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BY THE COMPTROLLER GENERAL

# Report To The Chairman, Committee On Government Operations House Of Representatives OF THE UNITED STATES

# Greater Emphasis On Information Resource Management Is Needed At The Federal Aviation Administration

The Federal Aviation Administration does not have an overall planning process or central management direction over its information resources used for administrative functions. As a result, it has acquired excess computer hardware and has experienced problems in developing major software systems projects.

To provide leadership and direction for FAA's information resources, GAO recommends that FAA centralize its management of information resources, assigning the central authority a clear mandate to carry out comprehensive information resources planning and other essential management functions.

GAO also recommends that the Secretary of Transportation develop a Department-wide computer capacity and workload management program and require that FAA make use of suitable computer capacity, if available in the Department, before acquiring new capacity of its own.

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GAO/RCED-83-60
NOVEMBER 24, 1982

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-206887

The Honorable Jack Brooks
Chairman, Committee on Government
Operations
House of Representatives

Dear Mr. Chairman:

As requested in the House Government Operations Committee report of June 11, 1981, we have reviewed the Federal Aviation Administration's (FAA's) planning, management, acquisition and use of information resources, specifically automatic data processing. This report concentrates on the use of automated systems for administrative functions. We plan to issue a separate report addressing FAA's automated system for air traffic control operations.

Our report discusses a number of problems with FAA's management and planning of automated systems used for administrative purposes and contains recommendations which should improve FAA operations in the immediate future and over the long term. We did not obtain agency comments on this report.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of the report. At that time we will send copies to the Secretary of Transportation; Administrator, Federal Aviation Administration; Director, Office of Management and Budget; Administrator, General Services Administration; and other interested parties. We will also make copies available to others upon request.

Sincerely yours,

Charles A. Bowsher

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CHAIRMAN COMMITTEE ON GOVERNMENT OPERATIONS, HOUSE OF REPRESENTATIVES

# GREATER EMPHASIS ON INFORMATION RESOURCE MANAGEMENT IS NEEDED AT THE FEDERAL AVIATION ADMINISTRATION

## D I G E S T


The Federal Aviation Administration (FAA) regulates civil aviation and provides for safe and efficient use of the Nation's airspace. FAA makes extensive use of automatic data processing (ADP) for both air traffic control operations and administrative purposes. The House Government Operations Committee asked GAO to evaluate FAA's planning, management, and acquisition of automated information systems for both uses. This report concentrates on the use of automated systems for administrative purposes such as personnel, financial management, accident/incident/violation reporting, and other administrative reporting functions. GAO plans to issue a separate report assessing FAA's automated systems for air traffic control. (See p. 2.)

FAA has taken steps to improve its ADP procedures and guidelines for initiating and approving national hardware and software development projects to meet its information needs. Recently, it has strengthened its regional project management and review process for software systems used for administrative functions.

Despite these improvements, GAO's review disclosed a number of management and technical problems remaining in information-related functions, especially ADP. GAO found that FAA is procuring excessive computer hardware capacity at the Aeronautical Computer Center in Oklahoma City, Oklahoma, and at its regional offices and is allowing major software projects to proceed or be developed without appropriate management controls. These conditions prevail because ADP management control and oversight are dispersed throughout the agency. In addition, information requirements analyses are not adequately conducted to support computer acquisitions. GAO concluded that FAA needs to provide more central management direction and control over its information resources and improve its information resource planning and project management. (See p. 9.)



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GAO's review also addressed the Department of Transportation's implementation of the ADP aspects of the Paperwork Reduction Act of 1980. GAO found that, at the secretarial level, the Department could provide better guidance on acquiring, managing, operating, and using information resources to its subunits, including FAA.

## NEED FOR AGENCYWIDE INFORMATION RESOURCES PLANNING

GAO found that, despite the growing complexity and size of FAA's computer hardware acquisitions and software projects, FAA has not made a comprehensive analysis of its overall information requirements. FAA orders require information requirements planning on a project-by-project basis, but they do not require overall planning to meet agencywide functional needs.

