
Office of Inspector General

Audit Report

Advance Automation System

Federal Aviation Administration

Report Number: AV-1998-113

Date Issued: April 15, 1998





Memorandum

**U.S. Department of
Transportation**

Office of the Secretary
of Transportation

Office of Inspector General

Subject: ACTION: Report on FAA's
Advanced Automation System

Date: April 15, 1998

From: 
Kenneth M. Mead
Inspector General

Reply to
Attn of:

To: The Secretary
Thru: The Deputy Secretary

This is our final report concerning the Office of Inspector General's (OIG) examination of the Federal Aviation Administration's (FAA) Advanced Automation System (AAS). The Senate Appropriations Committee, by Report accompanying the Department of Transportation Appropriations Bill for Fiscal Year 1998¹, directed OIG to examine and provide an accounting of contract costs associated with AAS. As agreed with the Senate Subcommittee on Transportation, we focused on (1) contract costs associated with the AAS program by major segment prior to its 1994 restructuring; (2) the value of contract software and hardware that was salvaged or wasted; and (3) issues of contractor liability and FAA employee culpability. Additionally, our report includes information on total program costs; however, because of data limitations with DOT's financial accounting system, we relied on unaudited financial data from FAA's program offices and contractor records. As referenced in our report, an FAA-provided listing of headquarters FAA personnel (GS-14 and higher grade) involved in the AAS program, up to the time of its restructuring, is being provided under separate cover due to privacy considerations.

As stipulated in the above-referenced Committee Report, the Secretary of Transportation is required to render to the Committee a written determination of whether or not any AAS contractor or subcontractor is potentially liable to the United States under any theory of liability. Please provide this office with a copy of your correspondence to the Committee regarding this matter.

¹ Senate Report 105-55, pp. 153-154, accompanying S. 1048 (enacted 10/27/97).

Per the Committee Report, we are also transmitting our report to the Subcommittee on Transportation of the Senate Committee on Appropriations. If I can answer any questions or be of further assistance in this or any other matter, please feel free to contact me on (202) 366-1959, or my Deputy, Raymond J. DeCarli, on (202) 366-6767.

Attachment

#

TABLE OF CONTENTS

Transmittal Memorandum to the Secretary of Transportation..... i

Predication and Summary of Findings..... 2

Section I: Background on AAS..... 5

Section II: Oversight of AAS Program..... 9

Section III: Observations on the AAS Contract and
Contract Costs..... 11

Section IV: Observations on What was Wasted and
Salvaged from the AAS Contract..... 14

Section V: Observations on Liability and Culpability
Issues 17

Section VI: Objectives, Scope, and Methodology..... 21

EXHIBITS

Exhibit A: AAS Appropriations..... 23

Exhibit B: Principal AAS Subcontractors 24

Exhibit C: Major Contributors to this Report..... 25

PREDICATION AND SUMMARY OF FINDINGS

The Senate Appropriations Committee, by Report accompanying the Department of Transportation Appropriations Bill for Fiscal Year 1998¹, directed OIG to examine and provide an accounting of contract costs associated with AAS. Our objective was to determine costs from the AAS contract prior to its 1994 restructuring; establish the extent to which those incurred contract costs were wasted or salvaged; and examine issues of contractor liability.

The AAS Program was the centerpiece of an ambitious effort begun in the 1980s to replace the computer hardware and software, including controller workstations, in en-route, terminal, and tower air traffic control facilities. Also, AAS was intended to provide new automated capabilities to accommodate increases in air traffic. After sustaining serious cost and schedule problems, FAA dramatically restructured the program into more manageable pieces. This action included terminating major segments of the contract.

AAS failed because of overambitious plans by both the FAA and the contractor, poor FAA oversight of contractor performance in developing software, and FAA's indecisiveness about requirements. This setback cost the Federal Government approximately \$1.5 billion in sunk costs, required expensive interim systems to be installed, and delayed important benefits to the aviation industry. Also, these problems caused a serious loss of confidence by the Congress and the aviation community in FAA's ability to develop and field new air traffic control systems.

As agreed with the Subcommittee on Transportation, Senate Committee on Appropriations, we focused on (1) contract costs associated with the AAS program by major segment prior to its 1994 restructuring; (2) the value of contract software and hardware that was salvaged or wasted; and (3) issues of contractor liability and FAA employee culpability. Additionally, our report includes information on total program costs; however, because of data limitations with DOT's financial accounting system, we relied on unaudited financial data from FAA's program offices and contractor records.

Despite the serious problems with the AAS Program, the contract was never terminated in its entirety, but rather was significantly restructured in 1994 after falling years behind schedule and several billion dollars over initial cost estimates.² Specifically, we found:

¹ Senate Report 105-55, pp. 153-154, accompanying S. 1048 (enacted 10/27/97).

² In 1988, FAA estimated that the AAS program--contract and supporting efforts--would cost \$4.8 billion. Before the program was dramatically restructured in 1994, FAA estimated the program could cost as much as \$7 billion with key segments expected to be behind schedule by as much as eight years.

