.9	137 systems[b]
OAP	1993	169.1	3 systems	236.5	3 systems
TATCA	1990	137.0	[c]	138.0	[c]
TDWR	1986	550.0	102 radars	380.9	47 radars
VSCS	1983	258.6	25 units	1452.9	23 units

[a]For comparison purposes, costs reflect the original FSAS project only. Costs for the replacement project, which includes OASIS/Next Generation FSAS, are not included.

[b]Eleven additional Mode S units have been purchased under the Interim Support Plan project.

[c]Exact number of units has not been determined yet because the project is still being prototyped.

CHANGES IN SCHEDULES FOR MAJOR ACQUISITIONS

During the last several years, implementation schedules for several major projects have continued to slip. We compared the original estimated implementation schedules with the current schedules for 9 of 15 major acquisitions. From project inception, first-site implementation for 9 projects was delayed from 1 to 7 years--an average of 5 years. We did not compare the remaining six projects with previous schedules because (1) the WAAS project is new this year, (2) first-site implementation dates had not been established for OAP and TATCA in 1994, and (3) data from previous years are not comparable for the en-route, terminal, and tower projects because of AAS' restructuring. Table 3.3 focuses on the milestones that estimate when the first and last system will be implemented.

Table 3.3: Changes in Implementation Milestones for Nine Major FAA Projects

	First-site implementation			Last-site implementation		
Project	Year		Years delayed	Year		Years delayed
	Original estimate	1995	Original estimate to 1995	Original estimate	1995	Original estimate to 1995
ADL	1993	1995	2	1998	1999	1
ARSR-4	1988	1995	7	1991	1997	6
ASDE-3	1987	1993	6	1990	1999	9
AWOS	1986	1989	4	1990	1997	7
ITWS	1999	2000	1	2000	2001	1
FSAS	1984	1991	7	1989	1995	6[a]
Mode S	1988	1994	6	1993	1996	3
TDWR	1992	1994	2	1998	[b]	N/A
VSCS	1989	1995	6	1992	1997	5[c]

[a]For comparison purposes, schedule reflects the original FSAS project only. Schedule for replacement projects currently included in FSAS such as OASIS/NextGen is not reflected in the table.

[b]Current last-site implementation date is indefinite.

[c]For comparison purposes, schedule reflects the project's first phase, when systems are scheduled to be installed in the existing en-route controller workstation. Schedule for the project's second phase, when the system will interface with new en-route systems, is not reflected in the table.

PROGRESS AND PROBLEMS ASSOCIATED WITH THE 15 MAJOR PROJECTS

The following summaries of the 15 major projects we reviewed identify changes in each project's cost and schedule, cite reasons for the changes, and describe the progress and problems encountered in each project since we issued our last report in April 1994.[3]

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[3]Air Traffic Control: Status of FAA's Modernization Program (GAO/RCED-94-167FS, Apr. 15, 1994).

Air Traffic Systems Development/En-Route, Terminal, and Tower Projects

The Air Traffic Systems Development Program includes the former AAS restructured into three areas: en-route, terminal, and tower. The FAA Administrator initiated this action in June 1994 to solve long-standing AAS cost, schedule, and technical problems. FAA's total estimated cost for the new restructured Air Traffic Systems Development Program is about $6.0 billion, which includes about $4.5 billion for en-route, $1.3 billion for terminal, and $259 million for tower areas. The cost to complete AAS and other related projects could have cost as much as $7.6 billion.[4]

AAS, first conceived more than a decade ago, was the centerpiece of FAA's program for long-term capital investment to modernize the nation's ATC system. As originally designed, AAS would replace existing display and computer systems. It also would have allowed FAA to consolidate 203 TRACONs and 20 ARTCCs into 23 Area Control Facilities (ACFs) by implementing five distinct segments. These segments included the Peripheral Adapter Module Replacement Item (PAMRI), which is a communications computer that connects en-route centers with external systems, such as radar; the Initial Sector Suite System (ISSS), which would have replaced existing en-route controller workstations; the Terminal Advanced Automation System (TAAS), which would have provided TRACON controllers with new workstations similar to the ISSS workstations; the Tower Control Computer Complex (TCCC), designed to replace hardware and software at selected ATC towers; and the Area Control Computer Complex (ACCC), a series of hardware and software enhancements and integration efforts that would have replaced the existing Host computer and would build upon the ISSS systems in the en-route centers and allow for their conversion to ACFs. AAS also included advanced, Automated En-Route ATC (AERA) software that is expected to provide controllers with tools to identify and resolve potential airspace conflicts. Only PAMRI--the least complex of all the segments--was completed.

The AAS design competition between IBM and Hughes Corporation lasted from 1984 to 1988. In 1988, FAA awarded an AAS acquisition contract to IBM. Shortly thereafter, design and development problems began to appear. In December 1990, IBM confirmed a 19-month slippage in the program. In November 1992, IBM announced a second slip of 14 months. Total AAS cost estimates rose from $2.5 billion in 1983, when AAS was introduced, to $4.8 billion in 1988 and $5.1 billion in 1992.

At Congress' direction, FAA studied alternatives for consolidation, including those not relying on AAS. In December 1992, the FAA Administrator announced a limited consolidation plan.

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[4]Air Traffic Systems Development Program also includes other separate CIP projects, such as Oceanic Automation. For purposes of this report, we are limiting our discussion to projects comparable to AAS.

Under limited consolidation, FAA planned to implement TAAS in 9 Metroplex Control Facilities (MCFs) that would consolidate 33 TRACONS and deploy a new stand-alone TRACON system to the remaining 170 TRACONs. ARTCCs would transition from ISSS directly to ACCC but would not perform any terminal ATC functions. TCCC was scaled back to more closely match automation capabilities to requirements. However, in late 1993, FAA determined that AAS' costs would increase to $5.9 billion. As a result, the new FAA Administrator directed three studies. One study--an internal FAA review of AAS' cost and schedule--indicated the likelihood of an additional schedule slip of about 20 months for ISSS and cost growth of another $1 billion. A second study conducted by the Center for Naval Analyses recommended that FAA revalidate AAS requirements. The final study conducted by an FAA automation strategy team developed alternative strategies for ATC modernization. In June 1994, on the basis of these studies' results, the FAA Administrator ordered major changes to the AAS contract and the establishment of the Air Traffic Systems Development organization, which includes several projects for modernizing ATC facilities, such as en-route, terminal, and tower.[5]

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[5]The new program is described in FAA's February 3, 1995, Office of Air Traffic Systems Development Program Master Plan in accordance with our recommendations and the House and Senate Subcommittees on Transportation and Related Agencies, Committees on Appropriations.

VENDORS: Loral Corporation, Rockville, Maryland

FINANCIAL INFORMATION

Dollars in millions	AAS FY 1994	En-route FY 1995
PAMRI	$46.4	$46.4
DCCR		30.0
DSR		1,055.3
ISSS	2,974.8	1,770.8 (sunk)
AERA	343.7	473.2
Host/EDARC Replacement		657.0
ACCC	803.5	19.0 (sunk)
ARTCC Modernization	413.9	413.9
Total estimated F&E costs as of	$4,582.3	$4,465.6
Cumulative F&E funds appropriated through	2,258.3	2,550.2
Unobligated F&E funds through	22.6	[a]

SCHEDULE

	FY 1994	FY 1995
Estimated first-site implementation as of	10/96[b]	9/98[c]
Estimated last-site implementation as of	Mid-1998[b]	1/00[c]

Legend

DCCR = Display Channel Complex Rehost
EDARC = Enhanced Direct Access Radar Channel

[a]Data will not be available until after fiscal year 1995.
[b]Implementation dates for ISSS.
[c]Implementation dates for DSR are based on FAA's staying with Loral.

Background

The ISSS segment of AAS was designed to replace existing controllers' work stations at en-route centers. ACCC was the segment of AAS that would consolidate ISSS and TAAS into 23 ACFs.

ACCC would also allow FAA to implement AERA software, which was designed to give controllers more tools to identify and resolve potential airspace problems. However, in response to ISSS' schedule delays and projected cost increases announced in December 1990 and again in November 1992, FAA revised its plans for ACCC. ACCC became a series of software enhancements and integration efforts that would replace the existing Host computer and build upon the ISSS systems in the ARTCC. ACCC would also no longer consolidate en-route centers and TRACONs.

With ISSS facing added cost overruns and schedule delays in late calendar year 1993, the FAA Administrator suspended funding for ACCC in early calendar year 1994 until a review of AAS' requirements was completed and announced that some AERA benefits would be introduced earlier than anticipated with ISSS.

Progress and Problems

A review of AAS' requirements led the FAA Administrator to announce, in June 1994, a restructuring of the project. ACCC was terminated, and ISSS was scaled back and renamed the DSR. DSR is expected to begin replacing en-route hardware and software by September 1998. FAA also hopes that DSR will provide the platform for adding more advanced capabilities. After FAA implements DSR, it plans to introduce an initial AERA capability in 1999. Additionally, FAA added a Display Channel Complex Rehost project, which is an insurance program that will execute old computer software on a new commercial off-the-shelf computer in the event that DSR cannot be fielded before the existing display channel reaches a critical point. In 2001, FAA also will add an enhanced Direct Access Radar Channel Replacement project to provide an up-to-date automation backup infrastructure to all en-route centers. In 2002, the Host computer is scheduled to be replaced to increase capacity.