FAA officials believe that project level planning and analysis of requirements is sufficient. However, because FAA has relied on project level planning, it is not in a position to (1) identify overlapping or duplicative systems or unmet functional needs, (2) lay out its long-term strategy for achieving the desired overall grouping or integration of software systems, and (3) evaluate the overall effectiveness of its existing information systems. Further, FAA does not have a complete and reliable basis for acquiring computer hardware to meet short-term or long-term computer capacity needs. (See pp. 4 to 6.)

FAA officials indicate that a more comprehensive planning approach, while desirable, would encounter "real world" constraints, including the long lead time involved in acquiring new systems and the need to concentrate personnel and funding resources on resolving anticipated shortages in computer capacity. However, GAO believes a comprehensive planning process could address long-term information requirements as well as anticipated computer capacity shortages. GAO recommends that FAA implement a comprehensive information requirements planning process. (See p. 10 .)

NEED FOR AN INFORMATION
RESOURCES MANAGEMENT OFFICE

FAA's organizational structure and management approach have not provided the central direction necessary for planning, acquiring, and using ADP and related information resources. FAA could carry out these functions by applying major aspects of the Paperwork Reduction Act of 1980, a law intended to improve the Government's approach to information management. The act stresses a unified approach to information resources management under the leadership of a high-level official.

GAO found that while FAA has assigned the authority for most of these functions to a high-level official, it has to date left significant responsibility dispersed among several headquarters and field offices and a committee. GAO believes that a management structure which places the high-level official directly in charge of an office having day-to-day responsibility for information resources would be more effective in carrying out these functions. (See pp. 7 to 9.)

GAO recommends that FAA strengthen and integrate its management structure for information resources by placing both the authority and responsibility in a central management office under the control of a high-level official for information resources. This official, as head of the central office, should direct the comprehensive planning process for information resources and oversee software development and hardware acquisitions as also recommended by GAO.

NEED FOR BETTER
SOFTWARE MANAGEMENT

FAA's systems review committee was established to provide management direction and review and approve proposed and on-going software projects. GAO reviewed 12 out of 119 administrative software development projects and noted shortcomings in the committee's adherence to FAA's own standards regarding analysis of requirements and consideration of alternatives as well as costs and benefits. Many of the problems occurred early in the initiation phase that precedes the development of software systems. (See pp. 11 to 14.)

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To provide a more unified and consistent approach for software management, GAO recommends that FAA shift the committee's overall management responsibilities to the central management office recommended above. The committee could continue reviewing software projects and hardware acquisitions to help ensure that they address the information needs of various user organizations. GAO also recommends that FAA require user organizations to prepare a thorough analysis of requirements, feasible alternatives, and cost-benefits to better justify and support proposed software projects. (See p. 16.)

NEED FOR BETTER HARDWARE MANAGEMENT

FAA is completing two major procurement actions--(1) minicomputer systems for its regional offices and (2) a large mainframe computer for the Aeronautical Center estimated to cost about $24 million. These procurements are continuing, even though GAO's review showed that FAA's current and projected workload does not support procurements of this size. Also, FAA did not adequately take into account the option of using the excess computer capacity at the Department of Transportation's Computer Center in Washington, D.C., to meet a substantial part of FAA's data processing requirements. The Department could minimize excess capacity by achieving a better balance between departmentwide computer capacity and workload. GAO recommends that the Department develop and implement a departmentwide information resources and workload management program to improve allocation of ADP workload and provide needed computer capacity within the Department. (See p. 21.)

AGENCY COMMENTS

GAO did not obtain agency comments on this report but discussed factual information contained in the report with FAA and Department of Transportation officials.

On April 20, 1982, GAO issued an interim report to the House Committee on Government Operations entitled "Examination of the Federal Aviation Administration's Plan for the National Airspace

System--Interim Report (AFMD-82-66)." Subsequently, the agency responded to sections of the interim report addressing FAA's use of ADP for administrative functions.

GAO's interim report concluded that two acquisitions of computers for administrative functions (the same as those covered in this report) were not adequately based on information requirements, an evaluation of alternatives, and cost-benefit analyses, and recommended canceling both procurement actions. The Department disagreed and stated that GAO's recommendations were not supported by the technical data provided to the GAO study team.

