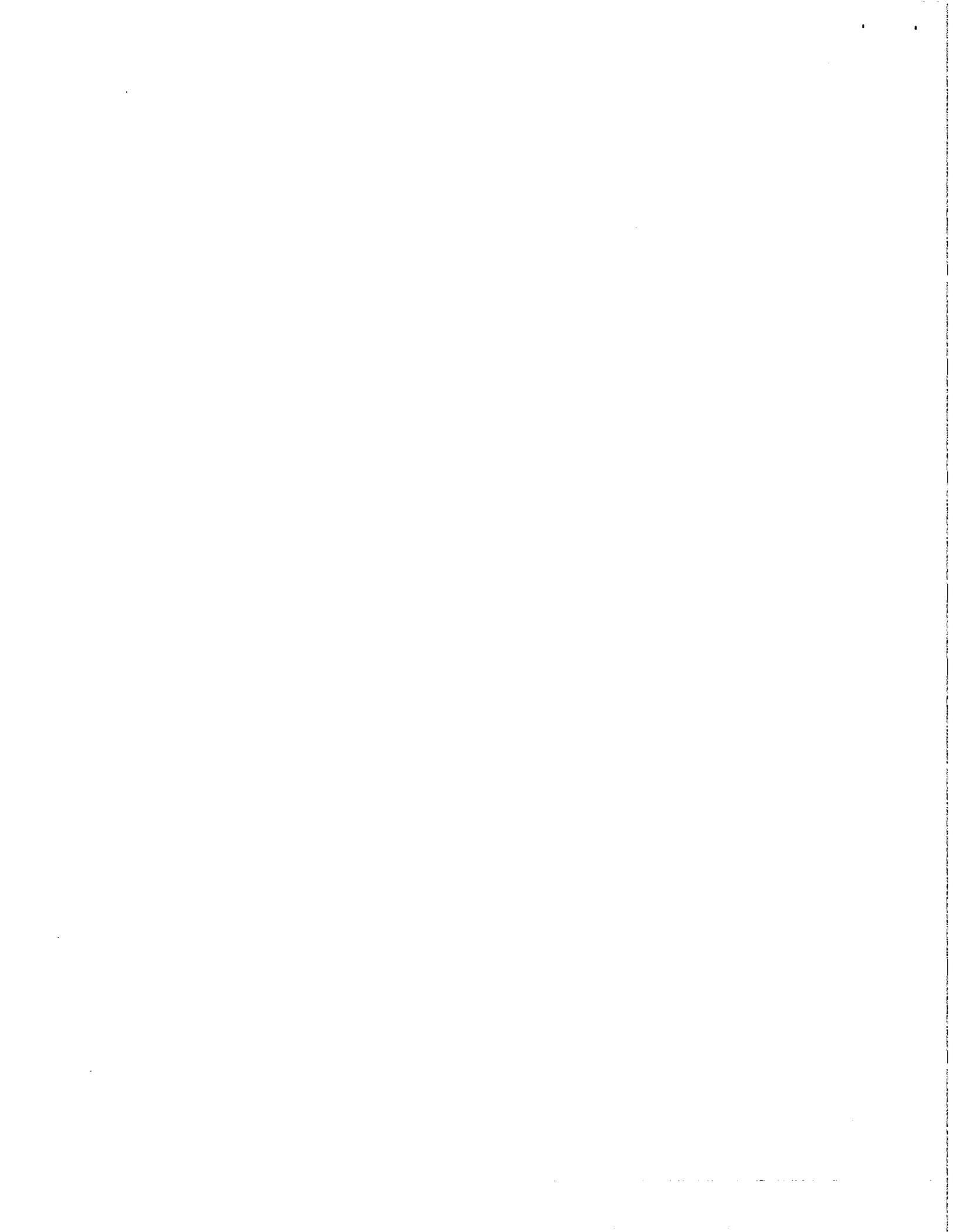United States General Accounting Office

# GAO

Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate

March 1991

# AIR TRAFFIC CONTROL

# FAA's Advanced Automation System Contract

# GAO

United States
General Accounting Office
Washington, D.C. 20548

/43540

Information Management and
Technology Division

B-242745

March 5, 1991

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

Dear Mr. Chairman:

In response to your July 3, 1990, request, we reviewed the Federal Aviation Administration's (FAA) Advanced Automation System (AAS) contract. AAS, the centerpiece of FAA's plans to modernize the air traffic control system, is intended to replace aging air traffic control computer systems with new hardware, software, and controller workstations. FAA is now in the third year of its contract, originally valued at $3.5 billion, with International Business Machines (IBM) Corporation to complete the design and production of AAS. As agreed with your office, we determined whether IBM has implemented a management control system that enables FAA to identify AAS costs. Appendix I provides details on our objective, scope, and methodology.