- FAA paid IBM and the subsequent AAS prime contractors--Loral and Lockheed Martin--\$1.5 billion for work on the contract between 1988 and 1994 when AAS was restructured.³ Because no definitive accounting of the five major segments of AAS exists, we reviewed FAA, Defense Contract Audit Agency (DCAA), and Lockheed Martin data to develop estimates and have included them in our report. It is important to note that contract costs do not include total program costs, such as support contracts and related projects funded through other budget line items. From a total program perspective, FAA spent about \$2.6 billion, excluding salaries of FAA personnel.
- We estimate that approximately \$1 billion of the \$1.5 billion spent on the contract was wasted and about \$500 million was salvaged for use in subsequent modernization efforts. Determining what was wasted or salvaged is difficult because FAA has not performed an in-depth analysis and little documentation on what was salvaged exists. Only one of the five major segments of AAS, the Peripheral Adapter Module Replacement Item (PAMRI), was completed. The key Initial Sector Suite System (ISSS) segment for en-route facilities was restructured and now survives as the Display System Replacement (DSR). Two other segments, the Terminal Advanced Automation System (TAAS) and the Area Control Computer Complex (ACCC) were completely terminated, and a third segment, the Tower Control Computer Complex (TCCC), was abandoned this past year because FAA did not believe it could afford widespread installation of the technology. We have included an analysis of AAS costs by segment in this report. Of the \$2.6 billion spent on the total program, we estimate the total loss to the Federal Government to be about \$1.5 billion, excluding FAA personnel costs.
- By terms and conditions of the AAS restructuring and termination agreements, FAA and the AAS contractors generally and mutually waived claims and liability concerning past performance, or non-performance, in connection with the original AAS contract through April 1995. However, the Government reserved all rights of action relative to contractor fraud or misrepresentation. Other than reporting a possible mischarging involving \$35 million in excess facility leasing costs by IBM, DCAA's approximately 430 audits of AAS have not disclosed any other potential misrepresentations or fraud regarding AAS. This excess leasing cost case is actively under investigation by DOT/OIG and DCAA, in coordination with the Department of Justice. We have included an analysis of the foregoing legal issues in this report.
- According to FAA, given the legal restrictions of the Government's personnel

³ On March 1, 1994, IBM sold its Federal Systems Division to Loral Corporation. In April 1996, Lockheed Martin acquired Loral and is now responsible for completing work on enroute segment of the contract known as the Display System Replacement.

system applicable to FAA at the time⁴, and the complexity of AAS, FAA opted to focus prospectively on what could be salvaged from the AAS program and ensure that such problems did not recur, rather than attempt punitive action against any individual. None of FAA's reviews of AAS identified specific FAA officials as being solely responsible for the program's problems. In March 1994, the FAA Administrator announced his decision to replace the senior management responsible for the program. The AAS program director at the time of the restructuring was reassigned to a regional position and subsequently retired in 1997. The deputy program director retired in April 1994.

An FAA-provided listing of headquarters FAA personnel (GS-14 and higher grade) involved in the AAS program, up to the time of its restructuring, reflects that of the 70 persons listed, 34 retired or separated from FAA; 19 transferred or were reassigned to other FAA positions; and 17 remain in the air traffic systems automation program office. One FAA employee who had served in an AAS program management position subsequently received a career promotion in another functional area. The FAA listing includes 30 members of the Senior Executive Service (SES), 17 GS-15s, and four Presidential appointees. The listing, which is not provided as an Exhibit to this report due to privacy considerations, is being provided to the Committee under separate cover.

We discussed our findings with senior level FAA and DOT management officials and they generally agree with our analysis. We also provided copies of our draft report to FAA legal, program, and contracting officials familiar with the AAS program for review and have incorporated their views as appropriate.

⁴ In April 1996, FAA instituted its own personnel management system, independent of the rest of the Federal Government, presenting fewer restrictions to administrative action.

SECTION I: BACKGROUND ON AAS

FAA's air traffic control mission is to promote the safe, orderly, and expeditious movement of aircraft through the National Airspace System (NAS). Air traffic controllers maintain separation between aircraft by utilizing radar and flight plan information processed by computers and displayed on video screens at controller workstations. FAA utilizes three types of air traffic control facilities: airport towers, terminal facilities, and en-route centers. AAS was intended to replace computer hardware and software at all three facilities.

FAA introduced the AAS project in the early 1980s and decided to pursue a two-phased acquisition strategy. First, the agency awarded competitive design phase contracts to both IBM and Hughes Aircraft Company in 1984. In July 1988, FAA awarded a contract to IBM for the second acquisition phase, the development and production of AAS. At that time, the contract was valued at \$3.5 billion, which included a baseline of \$1.6 billion with options totaling \$1.9 billion.

In 1988, FAA estimated that the AAS program--contract and supporting efforts--would cost \$4.8 billion. By late 1993, FAA estimated that it would cost \$5.9 billion. Before the program was dramatically restructured in 1994, FAA estimated the program could cost as much as \$7 billion with key segments expected to be behind schedule by as much eight years.⁵ FAA did not suffer from a lack of funding for this project as the agency received most of the funds it requested for the AAS program. (See Exhibit A for a summary of AAS Appropriations.) AAS was to be implemented in the following five distinct segments:

- The first segment, the Peripheral Adapter Module Replacement Item (PAMRI), replaced communications equipment that connects en-route facilities with external systems, such as radars and weather processors. PAMRI, the least complex of the AAS components, was completed and is currently in operation at en-route centers throughout the U.S.
- The second segment, the Initial Sector Suite System (ISSS), was to be installed at all en-route centers and provide state-of-the-art color displays, new consoles and software, and modern communication networks. ISSS was a critical segment of AAS since it would provide the hardware and software platform for later segments under development. This segment was restructured and now survives as Display System Replacement (DSR), which is scheduled to become operational at the Seattle en-route center in October 1998 and subsequently installed at other centers.

⁵ For additional information on the range of cost estimates for completing AAS developed by FAA's AAS Task Force, see Review of Cost and Schedule for the Advanced Automation System (March 3, 1994).