Initially, FAA did not know whether it would acquire DSR from Loral or from another vendor. As a result, FAA conducted negotiations with Loral while also preparing for a new competitive procurement as a contingency plan. In April 1995, FAA decided to stay with Loral.

While FAA's decision to stay with Loral provides no cost advantage over recompeting, FAA believes that staying with Loral is superior in terms of schedule. FAA estimates that DSR can be delivered 2 years earlier--in 1998 versus 2000--if FAA stays with Loral because of its knowledge of the project and work completed to date. FAA's decision to stay with Loral was based on a review of Loral's DSR technical and cost proposals and the results of a Lincoln Laboratory assessment of Loral's ability to deliver DSR.

We reported last year that with almost 2,100 unresolved program trouble reports (PTRs) and 100-percent software volatility, ISSS software was immature--on average, each line of code had to be rewritten once. Furthermore, the Software Engineering Institute and Lincoln Laboratory reported that while ISSS' software architecture was good, the code was only fair, and the software documentation was poor. According to Loral officials, progress is being made to stabilize the ISSS baseline, which is expected to comprise about 80 percent of the DSR code, excluding commercially available software. As evidence, they cite that as of February 1995, outstanding PTRs had decreased from 2,100 to 585.

Despite this, the stability of en-route software development remains an issue for several reasons. First, over 1,000 PTRs were set aside only because they relate to ISSS software that will not be part of DSR. Second, about 25 percent of the DSR software will consist of either modified or new code. Modifying or adding code can affect countless lines of unmodified code and thus open the door for more software problems. Third, defects arising from software inspections and documentation reviews are not included in the PTR count, thus masking the full extent of the outstanding software problems. Fourth, FAA has begun working with Loral to reclassify the outstanding ISSS PTRs and has established a goal of having no PTRs in the most critical two categories. However, after the reclassification of about 200 PTRs, over 100 have already been assigned to the most critical categories.

FAA needs to avoid past mistakes and not spend sizeable sums of money before it can determine that the system will meet its needs. Last year, FAA found out only after spending $1.8 billion that the program was in "dire straights." FAA is planning to spend about $584.7 million of the estimated $1.1 billion in total costs for DSR before it completes operational testing and before it can determine if the system meets its needs. The government accepts substantial risk with this up-front funding of an acquisition.

In October 1994, the General Service Administration (GSA), the federal agency responsible for computer acquisitions, expressed several concerns about FAA's decision to stay with Loral. GSA's concerns about FAA's approach to DSR are that the agency will not (1) achieve significant cost savings, (2) achieve early deployment as planned, or (3) adequately address the DSR program risks. Moreover, FAA may be restricting itself from obtaining new ATC technology. Without recompetition, GSA believes that FAA may not be able to take advantage of all of today's ATC innovations.

The contract for AERA is currently scheduled to be awarded in December 1995. However, in November 1994, FAA suspended work on AERA. AERA staff resources were assigned to the DSR effort because program officials believed that the DSR effort needed additional staff resources to meet the project's scheduled milestones. The suspension of the AERA effort could jeopardize the scheduled AERA contract award date.

TERMINAL

VENDOR: None at this time.

FINANCIAL INFORMATION

Dollars in millions	AAS FY 1994	Terminal FY 1995
TAAS	$810.1	$317.2(sunk)
TAAS/MCFs	106.6[a]	
STARS	599.1[a]	940.2
Automated Radar Terminal System (ARTS)IIIE		8.8
Total estimated F&E cost as of	$810.1	$1,266.2
Cumulative F&E appropriations through	$251.6	$333.0
Unobligated F&E funds through	$3.0	[b]

SCHEDULE

	FY 1994	FY 1995
Estimated first-site implementation as of	8/97[c]	12/98[d]
Estimated last-site implementation as of	Indefinite[c]	12/03[d]

[a]This item was not included previously as part of AAS.
[b]Data will not be available until after 1995.
[c]Implementation dates for TAAS.
[d]Implementation dates for STARS

Background

The TAAS segment of AAS was designed to be the automation platform for consolidated terminal facilities that support ATC operations within about 50 miles of an airport. As originally planned, TAAS was to be an interim step in the consolidation of 203 TRACONs into 23 ACFs. However, following FAA's December 1992 limited consolidation decision, TAAS was redesigned from an interim system to one that would "stand alone." Under limited consolidation, FAA planned to combine 33 TRACONs into 9 MCFs, each of which would receive a TAAS. The remaining 170 TRACONs would be accommodated through the new STARS; FAA intends to make maximum usage of industry-developed off-the-shelf software systems and components to develop STARS.

Progress and Problems

In June 1994, the FAA Administrator approved the termination of TAAS and expanded STARS to include all terminal facilities. FAA has $68.6 million of appropriated 1995 funds available for TAAS' termination.

The STARS acquisition is in its infancy. According to the project manager, it is oriented toward efficient contractor selection and rapid system development and deployment. Preliminary system requirements were released to industry for comment in September 1994. At this same time, FAA conducted a market survey to gain a better understanding of the maturity of current technologies as they apply to terminal automation system requirements. In the first quarter of 1995, FAA will be evaluating vendors on the basis of the extent to which their commercial off-the-shelf/nondevelopmental systems meet FAA's requirements. Later, prospective vendors may be asked to provide a system for test and evaluation at the FAA Technical Center. In August 1995, FAA plans to release the STARS request for proposal. The contract's award is scheduled for August 1996.

TOWER

VENDOR: Loral Corporation, Rockville, Md.

FINANCIAL INFORMATION Dollars in millions	AAS FY 1994	Tower FY 1995
Total estimated F&E cost as of	$ 541.3	$ 259.2
Cumulative F&E appropriations through	76.7	121.7
Unobligated F&E funds through	0	[a]

SCHEDULE	FY 1994	FY 1995
Estimated first-site implementation as of	10/96	4/97[b]
Estimated last-site implementation as of	Indefinite[c]	12/00[b]

[a]Data will not be available until after 1995.
[b]Implementation dates for High Availability Basic TCCC.
[c]Date not established.

Background

The TCCC segment of AAS replaces hardware and software at selected ATC towers. (See fig. 3.1.) Originally, TCCC was to be deployed at 258 sites. However, in 1992, FAA scaled back TCCC to 150 sites as the program faced funding uncertainties and assorted operational issues that could delay the program's completion. FAA also decided at that time to deploy TCCC in multiple phases. The first phase would introduce a basic version, called TCCC Type 3, in October 1996. Subsequently, the Type 3 version would be upgraded to more sophisticated Type 2 or Type 1 versions within a 2-year time period.

Progress and Problems

Under FAA's restructured AAS program, announced in June 1994, TCCC will now be procured for approximately 70 towers. Only the Type 3 TCCC will be acquired, but it will include higher availability requirements than originally planned and additional interfaces to other systems. As a result, FAA revised downward its total estimated cost for TCCC by $282.1 million. FAA has an option to procure 80 additional systems.

In December 1994, FAA received Loral's high-availability basic TCCC contract adjustment proposal. FAA and Loral negotiated the contract modification in April 1995. TCCC system testing at the Technical Center is scheduled for December 1995. According to the project manager, TCCC faces no major technical challenges.

AERONAUTICAL DATA LINK (ADL)

VENDORS: Arcon Corporation, Waltham, Mass.
Computer Sciences Corporation, Calverton, Md.
GTE Contel Federal Systems, Chantilly, Va.
Aeronautical Radio Corporation, Annapolis, Md.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$221.3	$ 221.3	None
Cumulative F&E appropriations through	92.6	116.4	$23.8
Unobligated F&E funds as of	1.6	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first site implementation (Tower Data Link Services) as of	11/94	07/95	+8 months
Estimated last site implementation (en-route data link) as of	02/98	05/99	+15 months

[a]Data will not be available until after fiscal year 1995.

Background

The Aeronautical Data Link (ADL) is designed to provide digital data link communications between ground and airborne automation systems. Other important projects such as TATCA and Airport Movement Area Safety System (AMASS) will depend on ADL for data link services. ADL is expected to give pilots direct access to weather and ATC information and reduce voice communications errors. ADL now comprises two major components--the en-route data link and Tower Data Link Services (TDLS). Other components such as terminal data link and oceanic data link are in the planning stages.

The en-route data link consists of three elements--(1) the Data Link Processor (DLP), (2) a software upgrade for the Data Link Processor, and (3) the Host Data Link. The DLP is designed to provide six basic weather products via Mode-S. The software upgrade for the DLP will enable the en-route data link to provide additional weather services, such as wind shear detection via Mode S, communication satellites, or very high frequency radio. Also included in the software upgrade will be a message router that complies with Aeronautical Telecommunication Network (ATN)[6] standards. The Host Data Link will enable the en-route data link to transmit ATC clearances and information to ATN-equipped aircraft. FAA plans to acquire 24 en-route data link systems--22 for ARTCCs, 1 for the FAA Academy, and 1 for the FAA Technical Center.

TDLS is designed to provide Pre-Departure Clearance (PDC) to aircraft and to combine Flight Data Input Output (FDIO) and PDC functions on a single platform. It will also provide the capability for data link deliveries of Automatic Terminal Information Service[7] (ATIS) messages via the Digital ATIS with Automatic Voice Generation application. FAA plans to upgrade the present 30 Pre-Departure Clearance systems and add 27 additional ATC tower sites to the TDLS program. TDLS is an interim system that will be replaced without loss of functionality by the TCCC.