## Results in Brief

IBM has installed a management control system, modeled after Department of Defense guidance, that provides detailed contract information and allows FAA to identify the cost and performance of AAS. The system and resulting information, when combined with periodic FAA verification of contractor-reported cost and performance, should provide a sufficient basis to monitor the contract.

## Background

The AAS contract was awarded to IBM on July 25, 1988, to complete the design and production of a new computerized air traffic control system intended to replace aging hardware, software, and air traffic controller workstations. The contract calls for AAS to be implemented in three steps:[1]

---

[1] The executive summary of the contract presents three implementation steps for the acquisition phase of AAS. Included within these three steps are five implementation phases for AAS. Appendix II discusses the three steps and five phases in more detail.

- First, IBM is to supply new controller workstations at en route centers[2] to replace existing controller displays, and automate some related manual processes.
- The second step is to provide additional hardware and software at existing en route facilities allowing FAA to consolidate some smaller terminal facilities into en route centers.
- The final step is to provide additional automation support to airport towers to allow consolidation of the remaining large terminal control facilities at en route centers.

## AAS Contract Is Complex, Modified Frequently, and Likely to Increase

The total estimated cost of the contract when it was awarded was about $3.5 billion—$1.6 billion for basic items to be completed by 2003, and $1.9 billion for options extending until 2010. As of December 1990, FAA had spent about $336 million.

The contract calls for IBM to deliver 152 individual service and supply items to FAA, ranging from hardware and software to training and support services. Because of the complexity of the contract and the varying levels of effort required from the contractor, several different pricing structures are used to determine costs under the contract. Additional details on the complexity of the costs and pricing structures for each of the AAS phases is provided in appendix III.

As of December 21, 1990, the AAS contract had been modified 63 times. These modifications primarily involve revising service and supply item requirements, delivery schedules, and contract administration procedures. The modifications have increased the contract's estimated cost by about $242 million, bringing the total estimate to about $3.8 billion[3] — $1.8 billion for basic items and $2.0 billion for options.

To date, the cost of 31 of the 152 contract line items has not been negotiated between IBM and FAA. FAA contracting officials state that they are currently unable to estimate the cost for these items because the government does not have enough information, such as the number of sites, to negotiate a cost. When these items are negotiated, the total estimated cost of the contract is likely to increase.

---

[2]FAA currently maintains 20 Air Route Traffic Control Centers in the continental United States that control air traffic between airports.

[3]This amount includes $2.8 million for overall contract performance fees awarded to IBM and $9.9 million for price adjustments resulting from a stop work order due to a contract protest in 1988.

# AAS Contract Management Control System Provides Cost and Performance Information to FAA

The size, complexity, repeated modifications, and likely future cost growth of the AAS contract require that FAA receive detailed information on the cost and performance of AAS. To ensure that it received this information and to help it monitor and administer the contract, FAA required IBM to follow Department of Defense guidance for establishing and maintaining a management control system. This guidance establishes the criteria for contract cost and schedule control systems necessary to monitor major systems acquisitions.[4] Such control systems should provide data that (1) indicate work progress; (2) relate cost, schedule, and technical accomplishments; (3) supply managers with summarized information; and (4) are timely and auditable. FAA contracting officials stated that management control systems based on the Defense guidance have proven effective in monitoring other complex government acquisitions.

To implement this guidance for the AAS contract, FAA identified and provided IBM with 13 broad categories of performance under the contract. IBM was then required to develop a detailed itemization of these broad categories, known as a work breakdown structure, to represent all work to be performed. This detailed breakdown resulted in 2,012 activities that form the basis for how IBM bills the government for work performed and reports cost and progress on the contract.

The contract requires IBM to submit a monthly cost and performance report on AAS contract activity. This report identifies the detailed activities that have been performed and the quantified level of effort expended on the contract during that reporting period. This information is compared with the estimated cost and schedule for each of the applicable 2,012 activities. The report then identifies any differences and provides the contractor's explanation for variances.

# IBM's Reporting Augmented in Response to Contracting Officer's Request

In November 1989, FAA's AAS contracting officer decided that the agency's ability to monitor costs for individual cost-reimbursable contract line items needed to be enhanced. Although the contractor was reporting costs by the 13 broad categories and 2,012 work breakdown structure activities, the contract did not require IBM to identify and report costs for each of the 152 contract line items.

---

[4]Department of Defense Instruction 7000.2, Performance Measurement for Selected Acquisitions (June 10, 1977); and Military Standard Number 881A, Work Breakdown Structures for Defense Material Items (Apr. 25, 1975).

To remedy this and obtain the needed information, the contracting officer requested that IBM begin reporting cost and performance information for each of the cost-reimbursable contract line items. IBM responded with a proposal to submit an additional report, at no cost to the government, to provide this information. In February 1990, FAA's contracting officer accepted IBM's proposal and began receiving the new report, which provides cost and performance for each cost-reimbursable contract line item.