- The third segment was the Terminal Advanced Automation System (TAAS). This system was intended to provide common consoles to the terminal controllers with many of the same automation features provided in ISSS, but tailored to the unique needs of terminal operations. Much of the software developed for TAAS was to be used in the Area Control Computer Complex phase. TAAS was terminated completely and FAA competitively awarded a separate contract to Raytheon to develop the Standard Terminal Automation Replacement System (STARS).
- The fourth segment, the Tower Control Computer Complex (TCCC) was to automate control towers at airports. Because air traffic controllers must be in a constant state of heightened awareness regarding the immediate surrounding location outside the tower windows, and because they require mobility within the tower to accomplish their job, TCCC was to provide maneuverable displays, hand-held entry devices, and voice activation technology. This segment was ultimately abandoned, this past year, because FAA concluded that its widespread implementation was not affordable.
- The fifth and last segment envisioned was the Area Control Computer Complex (ACCC). This system was designed to replace PAMRI and the Host computer system used at en-route centers. In addition, the system was envisioned to provide advanced capabilities known as Automated En-route Air Traffic Control (AERA) which would allow controllers to grant more fuel efficient routes to airlines. This segment of the contract was terminated but work on AERA continues under other programs such as Initial Conflict Probe.

AAS PROGRESS AND PROBLEMS

About one year after FAA awarded the contract to IBM, problems began to surface. The contract spelled out specific milestones and dates for delivery of equipment to individual en-route centers and eventually to terminal facilities. In fact, ISSS was to be delivered to the 21 en-route centers between January 1994 and October 1995.⁶ But by mid-1989, it became apparent that the schedule in the contract could not be met and in December 1990 the program was “rebaselined” with a schedule slip of 19 months. In November 1992, FAA announced that the schedule for the critical ISSS segment slipped again by another 14 months due to software development problems. Facing additional cost growth and schedule slips, the then-FAA Administrator ordered several evaluations of AAS, beginning in late-1993, that would ultimately lead to a major restructuring of the entire effort in mid-1994. At each point when the program slipped, it became more clear that

⁶ When the modernization effort began in the early 1980s, ISSS deliveries were expected to begin in 1990 and 1991, respectively.

FAA and IBM drastically underestimated the complexity of developing AAS software.

By June of 1994, the AAS program ceased to exist as originally conceived. FAA completely terminated the ACCC and TAAS segments and ISSS was restructured. Essentially, the en-route and tower segments of the original contract continued forward and were subsequently redefined and renamed. As previously mentioned, work on the en-route segment continued under the restructured contract for DSR, but FAA initiated a new contract in September 1996 with Raytheon for terminal facilities that is now known as STARS.⁷ By and large, FAA opted for less complex systems and focused more on commercial or “off the shelf” technology for projects that continued forward. FAA relaxed or eliminated six AAS requirements that were, in FAA’s view, unnecessarily contributing to project cost growth. For example, for both DSR and STARS, FAA relaxed the availability requirement from 3 seconds per year to no more than 5 minutes of malfunctions per year.

FAA officials believe the change in AAS prime contractors generated confusion about the program. This change, however, was not a root cause of its failure. Effective March 1, 1994, IBM sold its Federal Systems Division to Loral Corporation.⁸ In April 1996, Lockheed Martin acquired Loral and is now responsible for completing work on DSR. As mentioned previously, the first DSR console is scheduled to become operational at Seattle in October 1998.

Although FAA moved to the acquisition phase in 1988, considerable research and development needed to be done on many key components. In fact, many of the problems with AAS are directly traceable to the fact that FAA tried to accomplish research, development, and production tasks simultaneously. In our opinion, clearly demarcating development and production activities shortly after awarding the contract to IBM would have enhanced program management, helped identify problems in a more timely manner, and helped communicate more realistic AAS status and cost information to senior FAA and DOT management and Congressional decisionmakers.

AAS SOFTWARE DEVELOPMENT PROBLEMS

⁷ For additional details on the STARS program, see our report entitled Federal Aviation Administration’s Standard Terminal Automation Replacement Program (AV-1998-012, Nov. 12, 1997).

⁸ The Federal Government, IBM, and Loral entered into a novation agreement. Generally, a novation agreement substitutes a new party to a contract. Loral assumed all rights and claims which IBM had under the AAS contract and IBM waived all rights under the contract against the Government. However, nothing in the novation agreement relieved IBM or Loral from compliance with federal laws and regulations. According to FAA officials, because of the terms and conditions of the purchase of Loral by Lockheed Martin, a novation agreement was not required. A change of name agreement sufficed and did not alter the contractual rights and obligations of the parties involved.

Software development proved to be the Achilles' heel of the AAS program. At the time, AAS software ranked among the most complex software development projects in the world and was expected to operate in a real-time environment in which hundreds of functions must be executed within seconds and was expected to be fault tolerant.⁹ In other words, AAS software was expected to monitor its own execution and recover from failures without losing data. FAA required that key AAS systems function 99.99999 percent of the time, which is the equivalent of about 3 seconds of downtime per year. IBM attempted to meet this stringent requirement through a very complicated software design, but by 1994, the software volatility rate for the key ISSS segment was running at 100 percent.¹⁰ Thus, on average, every line of code needed to be rewritten once. According to FAA program and contract officials, major portions of AAS software were designed under complex cost reimbursable financial arrangements—which exposed the government to considerable risk.¹¹ We share GAO's opinion that FAA's lack of adequate oversight of software development, especially during the early phases of ISSS development, led FAA and IBM to agree to schedule and cost estimates that were unrealistic.¹²

⁹ For insight to FAA's problems in developing AAS software, see An Assessment of the Status and Technical Risk of Federal Aviation Administration's Advanced Automated System Software Development, IR-MA-1298-2, Volpe National Transportation Systems Center and Intermetrics, Inc., Apr. 1992.