ADL Progress and Problems

The total estimated cost of the ADL program has not increased, but the schedules for both the en-route data link and TDLS have slipped during the past year. FAA will have to obtain additional funding for the project if plans for additional ADL components--such as the terminal and oceanic data links--are approved.

FAA has procured 25 en-route data link DLP units--20 for use at ARTCCs and 5 for support purposes. The DLP passed factory acceptance testing and has been demonstrated to work with Mode S. However, formal Operational Test and Evaluation (OT&E) has not been completed, and ORD was deferred because of DLP application software requirement changes and delays in the Mode S project. FAA did not deploy these 25 systems as originally planned; instead, 18 DLP units are being stored until they can be used with a software upgrade, and 7 DLP units are being used for application software development, testing, and training.

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[6]The ATN is a data network being developed to provide a link between many U.S. and international airlines and FAA for exchange of flight plans, weather data, distress messages, and other data. The ATN will provide the air-ground data link communications required by other projects such as AAP and TATCA.

[7]ATIS automates the voice broadcasts put out by major airports around the world. These broadcasts contain important information about current weather, airport, and facility conditions.

The software upgrade for the DLP is being developed, but FAA has had to make major changes in its effort to adjust for changing international routing protocols for the ATN. FAA is currently considering a proposal from the contractor for completion of the software upgrade; additional contract costs will not be projected until negotiations with the contractor are complete. The development of the Host Data Link has been slowed by the need to make extensive specification changes designed to make the en-route data link compatible with the en-route ATC system and procedures.

OT&E for the DLP software upgrade and the Host Data Link is scheduled for November 1996 and August 1997, respectively. OT&E for the complete en-route data link system is scheduled for October 1997. First-site implementation for the complete en-route data link system is scheduled for May 1998.

OT&E for TDLS with PDC/FDIO is scheduled for May 1995. First and last ORD are scheduled for July 1995 and February 1996, respectively. OT&E for the full TDLS system, including digital ATIS with Automatic Voice Generation, is scheduled for January 1996. First and last ORD are scheduled for February 1996 and August 1996, respectively.

AIR ROUTE SURVEILLANCE RADAR (ARSR-4)

VENDOR: Westinghouse Electric Company, Baltimore, Md.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$403.2	$399.7	$(3.5)
Cumulative F&E appropriations through	360.1	374.1	14.1
Unobligated F&E funds through	65.2	[a]	[a]

SCHEDULE

	FY 1994	FY 1995	Change
Estimated first-site implementation as of	09/94	09/95	+1 year
Estimated last-site implementation as of	09/96	06/97	+9 months

[a]Data will not be available until after fiscal year 1995.

Background

ARSR-4 is a long-range primary surveillance radar that is intended to track en-route aircraft and weather by emitting radio signals that are reflected back to the radar. (See fig. 3.1.) Data from ARSR-4 will then be transmitted to en-route centers. FAA has procured 40 ARSR-4 units. Thirty-nine of these radars will be placed along the perimeter of the United States and will assist in en-route navigation, air defense, and drug interdiction. One radar will be used for field support and training in Oklahoma City, Oklahoma.

ARSR-4 Progress and Problems

The estimated total cost of the ARSR-4 decreased by $3.5 million to $399.7 million. Estimated costs for implementing the 40th FAA ARSR-4 site in northern Maine decreased from $20 million to $16.5 million. FAA plans to spend $25.5 million in 1996 and 1997 for implementation and cleanup activities at the ARSR-4 sites. In the first quarter of 1995, the program office obligated $37.2 million of the $65.2 million in unobligated funds from 1994.

According to the program manager, during the past year, ARSR-4's first-site implementation was delayed by 1 year--from September 1994 to September 1995--because of changes in the system's design and interface problems between ARSR-4 and other ATC systems that were noted during OT&E. All portions of development test and evaluation (DT&E), including reliability testing and a maintainability demonstration, were completed by August 1994. The ARSR-4 program manager expects OT&E to be completed by mid-July 1995. Completion of OT&E has slipped 11 months so that the corrections that were required to solve interface problems can be fully tested. Correction of the interfaces resulted in software modifications, thus further delaying OT&E and first-site implementation. In addition, regression testing needs to be conducted to verify that changes made to correct the discrepancies found during OT&E did not affect previously tested parameters.

Because of delays in first-site implementation, FAA will allow only eight ARSR-4s to be shipped until a deployment readiness review (DRR) is completed in August 1995. The remaining radars will be shipped after the DRR is completed. The ARSR-4's last-site implementation date slipped by 9 months--from September 1996 to November 1996--as a result of the same delays for first-site implementation.

Originally, FAA planned to replace 10 ARSR-3s with 10 ARSR-4s and then move the ARSR-3s to the interior of the United States to replace older radars or to provide coverage at new sites. However, FAA is still evaluating whether to continue with this program, known as ARSR-3 Leapfrog, because funding at this time is not available. FAA now plans to dismantle and store the ARSR-3s after the ARSR-4s are commissioned. An ARSR-4 program official stated that no final decision has been made on what FAA will ultimately do with the 10 ARSR-3s.

AIRPORT SURFACE DETECTION EQUIPMENT-3 (ASDE-3)

VENDOR: Norden Systems, Inc., Norwalk, Conn.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$223.8	$247.3	$23.5
Cumulative F&E appropriations through	216.8	223.8	7.0
Unobligated F&E funds as of	40.8	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation as of	11/93	11/93	None
Estimated last-site implementation as of	11/95	11/99	+4 years

[a]Data will not be available until after fiscal year 1995.

Background

The ASDE-3 is a primary radar designed to provide tower controllers with surveillance information on the aircraft and other vehicle operations on runways and taxiways in all weather conditions. (See fig. 3.1.) FAA developed these radars to replace the aging and less reliable ASDE-2 radars. Project officials said that they are procuring a total of 40 ASDE-3 systems--33 under the original contract with Norden Systems and 7 under a letter contract also with Norden signed in September 1993. Twenty-eight of the 40 systems will be located on top of ATC towers. The remaining 12 will be remote systems located on top of other towers or structures on airport land.

ASDE-3 Progress and Problems

During the past year, the cost of the ASDE-3 project increased by $23.5 million so that auxiliary items could be procured and installed and contract options could be exercised for remote systems. The $23.5 million will be split for use in 1996 and 1997--$8.8 million and $14.7 million, respectively.

According to project officials, part of the unobligated balance of $40.8 million that exists for ASDE-3 is due to the fact that under federal acquisition rules, FAA could not obligate more than 50 percent of estimated costs for the second Norden contract because it has not been definitized yet.[8] About $26 million of the unobligated balance is due to nonagreement with the contractor over the price per ASDE-3 system, inability to identify and replace obsolete parts, and difficulty in acquiring spare parts. Project officials stated that the second contract will be definitized no later then the end of May 1995 and they anticipate obligating the $26 million prior to August 1995. The remaining $14.8 million of the unobligated balance has been set aside for logistics, engineering services, software upgrades, spare parts, and site preparation.

According to an FAA official, of the seven ASDE-3s to be purchased under the second contract, FAA is planning to install two systems and to cancel the installation of the other five systems. However, FAA will purchase the five systems and store them until the end of the contract, around March 1996.

The ASDE-3 implementation schedule continues to slip. According to the project manager, the original 33 ASDE-3 radars will be fielded by 1997. However, last-site implementation has been delayed by 4 years--from November 1995 to November 1999--primarily because of difficulty in definitizing the second Norden contract and required completion of towers or structures at certain locations. The project office will request additional funds in 1997 to acquire remote systems. If this occurs, the project manager anticipates that FAA should be able to field all 40 systems prior to November 1999. Another factor in the ASDE-3 schedule's slippage is that FAA experienced a cadmium dust problem. An ASDE-3 project official stated that although FAA has resolved this problem, it has delayed the entire ASDE-3 program's installation schedule by 6 to 9 months.

Twelve ASDE-3s have been commissioned. As of mid-February 1995, 13 sites had not begun installation because of (1) site preparation and/or land acquisition problems, (2) the need for towers or structures to be built at the airports before the radar can be installed, or (3) limited site installation crews for the contractor to draw upon.

Schedule slippages delay potential safety benefits resulting from ASDE-3. One example of a possible consequence of not having the ASDE-3 radar installed on schedule was evident in an accident at Lambert Airport in St. Louis, Missouri. In November 1994, an MD-80 jet's wing clipped a small charter plane that should not have been on the runway, killing both pilots on board the aircraft. The Lambert Airport director could not say whether the ASDE-3 would have helped avoid the collision but acknowledged that ASDE could aid in the prevention of this type of accident. Likewise, ASDE-3 project officials stated that the ASDE-3 radar is an aid--not a guarantee--to help prevent such collisions.

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[8]A contract is definitized when two parties (i.e., FAA and the contractor) have agreed on conditions of scope, price, and overall work effort.

Problems continue to affect ASDE-3's implementation and cost.