GAO evaluated additional information on FAA's computer requirements and on its plans to proceed with both computer acquisitions. Based on further evaluation of additional data provided by the agency, GAO still believes that FAA is acquiring computer capability that it does not need. FAA's comments on this interim report and GAO's evaluation are discussed in more detail in appendix II.

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# Contents

## ABBREVIATIONS

| | |
|---|---|
| ADP | automatic data processing |
| DOT | Department of Transportation |
| FAA | Federal Aviation Administration |
| GAO | General Accounting Office |
| IRM | information resource management |
| ISRC | Information Systems Review Committee |
| OMB | Office of Management and Budget |
| TCC | Transportation Computer Center |

# CHAPTER 1

## INTRODUCTION

The Federal Aviation Administration (FAA), a part of the Department of Transportation (DOT), traces its origin to the Air Commerce Act of 1926, which led to the establishment of the Aeronautics Branch in the Department of Commerce. The Aeronautics Branch was given the authority to certify pilots and aircraft, develop air navigation facilities, promote flying safety, and issue flight information. The Civil Aeronautics Act of 1938 established the independent Civil Aeronautics Authority with responsibilities in both the safety and economic areas.

In 1958 the Congress passed the Federal Aviation Act, which created the independent Federal Aviation Agency with broad authority to regulate civil aviation and provide for the safe and efficient utilization of the Nation's airspace. In April 1967, the Federal Aviation Agency's responsibilities were placed with FAA in the new Department of Transportation. FAA functions within DOT under a separate budget authority. FAA's total budget for fiscal year 1982 was about $2.9 billion.

### AUTOMATIC DATA PROCESSING IS USED EXTENSIVELY BY FAA

FAA makes extensive use of automatic data processing (ADP) to support its missions, both for air traffic control operations and administrative purposes. FAA defines administrative computer systems as those hardware and software systems that are not directly controlling aircraft in the Nation's air space even though administrative information may originate in the air traffic control system. FAA operates over 100 automated systems for administrative purposes. The Personnel Management Information System, Instrument Approach Procedures Automation, and the Accident-Incident Data System are examples of such systems.

For fiscal year 1982, FAA estimates that its ADP and telecommunications costs, excluding acquisitions, may exceed $38 million. Actual expenditures for fiscal year 1981 exceeded $28 million. Although the automated air traffic control functions account for most of these expenditures, a clear trend toward increased costs and use of ADP for administrative purposes is continuing. Between fiscal years 1981 and 1982, FAA's expenditures for administrative ADP functions increased from approximately $4.5 million to nearly $9.7 million.

### OBJECTIVES, SCOPE, AND METHODOLOGY

House Government Operations Committee Report No. 97-137, June 11, 1981, requested that we review FAA's planning, management, and acquisition of automated systems for air traffic control and administrative purposes. In response to this request, we initiated concurrent reviews that will result in two separate reports. This,

the first of the two reports, covers our work on FAA's planning, management, and acquisition of ADP resources for administrative purposes. The second report will address FAA's National Airspace System Plan and issues related to air traffic control, including the modernization of automated systems.

In March 1982 the committee asked us to prepare an interim report covering our preliminary evaluation of FAA's plan to modernize the National Airspace System. Our interim report, which was issued April 20, 1982, included our final evaluation of procurement actions to acquire computer systems for administrative purposes. The purpose of this report is to (1) evaluate FAA's implementation of information resource management principles and Public Law 96-511, the Paperwork Reduction Act of 1980 (ch. 2), (2) evaluate FAA's management of software development activities (ch. 3), and (3) analyze FAA's actions on its two administrative computer procurements to the extent necessary to update information contained in our April 20, 1982, report (ch. 4).