¹⁰ Software volatility is a measure of code added, modified, or deleted to meet software requirements.

¹¹ Cost type contracts are generally used when labor hours, labor mix, and material requirements necessary to perform are uncertain and speculative. Hence, the Government assumes the risks inherent in the contract—benefiting if the actual cost is lower than expected cost; losing if the work cannot be completed within the expected cost of performance.

¹² See Advanced Automation System : Implications of Problems and Recent Changes (GAO/T-RCED-94-188, April 13, 1994).

SECTION II: OVERSIGHT OF THE AAS PROGRAM

Since the original prime contract award in 1988, AAS has been evaluated by the DOT/OIG, GAO, DCAA, internal FAA review teams and task forces, contracted reviews such as that performed by the Center for Naval Analysis, and others. Throughout the late 1980s and the early 1990s, GAO reported on the cost, schedule, and performance problems of the AAS program as well as its overall management.¹³ In addition, Congress held specific oversight hearings between 1993 and 1994 to determine the status of the AAS program, examine root causes of the problems, and explore solutions.¹⁴ A consensus exists that AAS failed because of (1) overambitious plans by FAA and the contractor, (2) poor FAA oversight of contractor performance in developing software, (3) FAA's inability to stabilize requirements, and (4) a poor statement of work in the original contract.

The OIG examined and reported on important aspects of the AAS program on several occasions between 1994 and 1995.¹⁵ We reported on, among other things, problems with the contractor's cost estimating system, ISSS software development, and assessing alternatives for automating airport towers. The general thrust of our work was to ensure that FAA followed a disciplined process and completed the necessary analysis and acquisition documentation while restructuring the program and moving forward. We made recommendations aimed at improving FAA's oversight of the program and ensuring that adequate and complete information was provided to FAA and DOT decisionmakers. FAA generally concurred with our recommendations and implemented them.

DCAA has audited various aspects of the AAS contract and issued approximately 430 audit reports since the contract was awarded in 1988, actively reviewing contractor costs, pricing estimates, accounting systems, and internal controls.¹⁶ DCAA completed comprehensive audits of costs incurred--including assessments of labor and payroll costs--on the AAS contract for fiscal years 1988 through 1992 and is in the process of completing work on fiscal year 1993. The incurred cost

¹³ See Aviation Acquisition: A Comprehensive Strategy Is Needed for Cultural Change at FAA (GAO/RCED-96-159, Aug. 1996), which includes a review of GAO oversight in the 1980s and 1990s.

¹⁴ See hearing before the Subcommittee on Aviation, Committee on Public Works and Transportation, U.S. House of Representatives, Review of Recent Developments in the Federal Aviation Administration's Advanced Automation System (April 13, 1994, 103rd Congress, 103-60).

¹⁵ See Management Advisory Memorandum On FAA's Advanced Automation System Program (Report Number AS-FA-4-007, March 3, 1994) and Advanced Automation System Program Common Console Issues (Report Number AS-FA-5-022, August 4, 1995).

¹⁶ The FAA employs DCAA to perform limited reviews of federal contractors that focus on, among other things, justifying cost and pricing data or verifying rate proposals. Federal Acquisition Regulations provide guidance to contracting officers that allow them to use DCAA before negotiating or modifying a contract in excess of \$500,000.

audits for costs from January 1994 through March 1996 are scheduled for completion by the end of Fiscal Year 1998. To date, these incurred cost audits have questioned over \$18 million. FAA is in the process of negotiating the final rates for the open years with the AAS contractor. The disposition of the questioned costs will be negotiated as part of the final rate settlement, which is expected to be finalized by October 1998.

Over the years, DCAA identified and reported on problems with the AAS prime contractor, including inappropriate use of source data for estimating costs, inconsistent approaches to allocating costs, and non-adherence to established federal policies, procedures, and regulations. In March 1994, DCAA's review of the contractor's estimating system reported that the system should be disapproved because recurring deficiencies remained uncorrected and resulted in estimates of contract costs coming out of the system being unreliable. Also in March 1994, OIG specifically requested DCAA to determine if the contractor was mischarging FAA by moving costs from the fixed price portion of the AAS contract to the cost type portion of the contract. DCAA found that due to the terms, structure, and termination of the segments, there was no practical way to conclusively prove that such mischarging occurred. Other than reporting a case of potential mischarging involving \$35 million in excess facility leasing costs by IBM, DCAA has not identified any other potential misrepresentations or fraud regarding AAS. This excess leasing cost case is actively under investigation by the OIG and DCAA, in coordination with the Department of Justice.

Subsequent to the restructuring of the AAS program, FAA introduced important reforms, including a new acquisition management system to include integrated product development teams, better software monitoring tools, and new executive positions to strengthen the agency's ability to develop and procure new technology for the National Airspace System. Many of these reforms were in response to Congressional direction. In October 1995, Congress provided significant relief from federal procurement rules and regulations to help FAA procure technology that suits its unique needs, hire technical specialists, and better manage complex contracts.¹⁷ In our view, the failure of AAS was a result of poor FAA oversight and poor contractor performance, not adherence to federal procurement rules and regulations.