-- First, ASDE-3 continues to experience multipath problems whereby radio frequency energy radiates off buildings or other aircraft, creating a momentary false target on the ASDE-3 radar's display. All radars experience multipath to some degree, and radars like ASDE-3 that radiate energy downward are especially subject to multipath. When multipath occurs, more targets than are actually present may show on the radar display screen. The amount of multipath experienced will depend on the number of reflective surfaces present including aircraft, buildings, vehicles, and other objects with radar reflective surfaces. As a result, every airport experiences multipath to a different degree, but the seriousness of the problems vary depending on configuration and operations. For example, controllers and technicians at the Atlanta Hartsfield International Airport said they are satisfied with the ASDE-3, despite multipath problems.

  FAA officials are trying to reduce the occurrence of ASDE-3 multipath by accelerating the implementation of the AMASS "tracker." The tracker will help mitigate multipath by placing symbols on real targets to distinguish them from multipath targets. However, AMASS will not be installed at all locations for approximately 2 to 3 years.

-- Second, delays in commissioning ASDE-3 are attributable to a July 1994 agreement between FAA and the National Air Traffic Controllers Association (NATCA) whereby the ASDE-3 radar has to provide 99.5 percent operational availability for a period of 30 consecutive days during the Operational Readiness Demonstration (ORD). However, this requirement does not allow for routine maintenance or downtime for other problems not attributable to the ASDE-3, thereby making commissioning of the ASDE-3 problematic. According to an FAA Air Traffic official, the order that outlines this 99.5-percent principle is being revised and should be finalized by May 1995. This official and a NATCA representative said they anticipate that NATCA will agree to the new order. However, the officials explained that the new order will not allow for routine maintenance during ORD. Therefore, commissioning of the ASDE-3 system may remain problematic.

AUTOMATED WEATHER OBSERVING SYSTEM (AWOS)/ AUTOMATED SURFACE OBSERVING SYSTEM (ASOS)

VENDORS: Qualimetrics, Inc., Sacramento, Calif. (AWOS); AAI Corporation, Hunt Valley, Md. (ASOS); and Commpower, Inc., Camarillo, Calif. (ADAS)

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E costs as of	$244.4	$255.3	$10.9
Cumulative F&E funds appropriated through	190.2	207.5	17.3
Unobligated F&E funds through	4.0	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation as of	7/89	7/89	None
Estimated last-site implementation as of	Indefinite[b]	12/97	N/A

[a]Data will not be available until after fiscal year 1995.

[b]In fiscal year 1993, FAA estimated that last-site implementation would occur by May 1997. Last year, in fiscal year 1994, FAA provided no estimate of last-site implementation because a portion of the project was being restructured.

Background

The Automated Weather Observing System (AWOS) uses automated sensors to measure wind speed, temperature, altimeter setting, cloud height, and visibility. After gathering the information, the system disseminates it to pilots via communications systems using a computer-generated voice. FAA procured 200 AWOSs for airports that do not have ATC towers or human weather observers. AWOS is available commercially and was procured to fill an immediate need for automated weather information during the development of the more sophisticated Automated Surface Observing System (ASOS). In addition to gathering the weather information provided by AWOS, ASOS is also expected to identify types and amounts of precipitation and provide weather information displays for use in towers. (See fig. 3.1.) Under the AWOS project's umbrella, FAA provides funds to a joint program administered by the National Weather Service (NWS) to procure, install, and maintain 537 ASOS units at both towered and nontowered airports. Also, under the AWOS project's umbrella, FAA is procuring the AWOS Data Acquisition System (ADAS). Each ADAS will acquire weather information from up to 137 AWOSs and ASOSs. It will then process the information, disseminate it to a variety of users via FAA's National Weather Network, and archive weather data products. FAA installed 25 ADASs at 23 en-route centers and at two different facilities that support hardware and software support.

AWOS/ASOS/ADAS Progress

In the last year, costs grew and implementation schedules slipped for the overall AWOS project (including ASOS and ADAS). The total estimated cost for the overall AWOS project increased by $10.9 million to $255.3 million because FAA delayed the ASOS implementation schedule in response to a $10 million budget cut in 1994, which led to deferring the planned procurement of 106 ASOSs until 1996. As a result, last-site implementation has slipped 7 months--from May 1997 to December 1997.

Further cost increases are anticipated because FAA will have to (1) acquire redesigned ASOS tower display equipment, (2) buy freezing rain sensors that were omitted from the deployed ASOS baseline configuration of equipment, and (3) buy 47 additional ASOS units. The status of the three AWOS components (AWOS, ASOS, and ADAS) is described below.

AWOS--FAA has purchased 200 AWOS units. As of January 1995, FAA had installed 189 units and commissioned 181 of them. The last-site implementation/commissioning for the AWOS system has slipped 1 year--from December 1994 to December 1995--largely because changing state environmental regulations caused FAA to miss the seasonal window for site preparation.

ASOS--With 352 ASOSs procured and 321 units installed, FAA commissioned its first two ASOSs in November and December 1993. The commissioning of additional sites was delayed because of (1) problems with FAA's telecommunication lines that cause data to be lost, (2) an FAA agreement with NATCA to halt the commissioning of units at towered airports until May 1995, during which time both organizations would evaluate ASOS' suitability for air traffic operations[9] and (3) an NWS-imposed moratorium on commissioning any ASOS until the systems' technical deficiencies and logistics problems are resolved. NWS lifted this moratorium in March 1995. Additionally, last-site implementation will be delayed until December 1997 as a result of the project's restructuring.

ADAS--While all of the 25 ADAS units have been installed, ADAS

[9]NATCA is concerned that ASOS observations are not representative of actual conditions when the weather is changing rapidly or conditions are patchy.

is not yet operational because several other NAS systems with which it must interface are not yet in place. The FAA program office estimates that ADAS' last-site implementation will occur in May 1996.

AWOS/ASOS/ADAS Issues

The project's costs are anticipated to increase in the future by about $25 million for three reasons.

-- First, FAA found that the towers' controller display equipment, which was originally specified in the ASOS contract, was unacceptable in that it required controllers to view multiple screens to obtain weather information. FAA specified enhanced displays that would integrate ASOS data with other tower displays. This new equipment has been developed by the ASOS contractor and is being tested in several towers. The program manager estimated that purchasing this new equipment will increase the project's costs by about $6 million.

-- Second, funding will be needed to procure freezing rain sensors. The freezing rain sensors were not included in the basic ASOS deployment because its performance was not yet acceptable. The program manager estimated that this procurement would add $3.6 million to the project's costs.

-- Finally, funding will be required to purchase 47 additional ASOS units. The program manager stated that these units will replace some AWOSs and will introduce ASOS into other towered and nontowered sites. He estimated that this procurement would add $15 million to project costs.

FLIGHT SERVICE AUTOMATION SYSTEM (FSAS)

VENDOR: E-Systems, Inc., Garland, Tex. for Model 1 Full Capacity

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$550.9	$540.5	$(10.4)
Cumulative F&E appropriations through	379.7	389.7	10.0
Unobligated F&E funds through	$23.7	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation as of	N/A[b]	05/98	N/A
Estimated last-site implementation as of	N/A[b]	05/01	N/A

Legend

N/A = not applicable

[a]Data will not be available until after fiscal year 1995.
[b]These are the dates for the OASIS/NextGen schedule. Last year, we used the schedule for Model 1 Full Capacity equipment.

Background

FSAS improves general aviation pilots' access to national aeronautical and meteorological information, simplifies flight plan filing, and consolidates, automates, and improves other flight service station functions.

In 1980, the Congress approved funding for modernizing FAA's flight service system. The project provided for establishing 61 Automated Flight Service Stations (AFSSs) while consolidating 318 Flight Service Stations into AFSSs. FAA's original contract called for Model 1 and Model 2 AFSS. Model 1 systems were commissioned between 1986 and 1987; however, FAA never developed any Model 2 systems. In 1987, FAA increased capacity for the flight service system by purchasing updated systems called Model 1 Full Capacity.

FAA maintains that no technical or operational flight service requirement justifies retaining any of the 318 Flight Service Stations. However, in 1991, the Congress directed FAA to develop and implement a system of manned auxiliary Flight Service Stations to supplement the 61 AFSSs. At congressional direction, FAA identified 31 Flight Service Stations that will remain open as auxiliary stations. According to a program official, FAA plans to consolidate 32 Flight Service Stations in 1995, leaving 31 auxiliary Flight Service Stations open.

As currently configured, the FSAS system consists of 61 AFSSs, 21 Flight Service Data Processor Systems, and 2 Aviation Weather Processors. Twenty-one Model 1 Full Capacity systems are located at the 21 Flight Service Data Processor Systems; each system supports situation displays at about 3 AFSSs. The FSAS system also consists of 31 auxiliary Flight Service Stations that do not have Model 1 full capacity equipment.

Five related projects are under the FSAS project. They are OASIS, NextGen, Graphic Weather Display System (GWDS), AFSS space, and AFSS power conditioning. The first three projects are designed to support or replace original equipment. OASIS was originally designed to alleviate problems in supporting AFSS equipment. NextGen was designed to replace the Flight Service Data Processor Systems and the Aviation Weather Processors. A standardized GWDS was planned to replace aging and deteriorating weather graphics equipment in each AFSS. One of the remaining two projects upgrades the power supply; the other improves space at AFSSs.

FSAS Progress and Problems

FSAS' costs decreased by more than $10 million since last year because of cost changes in the related FSAS projects. Schedule delays continued because of rescoping efforts for the OASIS and NextGen projects and commissioning problems with the final two Model 1 Full Capacity systems. Also, the supportability of Model 1 Full Capacity equipment remains an issue.