To evaluate FAA's management of software development activities, we selected 12 out of 119 software development projects as of November 1981. These activities involved 9 of 18 ongoing software development projects and 3 of 101 completed software development projects. The software activities we selected were significant in terms of estimated cost or potential benefits or were intended to provide management support to the National Airspace System. Within these parameters, we selected software projects that covered a broad range of functions and information areas such as airspace, accident/incident/violation, and financial. We examined FAA's software development practices for the 12 software development projects to identify specific systemic weaknesses. We relied, in part, on information FAA developed during its review of software and hardware issues. We also relied on our prior reviews of FAA's management of its administrative and management systems to help us identify potential deficiencies for further evaluation. Our prior reviews included:

--"Improved Planning and Management of Information System Development Needed," LCD-74-118, Aug. 18, 1975.

--"Large-Scale Computer for Administrative Purposes Not Needed at FAA's Aeronautical Center," letter to the Secretary of Transportation, Apr. 21, 1976.

--"Strong Centralized Management Needed in Computer-Based Information Systems," LCD-78-105, May 22, 1978.

--Our Apr. 20, 1982, interim report.

We analyzed contracts, records, reports, and related information. We interviewed FAA officials in (1) the Office of Management Systems which has operational responsibility for most of FAA's administrative software development and hardware procurement activities, (2) user divisions which have key roles in software

development, (3) the Aeronautical Center's computer facility, which is responsible for managing its computer hardware, and (4) FAA's southern, southwestern, and central regional offices, which are located in Atlanta, Fort Worth, and Kansas City, respectively.

Our scope also included an assessment of ADP aspects of information resource management (IRM) at the Department level. In this connection, we held discussions with officials of DOT's Office of the Secretary responsible for implementing the Paperwork Reduction Act of 1980, developing Department-wide ADP policy, and managing the Transportation Computer Center (TCC). We also met with Office of Management and Budget (OMB) officials responsible for providing guidance to Federal agencies in implementing the Paperwork Reduction Act. We conducted our field work from September 1981 to April 1982 and completed additional followup work in September 1982. We performed our work in accordance with generally accepted government audit standards.

Because we did not use a structured sampling methodology, we are not attempting any statistical projection of our results. The problems evident in the projects we reviewed, however, indicated several systemic weaknesses which formed the basis for our conclusions and recommendations. Our review of selected software projects is discussed in detail in chapter 3.

## CHAPTER 2

## FAA's INFORMATION RESOURCE PLANNING AND DIRECTION NEED IMPROVEMENT

Planning for ADP, like other resource planning, consists of an analysis of the total agency requirements, a description of systems needed to satisfy the requirements, feasibility studies of alternatives, and cost-benefit analyses for each alternative approach or system. While recognizing the need to update some planning procedures, FAA officials in charge of information resources have not developed a comprehensive plan because they believe that the current ADP planning process is responsive to FAA's needs. Our review shows, however, that FAA's planning approach has not kept pace with its growing ADP needs and has resulted in the development of redundant and costly information systems.

### FAA NEEDS TO ESTABLISH A COMPREHENSIVE PLANNING PROCESS

The key to a comprehensive ADP planning process is the identification of an organization's overall information requirements. This step was generally omitted in early automation efforts because the high cost of computer hardware usually meant that users could afford only a few automated software systems. With today's modern technology, however, automated systems can economically process a wide range of agency information applications simultaneously. The importance of comprehensive planning to meet information requirements is further emphasized in the Paperwork Reduction Act of 1980. The act formally recognized the significance of an agencywide comprehensive information resource management program under the direction of a single high-level official.

In a May 1978 report, 1/ we concluded that FAA needed to adopt a comprehensive planning process. The chief of FAA's Data Systems Management Division told us that FAA responded to our 1978 report by creating a long-range planning document and a modified Data System and Equipment Services document which includes current as well as prospective software descriptions. While these actions improved certain aspects of FAA's planning, they do not respond to the need for comprehensive planning.

By comprehensive requirements planning, we are referring to an agencywide process which documents the information FAA needs to collect and produce, who needs to use the information, and how accurate and timely it needs to be. These general information requirements are independent of specific manual and automated information systems intended to satisfy these requirements. In this regard, user organizations need to identify their total

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1/"Strong Centralized Management Needed in Computer-Based Information Systems," LCD-78-105, May 22, 1978.

requirements by translating mission statements into work processes and information flows. When collected and synthesized at the agency level, agencywide information requirements then can be identified, priorities established, and the specific software systems needed to satisfy the requirements can be identified.