¹⁷ Department of Transportation and Related Agencies Act 1996, P.L. 104-50, Section 348, 109 Stat. 436, 460 (1995).

SECTION III: OBSERVATIONS ON THE AAS CONTRACT AND CONTRACT COSTS

The original AAS contract was the most complex and largest FAA acquisition in FAA's \$36 billion investment portfolio to modernize the air traffic control system, known in the 1980s and early 1990s as the Capital Investment Plan. The contract called for IBM to develop millions of lines of computer code and new workstations for tower, terminal, and en-route controllers, as well as training programs. The AAS contract was in reality an amalgam of contracts, including firm-fixed-price, and cost-plus type financial arrangements.

As mentioned earlier, FAA failed to stabilize the requirements for AAS. Between the contract's award in July 1988 and June 1994, the AAS contract was modified over 300 times to, among other things, adjust prices, change requirements, and increase funding. FAA officials told us the agency changed requirements with little regard for how changes would affect the schedule and cost of the program. For example, FAA struggled with finalizing requirements for electronic flight strips and the color of display monitors. In addition, FAA program officials point out that important changes in the agency's plans for consolidation of air traffic control facilities were not formally reflected in the contract. According to senior FAA officials, the number and type of modifications reflected the agency's lack of experience in managing large-scale projects that relied so heavily on software.

OIG ANALYSIS

FAA spent about \$1.5 billion on the prime AAS contract. However, segregating all costs spent on the contract among the specific segments of AAS, such as ISSS, is difficult, if not impossible. All contractor's program management and program engineering for all five segments were contracted for under one Contract Line Item Number (CLIN) with no differentiation by segment. Also making our analysis of costs more difficult was the inclusion in the contract of "billing groups", which authorized the contractor to bill FAA by groups of CLINs. Thus, a review of contractor data from contract award through the restructuring indicates that almost \$700 million in program management and systems engineering costs were incurred with no direct linkage to specific AAS segments. FAA officials familiar with the program told us that the bulk of these costs were incurred for ISSS. This illustrates a serious flaw in the AAS contract that exacerbated FAA attempts to provide effective oversight of work being performed. In hindsight, FAA legal, contracting, and program officials told us that it would have been better to require the contractor to allocate 'program management and systems engineering' by specific AAS segment.

We allocated common program management and system engineering costs

according to the five major segments of AAS based on a methodology proposed by Lockheed Martin. This approach allocates program management and systems engineering by AAS segment based on December 1994 cost reporting data. FAA and DCAA officials with whom we spoke concurred with this approach and commented that it was the best methodology given the lack of other supporting data. The following table provides an analysis of AAS contract costs detailed by segment and reflects all costs of work terminated, work brought to a logical conclusion, settlement expenses, as well as costs for work that was not formally terminated but discontinued.

Table 1: AAS Contract Costs
(Dollars in millions)

AAS Segment	Identifiable Costs	Allocation of common costs	Total Costs
PAMRI	\$45.1	\$50.2	\$95.3
ISSS	388.5	417.6	806.1
TAAS	258.4	138.2	396.6
ACCC	15.3	13.3	28.6
TCCC	38.9	56.6	95.5
Laboratory Facilities	44.9	0	44.9
Other*	33.8	0	33.8
Total:	\$824.9	\$675.9	\$1,500.8

(* Includes costs associated with site surveys, demonstrations, stop-work activity, and travel)

Source: OIG analysis of FAA and Lockheed Martin data.

As the table shows, ISSS accounted for the majority of costs incurred followed by TAAS. We initially viewed the results of Lockheed’s allocation to PAMRI of \$50 million with some skepticism because this would almost double the cost of the system to over \$90 million. However, FAA officials explained that PAMRI required some redesign work after it was deployed, including the addition of a new computer board, and some maintenance. Thus, in their opinion, the allocation to PAMRI is reasonable. As previously mentioned, the original AAS contract was a combination of fixed-price and cost-plus contracts. Of the \$1.5 billion expended on the contract, FAA records indicate that over 80 percent was expended on cost-reimbursable financial arrangements.

Over \$652 million, or about 43 percent of the original contract cost was expended on subcontractor work. Information provided by Lockheed Martin indicates that Raytheon, Computer Science Corporation, and IBM Commercial Businesses accounted for a little over \$400 million, or about 62 percent of all subcontract work. Twenty-six vendors each received \$1 million or more to complete AAS-related work, such as software support and building hardware. (Exhibit B

provides information on these subcontractors.)

AAS contract costs represent approximately 60 percent of the total agency resources expended and committed to AAS during the 1982-1995 time frame. FAA documents show total AAS program costs at about \$2.6 billion, which include related programs and FAA contractor support. These figures do not include FAA salaries, benefits, or travel.

**SECTION IV: OBSERVATIONS ON WHAT
WAS WASTED AND SALVAGED FROM THE AAS CONTRACT**

It is uncertain how much was salvaged or wasted from the AAS contract because FAA has not undertaken a formal study or analysis of what was recovered in terms of software and hardware from the AAS contract before it was restructured. Our effort to examine what was wasted and salvaged from the contract was complicated by the passage of time, the complex nature of the contract, the lack of documentation, changes in prime contractors, and by the fact that many key program officials have either retired or left federal service and were unavailable to discuss the program.