## Audit and Agency Officials Confident About Monitoring Information

At the request of FAA, the Defense Contract Audit Agency (DCAA) is to provide continuous audit coverage of the AAS contract. As part of this coverage, DCAA identified IBM's major systems, and policies and practices planned for use in managing the AAS contract. DCAA's February 1989 survey generally found that IBM's systems and practices were sufficient and suitable for properly costing and administering government contracts. DCAA officials added that while they had not conducted an in-depth review of the IBM management control system, implementation of Defense guidance for a management control system provides detailed information on contract costs and contractor performance.

FAA has reviewed the AAS management control system and is continuing to conduct periodic reviews. FAA's reviews have concluded that the system in place is meeting the requirements of the Defense guidance and is accurately tracking cost and performance.

## Conclusions

AAS is a complex and costly development, central to the modernization of our nation's air traffic control system. Because of the size and complexity of the AAS contract and because further estimated cost increases are likely, it is important that FAA receive detailed information on the cost and performance of the contract. IBM has implemented a management control system that provides this information and permits FAA to identify the cost and performance of AAS. When combined with periodic FAA verification of contractor-reported cost and performance, this system should provide a sufficient basis to monitor the contract.

We discussed the contents of this report with FAA, IBM, and DCAA officials and have reflected their views in the report as appropriate. We plan no further distribution of this report until 30 days from the date of this letter. We will then send copies to interested congressional committees;

the Secretary of Transportation; the Administrator, FAA; and other interested parties. We will also make copies available to others upon request.

Should you have any questions about this report or require additional information, please contact me at (202)275-9675. Major contributors are listed in appendix IV.

Sincerely yours,

JayEtta Z. Hecker
Director, Resources, Community, and Economic
 Development Information Systems

# Contents

**Abbreviations**

| | |
|---|---|
| AAS | Advanced Automation System |
| DCAA | Defense Contract Audit Agency |
| FAA | Federal Aviation Administration |
| GAO | General Accounting Office |
| IBM | International Business Machines |
| IMTEC | Information Management and Technology Division |

# Objective, Scope, and Methodology

In response to a July 3, 1990, request from the Chairman, Subcommittee on Transportation and Related Agencies, Senate Committee on Appropriations, our objective was to determine whether IBM has implemented a management control system that enables FAA to identify AAS costs.

To address our objective, we met with key officials from FAA, IBM, and DCAA and discussed IBM's reporting of contract information. We reviewed Department of Defense Instruction 7000.2 and Military Standard 881A which FAA required IBM to follow in establishing and maintaining a management control system. We examined (1) a DCAA accounting system survey for IBM's Air Traffic Control Segment of its Federal Sector Division, and (2) several FAA reports on IBM's and its subcontractors' ability to implement an acceptable system. We also reviewed IBM monthly cost performance reports and other agency and contractor reports on AAS.

In addition, we determined the negotiated costs for the contract by reviewing the AAS contract, contract work breakdown structure, and the 63 modifications made to the contract as of December 21, 1990. We analyzed the estimated costs for the contract's 152 service and supply items and identified actual costs incurred to date by reviewing several IBM and FAA cost reports.

We did not attempt to verify that IBM's reported costs were valid and reasonable. In addition, we did not conduct an in-depth review of IBM's accounting systems, in view of the fact that DCAA is performing continuous reviews of the systems.

We conducted our work between August and December 1990 at FAA headquarters in Washington, D.C., IBM in Rockville, Maryland, and DCAA in Gaithersburg, Maryland. We conducted our work in accordance with generally accepted government auditing standards. We discussed the contents of this report with FAA, IBM, and DCAA officials and have reflected their views in the report where appropriate.

# Description of the AAS Program

AAS is to provide a new automated air traffic control system that includes improved controller workstations, computer software, and hardware. According to FAA, the system will make possible the full consolidation of en route and terminal operations into area control facilities. FAA plans to produce and implement AAS by integrating commercially available hardware and software, and specially developed software services.

To achieve a fully capable system, FAA's contract with IBM calls for implementing AAS in three steps. The first step consists of two primary phases:

- The peripheral adapter module replacement item is to provide an enhanced ability to interface with additional radars, and a capability to use higher data transmission rates for radar site interfaces.
- The initial sector suite system, which constitutes the largest portion of the AAS program, is to supply new controller workstations at en route centers to replace existing controller displays, and automate some related processes that are currently done manually.

The second step consists of the terminal advanced automation system, which is to provide additional hardware and software to support terminal automation capabilities. This hardware and software is to be installed in existing en route facilities to allow FAA to consolidate some smaller terminal facilities into en route centers.