FSAS' costs decreased $10.4 million--from $550.9 million to $540.5 million--largely because of an $8.2 million reduction in OASIS' estimated cost when it was combined with GWDS. In 1995, FAA received a total of $10 million in appropriations. According to the project manager, $7 million will be used to close 32 Flight Service Stations. OASIS and NextGen received $2 million and $1 million, respectively.

FAA has accepted all 61 Model 1 Full Capacity systems and commissioned 59 of them. Two systems--in Honolulu, Hawaii, and San Juan, Puerto Rico--have not been commissioned because of site-specific construction problems in both locations and inadequate phone lines in San Juan. Project officials anticipate last-site implementation in August 1995.

As we have reported for the past 3 years, program officials remain concerned about the Model 1 Full Capacity's supportability. According to program officials, FAA recognizes this problem and has taken several steps to correct the problem. For example, FAA is generating spare parts by reconfiguring Tandem processing equipment that became surplus equipment from another project for use at the

Flight Service Data Processing Centers. It is also using replacement computer terminals at the Flight Service Data Processing Centers to provide spare parts for other processing equipment. As the last resort for prolonging the current AFSS configuration, FAA also has the option of shifting work to facilities able to handle an increased workload, as was done after the Midwest flooding in the summer of 1993.

According to project officials, in September 1994, acquisition officials directed the former to explore the possibility of combining OASIS and NextGen. This would allow for replacing equipment at the 61 AFSS, 21 Flight Service Data Processor Systems, and 2 Aviation Weather Processors as one project instead of two as with OASIS and NextGen. The rescoping effort will rely on off-the-shelf equipment, an open computer architecture configuration, and a phased deployment schedule. FAA officials believe they can field OASIS/NextGen before the Model 1 Full Capacity system becomes unsupportable.

As of early March 1995, project officials were still rescoping OASIS and Nextgen and had not yet met again with acquisition officials to discuss the rescoped effort. As a result of this rescoping, the OASIS/NextGen schedule has slipped at least 7 months. FAA had planned to release a draft Request for Proposal by the first quarter of 1995. However, FAA officials now plan to issue it in June 1995 and award a contract by June 1996. Project officials are unsure that they can meet the May 1998 first-site operational readiness deployment date, and because of the rescoping effort could not provide a more definite date. Last-site implementation stands at May 2001.

INTEGRATED TERMINAL WEATHER SYSTEM (ITWS)

VENDORS: Massachusetts Institute of Technology (MIT), Lincoln Laboratory, Boston, Mass.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$138.9	$250.7	$111.8
Cumulative F&E appropriations through	23.5	34.2	10.7
Unobligated F&E funds as of	0	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation	09/99	03/00	+6 months
Estimated last-site implementation	09/00	06/01	+9 months

[a]Data will not be available until after fiscal year 1995.

Background

Air traffic personnel in tower and terminal facilities rely on a number of sensors to obtain weather data. Interpretation is labor intensive and performed manually. The main shortcoming of the present system is that it cannot anticipate short-term (0-30 minute) changes in ceilings, visibilities, winds, and precipitation.

ITWS will automatically integrate data from terminal weather sensors--such as TDWR, LLWAS, and aircraft in flight--to provide short-term automated weather information and predictions in easily understood graphical and textual form to air traffic controllers. ITWS' products include wind shear and microburst predictions, storm cell and lightning information, terminal area winds aloft, runway winds, and short-term ceiling and visibility predictions. ITWS will enable air traffic controllers to identify, in space and time, terminal area weather hazards, thereby improving safety and capacity in bad weather.

FAA originally envisioned fielding 47 ITWSs at 45 TDWR-equipped airports and 2 support facilities. FAA now intends to deploy 37 ITWSs, including 34 at terminal facilities and 3 at other locations for training, testing of interfaces, and software support and maintenance. This fielding strategy is a result of the alternative analysis conducted by the program office as a prerequisite to key decision point-3, approval for full-scale development. The 34 ITWSs are intended to address terminal weather needs at 45 TDWR-equipped airports. Some terminal facilities control multiple airports; one ITWS would serve more than one airport. For example, Miami International and Fort Lauderdale International airports will be served by one ITWS located at the Miami terminal facility.

Approximately 100 situation displays will provide the text information and graphics to air traffic controllers at the 34 terminal facilities, 45 towers, about 10 traffic management units in the en-route centers serving the 45 ITWS airports, and the three support facilities listed above.

ITWS Progress and Problems

The total estimated F&E cost of the ITWS project is $250.7 million, an increase of $111.8 million from last year's cost. Last year's cost reflected only the initial operating capability of the system, while the 1995 funding reflects the entire project. Project officials anticipate that the project's total costs may increase by $12 million this year to support the continued operation of the functional prototypes, ensure sufficient funding for the full-scale development contract, and continue development of future ITWS products.

ITWS successfully completed the demonstration and validation phase at the Memphis International Airport in July 1994 and at the Orlando International Airport in August 1994. According to the project manager, the response from air traffic controllers and airlines was enthusiastic. As a result, the functional prototypes remain in operation at these two locations. Additionally, FAA is planning to deploy a third functional prototype for the Dallas-Fort Worth International Airport in May 1995. This will provide prototype testing in a larger terminal facility and multiple towers at two airports. It will also provide experience in different types of weather.

Most key milestones are unchanged since last year. Program officials anticipate issuing draft specifications and a statement of work prior to issuing a final request for proposal in June 1995. The awarding of a contract remains unchanged for August 1996. Because of algorithm development problems, interface issues, and additional operational testing, first-site implementation has slipped about 6 months--from the last quarter of 1999 to the second quarter of 2000. Also, for the same reasons, last-site implementation slipped about 9 months--from the last quarter of 2000 to the third quarter of 2001.

MODE SELECT (MODE S)

VENDORS: Joint venture of Unisys Corporation, Paoli, Penn. and Westinghouse Electric Corporation, Linthicum, Md.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$ 438.2	$ 450.9	$ 12.7
Cumulative F&E appropriations through	413.3	438.2	24.9
Unobligated F&E funds as of	3.5	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Current estimated first site implementation	03/94[b]	03/94[c]	None
Current estimated last site implementation	12/96[b]	12/96[c]	None

[a]Data will not be available until after fiscal year 1995.
[b]First-site implementation of initial Mode S capability for terminal sites.
[c]Last-site implementation of Mode S for en-route sites.

Background

Mode S is a secondary surveillance radar. A secondary surveillance radar--ATC beacon interrogator (ATCBI)--identifies, locates, and tracks aircraft by using its signals to interrogate equipment (transponders) on board the aircraft. (See fig. 3.1.) Consequently, it can detect only aircraft equipped with transponders. Mode S is expected to be four times more accurate than the secondary surveillance radars that it is replacing. Also, it is designed to interrogate up to 700 aircraft individually and has a data communication channel that permits ground-to-air exchange of aviation-related data.

Before the initiation of the Mode S program, FAA had 392 secondary surveillance radars at terminal and en-route sites. These included 167 ATCBI-5s, 85 ATCBI-4s, and 140 ATCBI-3s--the oldest secondary surveillance radars. Because of limitations in the associated automated radar data processing equipment, each radar could interrogate only up to 250 aircraft. To replace most of the oldest ATCBIs, which use 1960's technology, FAA awarded a procurement contract in October 1984 for 137 Mode S systems, including installation and spare parts. FAA plans to implement 108 of these systems at terminal sites and 25 at en-route sites. Four systems will be used for training and technical support.

Mode S Progress and Problems

During the last year, the cost of this project increased, but its last-site implementation date did not change. The total estimated cost increased by $12.7 million because FAA approved 1996 funding for (1) enhancements to the system and continued development of software, (2) anticipated claims by contractors, and (3) additional site installation costs. Although the last-site implementation date did not change, the project did not meet intermediate milestones.

As we reported last year, the software that supports the Mode S surveillance and data communication components is still under development; therefore, FAA will continue to use an incremental strategy to implement the system. First, to replace aging secondary surveillance radars, FAA is implementing a terminal interim beacon system, which is based on the Mode S hardware. According to FAA, these terminal systems are only as accurate as the secondary surveillance radars they are replacing and do not have the capacity to interrogate aircraft selectively or interrogate a data communications channel. As of February 7, 1995, FAA had delivered 103 interim systems and commissioned 43 of them.

Second, FAA is incrementally upgrading the terminal interim beacon systems to full Mode S capability. As of January 31, 1995, only two interim systems had been commissioned as Mode S systems. These systems can interrogate up to 400 aircraft selectively and operate a data communications channel. The upgrade is behind schedule because of Mode S system design changes required by, for example, (1) modifications in the ASR-9 interface and (2) the need for the full Mode-S system to detect faulty transponders used by about 5,000 aircraft.

By March 1996, a year later than reported last year, FAA will be ready to upgrade the interim systems to full performance. At that time, the software upgrade necessary to support interrogation of up to 700 aircraft selectively and a data communication channel will be ready. Another software upgrade and a planned hardware upgrade may not be necessary because they were driven by surveillance enhancements required for AAS.[10] The current terminal

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[10]These surveillance enhancements are terminal sensor fusion and Surveillance Advanced Message Formats. Through terminal sensor fusion, Mode S beacon surveillance data will be correlated with primary surveillance radar data to provide a combined radar/beacon

advanced automation replacement program (i.e., STARS) may not require these enhancements.