Although FAA undertook an important recovery effort--known as the Hinson-Daschle Report--when AAS was in the process of being restructured in 1994, the estimation of costs, usable lines of computer code, and the value earned from previous contractor efforts was generally done at a very high agency level. FAA did not attempt a "bottom-up" costing analysis and used the AAS program office's September 1993 estimate of \$5.9 billion as a baseline. For example, to determine the dollar value of certain segments of ISSS that were restructured and ultimately used for the DSR, FAA officials used ratios and percentages. FAA documents reflect that about 40 percent of the software developed for ISSS is being utilized today in the DSR Program.

OIG ANALYSIS

From a contract perspective, we conservatively estimate that about \$1 billion of the dollars expended on the AAS contract were wasted. Again, because no definitive analysis of costs and what was salvaged from the AAS program was performed, we relied on discussions with program managers to develop estimates based on their judgment regarding what was usable for other modernization efforts. The following table represents our estimate of what was wasted and salvaged from the AAS contract.

Table 2: Contract Costs Salvaged and Wasted
(Dollars in millions)

Segment	Costs	Amount Salvaged	Amount Wasted
PAMRI	\$95.3	\$95.3	\$0
ISSS	806.1	337.1	469.0
TAAS	396.6	20.9	375.7
ACCC	28.6	0	28.6
TCCC	95.5	4.3	91.2
Laboratory Facilities	44.9	44.9	0
Other*	33.8	0	33.8
Total:	\$1,500.8	\$502.5	\$998.3

(* Includes costs associated with site surveys, demonstrations, stop-work activity, and travel)

Source: OIG Analysis of FAA and Lockheed Martin data.

As shown above, we estimate that about \$1 billion of hardware, software, and other items from the AAS contract was wasted and \$500 million was reused by the FAA. FAA property records show that \$49 million worth of hardware--or about 3 percent of the total contract expenditures--was used for other modernization efforts or transferred to the FAA Depot. Many of consoles developed for ISSS are now being used by FAA's oceanic program.¹⁸ FAA officials point out--and we agree--that it is very difficult to place a value on the intellectual property developed on system software for discontinued portions.

As mentioned previously, the AAS contract only accounted for about 60 percent of the agency's total investment in the AAS program. The following table provides information on what was wasted and recovered from related AAS programs.

¹⁸ As its name implies, FAA's oceanic program provides for air traffic control services over oceans. FAA has facilities located in Oakland, CA and New York, NY which provide air traffic control services over portions of the Pacific and Atlantic Oceans.

Table 3: Total Program Costs Salvaged and Wasted for AAS
(Dollars in millions)

Element	Costs	Amount Salvaged	Amount Wasted
Design Competition	\$276.7	\$0	\$276.7
Prime Contract	1,500.8	502.5	998.3
Support Contracts	264.5	105.8	158.7
Air Route Traffic Control Center	374.4	374.4	0
Implementation	117.6	84.2	33.4
Training	3.5	0	3.5
Automated En Route Air Traffic Control (AERA)	47.7	41.7	6.0
Total:	\$2,585.2	\$1,108.6	\$1,476.6

Source: OIG analysis of FAA data.

As table 3 shows, about \$1.5 billion of AAS total program dollars were wasted and a little over \$1 billion salvaged for use in other modernization efforts. Because no detailed accounting exists, we relied on the judgment of FAA officials familiar with the program to estimate what was wasted and salvaged of total program costs. We did not attempt to determine the value of research and development conducted on the AAS program in the early 1980s prior to the design competition. FAA relied on a relatively simple methodology to determine what was salvaged from various efforts--officials assumed that 40-44 percent of related projects were useful. GAO believes this is a valid approach given the lack of supporting data.¹⁹ These estimates do not include FAA personnel costs.

¹⁹ See Air Traffic Control: Evolution and Status of FAA's Advanced Automation Program (GAO/T-RCED/AIMD-98-85, March 5, 1998).

**SECTION V: OBSERVATIONS ON AAS CONTRACTOR LIABILITY
AND FAA EMPLOYEE CULPABILITY ISSUES**

LIABILITY CONSIDERATIONS

OIG legal review and analysis found that as part of the consideration for restructuring the contract, FAA and the AAS contractors generally and mutually waived claims and liability concerning past performance and non-performance (e.g., breach of contract, inferior product quality, delinquent delivery, overcharging) from the date of the award of the contract through the issuance of the “Restructure Modification” (Mod. #339) in April 1995. Both the Government and AAS contractors had significant potential claims that needed to be addressed as part of the contract restructure. The waiver of claims and liability provided consideration and facilitated agreement on the establishment of revised contract requirements, schedule, pricing, and obligations. The waivers of claims and liability essentially enabled the parties to address and settle the numerous contract issues stemming from the original agreement and to focus prospectively on performance and contract management of the revised contract requirements.

It is important to note that other than reporting a possible mischarging involving \$35 million in excess facility leasing costs by IBM, DCAA’s approximately 430 audits of AAS have not disclosed any other potential misrepresentations or fraud regarding AAS. This excess leasing cost case is actively under investigation by DOT/OIG and DCAA, in coordination with the Department of Justice. The Government specifically reserved its right to pursue any and all causes of action related to this issue under Modifications #339 and #347. Outside of this investigative issue, no other facts have surfaced to date that would implicate potential contractor/subcontractor liability aside from contractual claims which were waived in the waivers of claims.

Although the waiver of claims provisions were intended to be broad, several important rights have been reserved by the Government. The Government’s rights with respect to the ongoing facility leasing issue have been expressly reserved by the above-referenced contract modifications. In addition, the “Restructure Modification” (Mod. #339) expressly reserved the Government’s right to bring claims or any other cause of action that may arise from DCAA, GAO, or IG audits or investigations, or actions based on fraud or misrepresentation of fact. If facts giving rise to such potential contractor liability are discovered in the future, these reservations should preserve the Government’s right to pursue legal action.