The third step is to provide (1) additional automation support to allow for the consolidation of the remaining large terminal control facilities at en route centers, and (2) automation support in airport towers. This step is composed of the following phases:

- Area control computer complexes are to provide the software to perform en route functions in area control facilities and install additional hardware to enable the conversion of air route traffic control centers into area control facilities.
- Tower control computer complexes are to be installed in selected airport traffic control towers.

# Description of the AAS Contract

To meet AAS' production and implementation approach, FAA awarded a contract to IBM, currently valued at approximately $3.8 billion. The table below identifies the estimated costs as of December 1990 for each of the AAS phases.

**Table III.1: Estimated Costs of AAS Phases as of December 1990**

Dollars in millions

| Phase | Estimated cost |
|---|---|
| Peripheral adapter module replacement item | $57 0 |
| Initial sector suite system | 903 9 |
| Terminal advanced automation system | 918 9 |
| Area control computer complex | 356 4 |
| Tower control computer complex | 653 4 |
| Other[a] | 906 6 |
| **Total** | **$3,796.2** |

[a]Contains items that cannot be easily identified by phase, or that are necessary for many or all phases

The contract requires that IBM deliver 152 service and supply items. These items include the software, hardware, training, engineering services, and maintenance support necessary to produce a fully capable system. These service and supply items are divided into several different pricing categories depending on the type of effort necessary to produce each item. Table III.2 depicts the number of service and supply items for each phase by pricing structure.

**Table III.2: Contract Supply and Service Items Pricing Structures by Implementation Phase**

| | Pricing Structure | | | | | |
|---|---|---|---|---|---|---|
| | Cost-reimbursable | | | | | |
| Phase | Cost-plus-Phase fixed-fee | Cost-plus-incentive-fee | Fixed-price-incentive | Firm-fixed-price | Fixed-price-level-of- effort | Total |
| Peripheral adapter module replacement item | 0 | 4 | 4 | 1 | 5 | 14 |
| Initial sector suite system | 2 | 5 | 5 | 3 | 5 | 20 |
| Terminal advanced automation system | 0 | 4 | 38[b] | 4 | 3 | 49 |
| Area control computer complex | 0 | 5 | 0 | 1 | 3 | 9 |
| Tower control computer complex | 0 | 9 | 15 | 2 | 5 | 31 |
| Other[a] | 2 | 8 | 7 | 1 | 11 | 29 |
| **Total** | **4** | **35** | **69** | **12** | **32** | **152** |

[a]Contains items that cannot be easily identified by phase, or that are necessary for many or all phases.

[b]Contains two items that are shared with the area control computer complex.

Descriptions of each of the types of contract pricing structures used for
AAS follow.

- The cost-plus-fixed-fee category is for cost-reimbursable items that
  include a negotiated fixed fee. This category permits contracting for
  efforts that might otherwise present too great a risk to contractors, but
  provides the contractor with only a minimum incentive to control costs.
- The cost-plus-incentive-fee category is a cost-reimbursable pricing
  arrangement that provides the contractor with an incentive to effi-
  ciently develop hardware and software. The development incentive lies
  in the fee portion of this arrangement. Under this arrangement, a target
  cost and target fee for contractor performance are negotiated for the
  item. If the total allowable cost for the item exceeds target cost, the con-
  tractor will begin to forfeit a percentage of the fee for every dollar
  above the target cost.
- The fixed-price-incentive category provides a profit incentive for con-
  tractors to control costs or improve contract performance. This incen-
  tive is based on the costs incurred for producing the item. Under this
  pricing arrangement a target cost, profit, and ceiling price are negoti-
  ated. If the final cost for the item exceeds target cost, the contractor will
  begin to forfeit a percentage of the target profit for every dollar above
  the target cost. If final cost exceeds ceiling price, the contractor will
  absorb the difference as a loss.
- The firm-fixed-price category provides for a price that is not subject to
  change based on the contractor's cost experience in performing the con-
  tract. This category is used for commercially available products that
  require minor variations to meet government specifications, or other
  supplies or services that use reasonably definite functional or detailed
  specifications where the contracting officer can establish a fair and rea-
  sonable price from the outset.
- The fixed-price-level-of-effort category requires that the contractor pro-
  vide a specified level of effort over a given period of time on work that
  can be stated only in general terms for a fixed dollar amount.

# Major Contributors to This Report

## Information Management and Technology Division, Washington, D.C.

Joel C. Willemssen, Assistant Director
M. Rose Hernandez, Evaluator-in-Charge
Matthew D. Ryan, Staff Evaluator

## Ordering Information

The first five copies of each GAO report are free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

U.S. General Accounting Office
P. O. Box 6015
Gaithersburg, MD 20877

Orders may also be placed by calling (202) 275-6241.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300