Third, FAA is implementing a Mode S system for en-route sites. The agency was simultaneously developing two software versions for the en-route Mode S to ensure timely deployment of the system--one version uses one side of the back-to-back antenna as a single-face antenna and a second version uses both sides of the antenna. FAA has now decided to postpone the testing and deployment of the second version indefinitely because various ATC systems would have to be extensively altered to use the information gathered by the back-to-back antenna version.

Over the past year, FAA has pushed back its schedule for this last phase of Mode S. OT&E for an en-route interim beacon system was completed in December 1994. OT&E for the full Mode S en-route system with a single-face antenna will be completed by August 1995, 10 months later than scheduled last year. The first-site implementation date for the full Mode S system is now December 1995, 1 year later than reported last year. However, last-site implementation is still scheduled for December 1996. According to project officials, the en-route Mode S system has experienced delays because of the additional effort required to upgrade the terminal systems to full Mode S capability. In addition, the development of the en-route software has been delayed by the need to make modifications to the Mode S interface with the Common Digitizer-2. The Common Digitizer-2 links Mode S and the primary surveillance radar at en-route sites.

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surveillance data stream to the NAS automation system. Surveillance Advanced Message Formats is the interface format in which the combined data stream will be sent to the automation system.

OCEANIC AUTOMATION PROGRAM (OAP)

VENDOR: Aviation Technology Systems Corporation, Arlington, Va.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$216.6	$236.5	$19.9
Cumulative F&E appropriations through	43.3	79.6	36.3
Unobligated F&E funds as of	19.4	[a]	[a]

SCHEDULE

	FY 1994	FY 1995	Change
Estimated first-site implementation as of[b]	Indefinite[d]	Indefinite[d]	N/A
Estimated last-site implementation as of[c]	Indefinite[d]	Indefinite[d]	N/A

[a]Data will not be available until after fiscal year 1995.

[b]First-site implementation date for Build 1 of the Oceanic System Development and Support contract.

[c]Last-site implementation date for Build 5 of the Oceanic System Development and Support contract.

[d]The Oceanic System Development and Support contract will not be awarded until the summer of 1995.

Background

Domestic air traffic controllers use data provided by surveillance radars to direct traffic; in contrast, oceanic air traffic controllers must rely on aircraft position reports provided by pilots through high-frequency radio relays. Because the oceanic ATC system is procedural and largely manual in nature, large separation standards are required to ensure the safe separation of aircraft in oceanic airspace. These standards, coupled with increasing oceanic air traffic, have created a capacity problem.

FAA created OAP to automate the control of oceanic airspace. The project is designed to improve, through a series of incremental steps, the display, communication, and surveillance of aircraft positions. The OAP consists of three major components--oceanic ATC, an oceanic traffic management system, and offshore ATC.

Oceanic ATC is designed to evolve from the current Oceanic Display and Planning System (ODAPS) into the Oceanic Automation System (OAS), and eventually into the Advanced Oceanic Automation System (AOAS). ODAPS currently provides flight data processing and a situational display of estimated aircraft positions. It is also intended to provide a conflict probe capability that will alert controllers when any flight plan or pilot-requested aircraft route change will violate appropriate separation standards. FAA plans to improve on ODAPS with OAS, which is designed to improve data display and communications. The OAS will eventually be upgraded to the AOAS, which will include features such as a new flight data processor, Automatic Dependent Surveillance (ADS) position reporting, and an advanced conflict probe. Oceanic ATC systems will be installed at the Oakland, New York City, and Anchorage en-route centers.

The Oceanic Traffic Planning System (OTPS) is designed to manage oceanic air traffic using automated information gathering and route development and analysis. OTPS services will be available at the Oakland, New York City, and Anchorage en-route centers and the Air Traffic Control System Command Center.

Offshore ATC consists of the microprocessor-based (Micro) En-Route Automated Radar Tracking System (EARTS) Phase I and II. Micro-EARTS Phase I is the backup for EARTS, which generates the controller's aircraft situation display. The existing EARTS equipment has capacity limitations that preclude development and deployment of planned system enhancements. Therefore, Micro-EARTS Phase I will be used as the platform for Micro-EARTS Phase II, which will provide full EARTS functionality through software enhancements. Micro-EARTS Phase II is an interim replacement for EARTS until a long-term solution is devised. Offshore ATC systems will be installed at the Anchorage, San Juan, Honolulu, and Guam en-route centers as well as at several military installations.

<u>OAP Progress and Problems</u>

The total estimated cost of the OAP increased during the last year because an additional $19.9 million in funding was approved to accelerate the program to enable faster realization of anticipated benefits and to finance new initiatives, such as Micro-EARTS.

FAA is in the process of updating ODAPS. ODAPS was delivered to the Oakland en-route center in 1989 and the New York en-route center in 1991. A software release that includes new software enhancements was to be operational without the conflict probe in New York, in April 1995. The software release was delayed because instabilities that were not apparent during testing at the FAA Technical Center were discovered after initial delivery to the operational sites. Another software release--which will include the conflict probe and modifications needed by the New York en-route center to control additional airspace in the Caribbean--will be delivered to the FAA Technical Center in mid-September 1996. It will be operational at Oakland and New York by the end of calendar year 1996.

ODAPS hardware components will be replaced incrementally to evolve the system into the OAS. The Flight Data Input/Output system and the Plan View Display will be replaced with a Telecommunications Processor and an Interim Situation Display, respectively. First and last ORD for the Telecommunications Processor are scheduled for June 1995 and October 1995, respectively. The Interim Situation Display is scheduled for first and last ORD in May 1996 and July 1996, respectively. The OAS is also designed to incorporate the prototype Oceanic Data Link to provide air-to-ground and ground-to-ground satellite-based data communications. It will be installed and tested at the Oakland en-route center in the summer of 1995.

FAA is currently reviewing proposals for AOAS and plans to award a contract in the summer of 1995. This Oceanic System Development and Support (OSDS) contract will involve five different builds that will ultimately result in a fully operational AOAS.

FAA has installed elements of OTPS--the second component of the OAP--at the Oakland, New York City, and Anchorage en-route centers. The system's functionality will transition into AOAS in Builds 3 and 4. Micro-EARTS Phases I and II--elements of the third OAP component--will be commissioned during 1995 and 1996.

TERMINAL AIR TRAFFIC CONTROL AUTOMATION (TATCA)

VENDOR: None at this time.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$138.0	$138.0	None
Cumulative F&E appropriations through	8.7	21.7	13.0
Unobligated F&E funds as of	0.5	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation as of	Indefinite	12/97	N/A
Estimated last-site implementation as of	Indefinite	Indefinite	N/A

Legend

N/A = not applicable.

[a] Data will not be available until after fiscal year 1995.

Background

TATCA is designed to address present-day needs for increased terminal airspace capacity. TATCA comprises three projects: the converging runway display aid (CRDA), the Center/TRACON Automation System (CTAS), and the controller-automated spacing aid (CASA).

CRDA is an aid that allows controllers to space aircraft more precisely for landing and departing from converging runways. (See fig. 3.1.)

CTAS is the main component of TATCA. It provides controllers with efficient four-dimensional aircraft flight paths for directing aircraft and advisories to predict potential conflicts. Four integrated tools are being developed under the CTAS project:

-- The traffic management advisor (TMA) sequences and schedules arrivals about 200 to 100 miles from the runway. TMA acts as the first step in minimizing aircraft arrival delays.

-- The descent advisory (DA) is an extension of TMA. It provides controllers with speed, descent, and heading advisories. This information helps aircraft arrive on schedule with minimum aircraft fuel consumption. DA covers airspace about 100 to 50 miles from the runway.

-- The final approach spacing tool (FAST) assists controllers in sequencing and spacing aircraft accurately on their final approach and landing. FAST provides controllers with speed and heading advisories.

-- The expedited departure path (EDP) assists controllers in sequencing and timing departure aircraft from an airport. It provides controllers with advisories similar to FAST and DA. It also merges aircraft departing from small local airports into a major airport's arrival sequence.

CASA is a follow-on project to CRDA. It enhances the software package, enabling controllers to stagger aircraft for landing on asymmetric runways. CASA will also work to merge aircraft in routes farther out from the airport.

TATCA Progress and Problems

Of the three TATCA projects, CRDA is being implemented, elements of CTAS are being evaluated in the field, and CASA is being developed. CRDA was deployed to 62 ATC facilities in July 1992. As of January 1995, CRDA was operational at six sites. By the end of 1995, CRDA is scheduled to be operational at three additional sites.

The TMA and DA portions of CTAS are being evaluated at the Denver, Colorado, en-route center. Initial evaluation of TMA began in March 1992 and is scheduled to continue through March 1995. Evaluation of DA is scheduled from September 1994 through June 1996. The FAST element of CTAS is being evaluated at the Dallas/Fort Worth terminal. Evaluation of this element began in November 1992 and continues through October 1995. The EDP element of CTAS is only in a research and development stage.

CTAS' contract award is scheduled for January 1997. CTAS is planned to be implemented at 10 en-route centers and 5 terminals. First-site implementation is scheduled for December 1997. Last year, FAA did not establish first- and last-site implementation dates for CTAS because it did not know whether a prototype or developmental type of equipment would be fielded.