The following is a summary of significant events regarding the restructuring of the AAS contract and waiver of claims provisions:

- On November 20, 1992, FAA and IBM entered into a Replan Agreement which essentially extended the time frame for completing the ISSS segment of the AAS contract. On September 2, 1994, FAA and IBM executed contract Modification #312 to contractually recognize provisions of the Replan Agreement. Under Modification #312, FAA and IBM mutually relieved each other of all claims, including performance-related claims, liabilities, and causes of action associated with the ISSS segment from contract award through September 1993.
- Per a Novation Agreement effective March 1, 1994, the Government, IBM, and Loral agreed to a transfer of obligations under the AAS contract, as well as other federal contracts, from IBM to Loral. Loral became the successor in interest to these contracts.
- By FAA letters to the contractor dated June 10, 1994, FAA initiated termination of the TAAS and ACCC segments for the convenience of the Government. Under Modification #322, effective October 3, 1994, ISSS was partially terminated for the convenience of the Government. The TAAS and ACCC terminations were formalized contractually via Modification #324, effective November 4, 1994. An analysis of termination risks, costs, and alternatives performed by the FAA Office of Chief Counsel prior to the termination supported FAA's decision to terminate the above-referenced AAS segments for convenience versus termination for contractor default. As shown in the Chief Counsel's Office analysis, FAA would have incurred considerable litigation costs and loss of time irrespective of whether it prevailed in the default litigation. Moreover, as reflected in the analysis and affirmed by officials of the Chief Counsel's Office, a primary consideration weighing against termination for default was that numerous FAA personnel believed there to be an inadequate basis for termination for default, namely that FAA constantly changed contract requirements and was thus partly responsible for cost growth and schedule slippages. According to officials of the Chief Counsel's Office, such testimony from FAA employees would have supported the contractor in default litigation.
- On April 27, 1995, FAA and Loral executed contract Modification #339 which, in part, restructured the contract, changed the name of ISSS to DSR, and incorporated FAA's and Loral's mutual waiver of performance-related claims and liability in connection with the contract for the period September 30, 1993, to April 27, 1995. Per this modification, the Government expressly reserved the right to bring claims or any other cause of action that may arise from DCAA, GAO, or IG audits or investigations, or actions based on fraud or misrepresentation of fact.

- By Modification #347, FAA and Loral mutually waived performance-related claims and liability associated with the TAAS and ACCC segments as part of the termination settlement. The TCCC segment is subject to an agreement to terminate for the convenience of the Government; however, FAA is awaiting cost figures prior to finalizing this termination.
- FAA contractually recognized Lockheed Martin's acquisition of Loral effective May 21, 1996.

CULPABILITY CONSIDERATIONS

Regarding the issue of culpability on the part of individual FAA employees for the failure of AAS, the FAA Chief Counsel's Office advised OIG that FAA did not take disciplinary action against any employee substantially involved in the AAS program for several intertwined reasons. First, under the Federal Government's personnel management system governing FAA at the time²⁰, it would have been extremely difficult to sustain any formal adverse personnel action against an employee for poor performance unless a supervisor created a written record specifically documenting an employee's substandard performance and that the individual failed to improve his/her job performance within a prescribed period of time. All supervisors and managers with substantial involvement in AAS had consistently received "Fully Successful" or better annual performance ratings. These ratings were based upon the fact that within the confines of FAA's acquisition system and organization in place at the time, each individual was judged to have performed satisfactorily or better. Secondly, contracting officers implemented direction given by the program managers. Program managers attempted to implement continually changing requirements based on input, requested by program elements, from air traffic controllers and airways facilities technicians on how the system could best meet their needs.²¹

According to the FAA Chief Counsel's Office, given the legal restrictions of the Government's personnel system governing FAA at the time, and the complexity of AAS, FAA opted to focus prospectively on what could be salvaged from the AAS program and ensure that such problems did not recur, rather than attempt punitive action against any individual. The intent of FAA's reviews of AAS was to assess

²⁰ In April 1996, FAA instituted its own personnel management system, independent of the rest of the Federal Government, presenting fewer restrictions to effecting adverse personnel action.

²¹ For example, according to FAA's Office of Chief Counsel, the AAS program managers understood that their task was to provide the best system possible that would represent cutting edge technology for more than 20 years into the future. These managers, therefore, requested and received opinions from hundreds of air traffic controllers and airway facilities technicians as AAS was being developed. These opinions were treated by the contractor as contract requirements changes, which led to substantial cost and schedule growth.

the cost and schedule of the program, identify the organizational, management and financial concerns related to the program, and develop cost-effective solutions to meet FAA's automated air traffic control needs. However, none of the reviews identified specific FAA officials as being solely responsible for the program's problems. Upon conclusion of its initial reviews of the program in 1993 and 1994, the FAA Administrator announced in March 1994 his decision to replace the senior management responsible for the program. The AAS program director at the time of the restructuring was reassigned to a regional position and subsequently retired in 1997. The deputy program director retired in April 1994.

An FAA-provided listing of headquarters FAA personnel (GS-14 and higher grade) involved in the AAS program, up to the time of the restructuring, reflects that of the 70 persons listed, 34 retired or separated from FAA; 19 transferred or were reassigned within FAA; and 17 remain in the air traffic systems automation program office. One FAA employee who had served in an AAS program management position subsequently received a career promotion in another functional area. The FAA listing of staff involved with AAS includes 30 members of the Senior Executive Service (SES), 17 GS-15s, and 4 Presidential appointees. The listing, which is not provided as an Exhibit to this report due to privacy considerations, is being provided to the Subcommittee on Transportation, Senate Appropriations Committee, under separate cover.

SECTION VI: OBJECTIVES, SCOPE, AND METHODOLOGY

The 1998 Senate Appropriations Committee Report directed the DOT/OIG to examine the contract costs associated with the FAA's AAS Program. As agreed with the Committee, we focused on (1) contract costs associated with the AAS program by major segment before it was restructured in 1994, (2) the amount of software and hardware that was salvaged and wasted from the contract, and (3) issues of contractor liability. In addition, we are providing information on total program costs. Our work was complicated by the passage of time, complex nature of the contract, lack of documentation, changes in prime contractors, and by the fact that many key program officials have either retired or left federal service.

Because of limitations with the Departmental Accounting and Financial Information System (DAFIS), we relied exclusively on program office and contractor records. DAFIS does not have the capability of identifying individual transactions which are more than 6 years old (prior to FY 1992). Therefore, since a significant number of AAS transactions occurred prior to FY 1992, we were not able to use DAFIS to identify total expenditures. Additionally, DAFIS could not provide cost data by AAS segment.

To examine the contract costs of AAS and the costs of the five major segments, we:

- interviewed FAA officials to identify all prime contracts and support contracts associated with the AAS program and the location of key documentation;
- interviewed contractor officials to identify all major subcontractors to the AAS prime contractor;
- reviewed records and files on the AAS program and associated contract files to identify the procurement of computers and related equipment;
- worked with FAA, DCAA, and Lockheed Martin to develop a methodology to allocate previously unsegregated program costs to the five major segments of AAS.

To provide a detailed accounting of the costs (including losses and waste) to the Federal Government as a result of each contract, we:

- reviewed cost data provided by the prime contractor to determine costs incurred for each major segment of the program;

- interviewed FAA officials to identify costs incurred for elements of the program outside of the AAS prime contractor;
- analyzed FAA's records and files related to the AAS restructuring effort in order to determine the percentage of program segments that were salvaged or lost.

To determine whether or not any such contractor is potentially liable to the Federal Government, including the identity of the contractor or subcontractor, the basis of liability and the potential amount of liability, we:

- reviewed past GAO and DOT/OIG reports and Congressional testimony, as well as FAA internal reviews of the AAS program for indications of contractor actions that would implicate potential liability;
- analyzed DCAA reports on the AAS prime contractor for reportable conditions implicating liability;
- interviewed DCAA officials who conducted the audits of the AAS prime contractor to solicit their view of the prime contractor's actions;
- interviewed FAA's Assistant Chief Counsel for Procurement Law to determine the extent to which liability applies to AAS contractors/subcontractors;
- reviewed files and records, including FAA's liability risk analysis, related to the AAS prime contract to determine the circumstances and legal implications of FAA's actions to terminate portions of the contract;
- reviewed the restructuring agreements and contract modifications to render a legal opinion regarding liability of the AAS prime contractors.

Our review was conducted in accordance with generally accepted auditing standards. We performed our work at the Federal Aviation Administration in Washington DC, and at Lockheed Martin in Rockville, MD, as well as DCAA offices in Rockville, MD, between September 1997 and March 1998.

Exhibit A

AAS Appropriations and Expenditures

AAS Appropriations
(Dollars in millions)

<u>Fiscal year</u>	<u>Appropriation</u>
1983	\$30.0
1984	45.9
1985	27.2
1986	12.2
1987	93.3
1988	170.0
1989	210.5
1990	377.9
1991	514.4
1992	449.4
1993	359.5
<u>1994</u>	<u>293.2</u>
Total:	<u>\$2,583.5</u>

Source: FAA

FAA's Allocation of AAS Costs
(Dollars in millions)

<u>Program Element</u>	<u>Appropriation</u>
Design Competition	\$276.7
Prime Contract	1,492.8
Support Contract	269.3
Air Route Traffic Control Center Modernization	374.4
Training and Implementation	122.7
AERA	<u>47.6</u>
Total:	<u>\$2,583.5</u>

Source: FAA

Exhibit B

AAS SUBCONTRACTORS

AAS Subcontractors With Over \$1 Million in Costs
(Dollars in millions)

<u>AAS Subcontractor</u>	<u>Amount Expended</u>
Raytheon	\$173.6
Computer Sciences Corp	156.6
IBM	74.8
Formation	44.0
Whiting-Turner	30.4
Sony	17.2
Unisys	14.7
Teragon	9.9
Science Application International	8.9
Princeton	7.8
McDonnell Douglas	7.7
Rational	7.0
Denro Inc	5.7
Tresp Associates Inc	5.5
Pailen-Johnson	5.5
Digital System Resources	4.2
Keyboard Comm Inc	3.7
Consulting & Design Inc	3.5
MASTECH Corp	3.4
CENTECH	3.3
TAD Technical Services	3.2
Arcon	2.6
Tech & Management Assist	2.0
Systems Technology Development Corp.	1.6
Data Transformation	1.5
BBN Syst & Tech	1.2
Total:	<u>\$599.5</u>

Note: total expenditures for all subcontractors were \$652 million.

Source: OIG Analysis of Lockheed Martin data.

Exhibit C

Major Contributors to this Report:

Richard C. Beitel, Jr.

Michael P. Dunn

M. E. Hampton

Sonia S. Ingle

Roger P. Williams