CASA's research and development began in mid-1992 and is scheduled to continue through mid-1995. CASA's site installation is scheduled to begin in mid-1996.

According to the TATCA project manager, some uncertainty exists in meeting the established CTAS implementation schedule. The technical complexity of this project requires sufficient time to enable a national implementation, as new functions and capabilities are introduced to controllers. In addition, the cumulative effect of new operational concepts and the development of new external systems such as STARS and DSR require that these systems be monitored as they develop and evolve for CTAS integration. The development of initial CTAS software has also shown that the process of adapting CTAS to the individual sites is complex.

TERMINAL DOPPLER WEATHER RADAR (TDWR)

VENDORS: Raytheon Company, Sudbury, Mass.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	$373.3	$380.9	$7.6
Cumulative F&E appropriations through	343.4	368.4	25.0
Unobligated F&E funds as of	15.9	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation[a]	04/94	07/94	+3 months
Estimated last-site implementation	Indefinite	Indefinite	None

[a]Data will not be available until after fiscal year 1995.

Background

TDWR is a radar designed to detect hazardous weather conditions such as microbursts and gust fronts in the vicinity of the airport and to relay this information to air traffic controllers. (See fig. 3.1.)

TDWR Progress and Problems

TDWR's total program costs increased by $7.6 million to $380.9 million because of the schedule delays resulting from site availability and land acquisition problems.

FAA will implement TDWR at 47 locations. As of March 1995, FAA had accepted 16 TDWRs and commissioned 3--1 at the Houston International Airport in July 1994, another at the Memphis International Airport in December 1994, and a third at St. Louis, Missouri, in February 1995. Two systems will not be commissioned because they will be used for training. One of these at the FAA

Aeronautical Center in Oklahoma is fully operational. FAA officials anticipate implementing 11 additional systems by July 1995. Of the remaining 31 locations, 10 have been cleared for construction, 2 have had equipment delivered but not accepted by FAA, and 19 are in different stages of implementation.

According to the project manager, the first-site implementation date for Houston International Airport slipped 3 months--from April to July 1994--because of problems identified during operational testing, including unacceptably poor power levels from commercial power sources. He added that commissioning was delayed at Memphis because of a site-specific computer problem that was resolved by replacing the computer.

In general, implementation continues to proceed more slowly than planned primarily because of the unavailability of a site and land acquisition problems, thus keeping the last-site implementation date indefinite. In January 1995, FAA issued stop work orders for 11 locations because of these problems. For example, FAA is having difficulty in locating suitable sites for the two TDWRs planned for Kennedy and LaGuardia airports because of local and political resistance. According to a project official, two locations were opposed by residents and local politicians who argued that electromagnetic radiation emitted by the radar would pose health problems and that the radar would be inappropriate and unsightly for a neighborhood. As a result, FAA is trying to locate only one TDWR on public land in the New York area to cover both airports. The second TDWR originally scheduled for LaGuardia may be used in Las Vegas, Nevada, which FAA determined was the next most cost-beneficial location.

At the same time, however, FAA is trying to accelerate TDWR installation in the wake of the July 1994 crash at Charlotte, North Carolina, allegedly caused by a severe microburst. According to a project official, FAA is streamlining the review process in two ways to accelerate installation. First, FAA is conducting "in-process reviews," whereby FAA officials review site construction proposals with the contractor and other involved parties and resolve issues immediately. Second, FAA has reduced the number of design reviews it does for site construction. Project officials do not consider this action risky, since both Raytheon and FAA have gained experience with the already-fielded TDWRs.

A TDWR system was originally scheduled to be delivered and accepted by FAA for Charlotte in June 1993. However, according to the project manager, TDWR would not have been operational in Charlotte at the time of the crash. FAA purchased land in Charlotte in November 1994. FAA officials planned to begin site construction in Charlotte in April 1995 and to commission TDWR there by December 31, 1995, as directed by the Senate

Appropriations Committee.[11] According to a project official, as a result of these site problems and subsequent delays, last-site implementation for TDWR continues to be indefinite because of schedule uncertainties involving five sites.

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[11]Record of hearing before the Subcommittee on Transportation, Senate Committee on Appropriations, on the Department of Transportation and Related Agencies Appropriations for 1995, Senate Report No. 103-310, p. 77.

VOICE SWITCHING AND CONTROL SYSTEM (VSCS)

VENDORS: Harris Corporation, Melbourne, Fla.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E costs as of	$1,407.0	$1,452.9	$45.9
Cumulative F&E funds appropriated through	921.7	1,130.2	208.5
Unobligated F&E funds through	30.2	[a]	[a]

SCHEDULE	FY 1994	FY 1995	Change
Estimated first-site implementation as of	4/95	6/95	+2 months
Estimated last-site implementation as of	7/98	1/00	+18 months

[a]Data not available until after fiscal year 1995.

Background

VSCS is designed to replace existing communication systems with an expandable, highly reliable system for both ground-to-ground and air-to-ground communication. (See fig. 3.1.) VSCS will provide a communication capability for new en-route center controller work stations.

VSCS was originally designed as a stand-alone system that could support 430 en-route controller positions. Such a large capability was required to transition from the existing to the new control room and to accommodate the proposed consolidation of terminals into en-route centers. However, under FAA's revised consolidation plan, announced in 1992, terminals will not be consolidated into centers.

After developing prototypes for 5 years, FAA awarded a VSCS production contract to the Harris Corporation on December 31, 1991. The contract required Harris to upgrade its prototype system, which supported 60 controller positions, to a full-production 430-controller-position system to interface with the ISSS segment of the AAS project. Harris was to deliver at least 25 VSCS production systems. VSCS equipment is scheduled to be delivered to the field in two phases. During the first phase, Harris is to develop an initial system to be installed in the existing en-route controller work stations. During the second phase, Harris is to develop the primary system to interface with new en-route controller work stations.

FAA authorized the VSCS program to proceed with the limited production phase of the program on March 31, 1993. This authorization included ordering four systems. The Transportation Systems Acquisition Review Council, held on March 3, 1994, authorized the continued ordering of VSCS systems at the rate of one per month with the provision that approval of FAA's Acquisition Executive is obtained before ordering each system. Authority for full production was withheld until the testing of the existing controller workstations with the initial version of VSCS, scheduled in June 1995, was satisfactorily completed. FAA has ordered 16 production systems as of February 1995.

VSCS Progress and Problems

According to project officials, FAA's September 1994 decision to cancel the AAS component, ISSS, and replace it with DSR will cause VSCS' project cost to increase by $45.9 million. The cost increase is needed to fund escalating equipment cost, additional testing, and the extension of contractor and project office personnel longer than planned to field VSCS equipment with DSR equipment. VSCS was originally scheduled to become operational with ISSS at the first site in October 1996 and be completed in July 1998. FAA now estimates that VSCS' first-site implementation with DSR equipment will begin in 1998 and end in January 2000--a 17-month schedule delay. The VSCS project manager stated that FAA's decision to cancel ISSS and replace it with DSR does not require any additional costs to the current baseline VSCS hardware design.

The project office has slipped its schedule for first-site implementation at the Seattle, Washington, en-route center with existing controller workstations by 2 months--from April to June 1995. The change was made because the schedule was too compressed to test additional software and to fix known and predicted software problems identified in testing at the FAA Technical Center. According to the project manager, the impact of software delay is primarily on the near-term site implementation dates. However, various FAA oversight groups predict that first-site implementation will need to slip about 6 months because the test schedule is too compressed to fix and retest current and expected problems. Moreover, an oversight group stated that FAA added new requirements that resulted in about 30 percent more software than the agency planned without any additional schedule extension at this time last year.

Harris has essentially completed software development for the initial system to be fielded with the existing controller workstations. However, a review of VSCS test results indicates that three primary areas need improvement before the system can be deployed at the Seattle en-route center: system stability, failure/recovery, and on-line software maintenance. System stability is the primary concern of the user and test communities. The system has not met the baselined goal of 72-hour stability testing, specifically in the area of VSCS console equipment. For the failure/recovery area, the problem has been system diagnostics. The off-line diagnostics are still deficient in locating failed units. Under on-line software maintenance, the critical issues are the speed of loading new software, the speed of reverting back to a previous software version, and verification/certification that the software is functioning properly. To focus on these issues, FAA and Harris have put on hold planned product improvements for the primary system to be fielded with the new controller workstations.

According to the VSCS project manager, FAA's recent decisions to discontinue the AAS' TAAS component have caused a reduction in the number of systems specified in the VSCS contract. Last year, the contract called for 25 VSCS systems--22 for centers, 1 for the New York TRACON, 1 for the FAA Technical Center, and 1 for the FAA Academy. Now, however, FAA will be procuring only 23 systems. Deleted were the systems previously scheduled for the Honolulu ATC facility and the New York TRACON. FAA deleted these two systems because it believes that VSCS is not the preferred system for meeting its communication needs at those locations. This action did not result in a change in the total estimated cost for VSCS because FAA plans to use VSCS funds to install a new communication system at these two sites. FAA continues to have the option to purchase 18 additional systems from Harris.

WIDE AREA AUGMENTATION SYSTEM (WAAS)

VENDOR: No contract awarded yet.

FINANCIAL INFORMATION Dollars in millions	FY 1994	FY 1995	Change
Total estimated F&E cost as of	[a]	$512.6	N/A
Cumulative F&E appropriations through	11.9[b]	79.8	$67.9
Unobligated F&E funds as of	0	[a]	[c]

SCHEDULE	FY 1994	FY 1995	Change
Estimated initial WAAS implementation	[a]	09/97	N/A
Estimated final WAAS implementation as of	[a]	06/01	N/A

N/A - not applicable.

[a]The total estimated cost and schedule was not included in the 1994 CIP.
[b]Congress appropriated $3.7 million for WAAS research and development. FAA reprogrammed $8.2 million from other projects.
[c]Data will not be available until after fiscal year 1995.

Background

FAA is working to enhance DOD's GPS. FAA and the aviation industry expect that this satellite-based system, when augmented by WAAS, will result in a navigation capability that will be superior to most of the currently used navigation aids and provide major benefits to its users. Augmented by WAAS, GPS will support all phases of flight, including navigation in domestic and oceanic air routes.

GPS uses satellite radio signals to transmit information to users for calculating the time and their position and speed. Designed for military purposes, however, GPS does not satisfy civil air navigation requirements dictating, for example, that the system's signals be available for use virtually all the time. WAAS will ensure that GPS satisfies these requirements. As a result, civil aviation users will receive GPS' signals continuously, warning messages about GPS and WAAS malfunctions, and corrections to improve the accuracy of these signals for landing in the worst weather conditions.

FAA will implement WAAS in two phases. In the first phase, FAA will build an initial WAAS, which will permit aircraft to navigate in air routes and fly nonprecision approaches.[12] The initial system will consist of 2 master stations, 24 reference stations, and 6 communication (ground earth) stations. The stations will be joined by ground telecommunications networks. The system will use three communication satellites to deliver augmented signals similar to those provided by GPS to users.

In the second phase, FAA will build a final, end-state WAAS that will permit aircraft to navigate in air routes and fly Category I precision approaches.[13] FAA envisions that the final system will consist of about 4 master stations, up to 40 reference stations, and up to 16 communication stations. The final system may use up to eight communication satellites.

In the first phase, FAA will also implement a functional verification system that will be used for WAAS development, testing, and evaluation. This system will consist of two master stations, five reference stations, and one communication station. It will use one communication satellite.

WAAS Progress and Problems

FAA began research and development work on WAAS in 1993. The agency estimates that the total F&E cost for WAAS will be $512.6 million by 2001. This cost will fund, among other things, system development, implementation, maintenance, and operational support.

FAA plans to award a contract in May 1995 for the development and implementation of WAAS. The agency expects to complete implementing the initial WAAS by September 1997. To ensure that this system is implemented on schedule, FAA has undertaken mitigating actions. For example, contractors have been working on key elements of WAAS' software so that they can be furnished to the prime contractor selected. However, WAAS' initial implementation may be delayed because, as we reported in May 1995, the time frame for implementing WAAS is tight, and potential problems could affect the system's development.[14] Some of these potential problems include software development difficulties and communications satellite launching delays. If these problems are realized, FAA recently estimated that its 1997 milestones for GPS may slip for up to 18 months.

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[12]On a nonprecision approach, an aircraft receives electronic guidance for flying toward the runway's centerline.

[13]On a precision approach, an aircraft receives electronic guidance not only for flying toward the runway's centerline but also on the slope of descent. Under a Category I precision approach, an aircraft can safely descend to a height of 200 feet when the runway's visibility is at least 1,800 feet.

[14]National Airspace System: Comprehensive FAA Plan for Global Positioning System Is Needed (GAO/RCED-95-26, May 10, 1995).

After the initial WAAS becomes operational, FAA may execute up to four contract options to build the final WAAS. The agency anticipates that three options will be exercised in 1998 and that the last option will be executed in 2000. FAA expects to implement the final WAAS by 2001.

ATC MODERNIZATION PROJECTS COMPLETED THROUGH CALENDAR YEAR 1994

Dollars in millions

Project/project number	Actual completion date	Total F&E cost
Automated Radar Terminal System (ARTS) IIIA Assembler (22-02)	1983	$0[a]
ARTS II Displays (22-07)	1984	3.6
Radar Remote Weather Display System (23-10)	1984	0[a]
Interim Voice Response System (23-06)	1985	0[a]
Geostationary Operational Environmental Satellites Recorders ((23-11)	1985	1.9
En-Route Automation (21-01)	1986	2.3
ARTS IIIA Memory (22-04)	1986	8.6
Additional ARTS IIIA at FAA Technical Center (22-05)	1986	4.7
ARTS II Interfacility Interface (22-08)	1986	0[a]
Consolidated Notice to Airmen System (23-03)	1986	0[a]
Radar Microwave Link Trunking (25-01)	1986	8.2
Teletypewriter Replacement (25-09)	1986	5.1
Non Radar Approach (21-14)	1987	1.6
Visual Flight Rules ATCT Closures (22-14)	1987	1.5
Air/Ground Communications Equipment Modernization (24-01)	1987	60.6
Airport Telecommunications (25-05)	1987	4.2
Data System Specialist Support (51-20)	1987	32.0
Host Computer (21-07)[b]	1988	290.7
Mode-C (21-10)	1988	0[a]
Enhanced Target Generator Displays (ARTS III) (22-03)	1988	0[a]
Nondirectional Beacon (24-04)	1988	24.2
National Airspace Data Interchange Network IA (25-06)	1988	17.0
Aircraft Fleet Conversion (26-11)	1988	68.6
Enhanced Terminal Conflict Alert (22-01)	1989	0.4

Dollars in millions

Project/project number	Actual completed date	Total F&E cost
Automatic Terminal Information Service Recorders (22-10)	1989	$11.2
High-Altitude En-Route Flight Advisory Service (23-07)	1989	6.3
Hazardous In-Flight Weather Advisory Service (23-08)	1989	7.3
Instrument Landing System (24-06)	1989	69.6
Power Conditioning Systems for ARTS III (26-06)	1989	21.5
TPX-42 Replacement (22-17)	1990	40.0
Flight Data Entry and Print Out Devices (21-02)	1991	18.8
En-Route Automated Radar Tracking System Enhancements (21-04)	1991	2.8
Offshore Flight Data Processing System (21-16)	1991	1.0
Sustain New York TRACON (22-18)	1991	95.4
Computer-Based Instruction (26-02)	1991	10.4
National Radio Communication System (26-14)	1991	82.7
Direct Access Radar Channel System (21-03)	1992	45.0
ARTS IIA Enhancements (22-06)	1992	12.9
ATCT/TRACON Modernization (22-13)[c]	1992	391.4
Communications Facilities Consolidation/Network (24-02)	1992	16.8
National Airspace Data Interchange Network II (25-07)	1992	42.4
Power System (26-07)	1992	71.5
Modernization of Unmanned FAA Buildings/Equipment (26-08)	1992	85.7
Aircraft and Related Equipment (26-12)	1992	68.9
NAS Spectrum Engineering (26-15)	1992	9.4
System Support Lab (26-17)	1992	31.5
General Support Lab (26-18)	1992	25.6
ACFs (21-15)	1993	9.6

Dollars in millions

Project/project number	Actual completion date	Total F&E cost
Central Weather Processor (23-02)	1993	$81.2
Data Multiplexing Network (25-02)	1993	34.0
Radar Microwave Link Replacement/Expansion (25-03)[d]	1993	268.4
Large Airport Cable Loop Systems (26-05)	1993	20.3
General Support (26-16)[e]	1993	828.5
National Implementation of the "Imaging" Aid for Dependent Converging Runway Approaches (62-24)	1993	4.6
Interfacility Data Transfer System for Edward Air Force Base Radar Approach Control (35-20)	1994	1.8
Visual Navaids (24-09)	1994	137.9
Acquisition of Flight Service Facilities (26-10)	1994	80.1
Interim Support Plan[f] (46-30)	1994	362.9
Tower Integration Program (42-20)	1994	11.2
Radar Pedestal Vibration Analysis (44-43)	1994	5.0
LLWAS (23-12)	1994	47.2
Human Resource Management (56-22)	1994	7.7
Brite Radar Indicator Tower Equipment (22-16)	1994	64.5
Approach Lighting System Improvement Program (24-10)	1994	124.1

[a]The cost of this project was covered under another F&E project.

[b]Installed at en-route centers to allow processing of existing ATC software on new equipment. Original first-site implementation date was 1986, while the actual first-site implementation date was 1987. Original last-site implementation date was 1987. Original estimated cost was $316.4 million.

[c]Project comprised a variety of tower and terminal replacement and modernization projects. Project was continued in the CIP under Project 42-13 and 42-14. (See table 2.3.)

[d]Also known as the Radio Communications Link project designed to convert aging "special purpose" Radar Microwave Link system into a "general purpose" system for data, voice, and radar communications among en-route centers and other major FAA facilities. Original first-site implementation was scheduled for 1985, while the actual first-site implementation date was 1986. Original last-site implementation date was 1989. Original total cost estimate was

$264.3 million for 1,000 sites, while the completed cost was for 871 sites.

[e]Project comprised a variety of diverse support projects and has been continued in the CIP under Continued General Support (46-16).

[f]Project was activated to sustain and upgrade ATC operations and acquire eight terminal radars awaiting the full implementation of AAS. Original total cost estimate was $517 million. Actual costs were lower than estimates because the project was downscoped. Original completion date was scheduled for 1995. Actual completion date was 1994.

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