This analysis on a comprehensive basis provides a baseline for evaluating the existing manual and automated information processes. The evaluation of processes, in turn, provides a basis for assessing current hardware capacity and future hardware requirements. In other words, FAA needs a comprehensive analysis of information requirements to validate its existing software systems and justify using its current software systems as a basis for projecting hardware requirements.

We found that FAA's planning document "Management Information ADP Concepts and Support Plan for the 1980's" provides a conceptual framework for requirements planning. However, it does not describe major and specific information requirements and planning elements such as strategies, tasks, and milestones. As a result, FAA acquires computers and develops software systems without the benefit of comprehensive plans that address FAA's agencywide information needs.

We also found that the results of FAA's current planning efforts are essentially (1) an annual compilation of the administrative software applications presently being processed and (2) short, descriptive narratives of ongoing software development projects. Individual software development projects are considered on a project-by-project basis, and individual program officials are primarily responsible for analyzing information requirements and initiating software development projects. Although these projects are reviewed at higher management levels before they are approved, the appropriateness of decisions on approving system development projects is limited by the absence of an agencywide plan.

We were told that a comprehensive plan has not been developed because FAA believes that its current planning approach is sufficient and that it is responsive to agency needs. FAA acknowledges that more comprehensive planning would be desirable but believes it is not practicable given real world constraints, including the long lead time involved in acquiring new systems and the need to provide adequate computer capacity for new systems that are currently under development.

We did not analyze the personnel and funding resources needed to enhance FAA's planning efforts. However, we do discuss in chapters 3 and 4 FAA's expenditure of funds and use of staff to develop and maintain software and acquire computer hardware without adequate planning and justification. We believe that FAA could better utilize its limited staff and funds to develop comprehensive ADP plans and thus provide a greater level of assurance that planned software development and hardware acquisitions are actually needed. We further believe that a comprehensive planning effort can and

should address anticipated computer capacity shortages at the same time it addresses broader needs.

Our review showed that FAA's current inventory of software systems does not provide a reliable basis for long-range planning for several reasons, including:

--Programs, while functionally different, often interact in accomplishing its missions. Therefore, these functions need to be viewed collectively to ensure that total information needs are met through consolidated systems, rather than through a series of individually tailored systems.

--Existing software systems which have evolved on a piecemeal basis over several years may no longer meet FAA's management information needs. Further, these systems are in some instances, redundant and inefficient, resulting in an uneconomical use of staff or computer resources.

The potential for inefficient and uneconomical results in a project-by-project approach is illustrated by one of FAA's ongoing projects, the Aviation Safety Analysis System. The plans for the system are to consolidate approximately 30 different aviation safety data bases and software systems, covering areas such as personnel registration, aircraft certification and tracking, and safety incident identification. The system is designed to meet the individual needs of 14 FAA organizations in addition to FAA regions and centers. However, the design does not take into account the existing component data bases and other elements of the overall information system. Therefore, any redundancy or inefficiency existing in the individual data bases and systems will be incorporated into the "new" consolidated system.

Duplication of systems exists, for example, in FAA's energy management information activities. Specifically, in satisfying Executive Order 12003 which requires FAA to provide energy consumption data to the Department of Energy, two FAA regions have independently developed automated systems. Meanwhile, a similar national agencywide system has been in the initial planning stage for 4 years. The concurrent and independent development of such local and national systems has resulted in the expenditure of duplicative resources to analyze information requirements and to develop the necessary software. To further illustrate this point we found 13 financial information and accounting systems have been independently developed by two or more regions. Proliferation of systems is also a problem. We found 42 separate financial information needs being met by 32 local systems. FAA can reduce the number of systems by consolidating financial and accounting systems. Although FAA has initiated steps to correct the duplication and proliferation problems, a more concerted effort on an agencywide basis is required.

## NEED FOR CENTRAL MANAGEMENT DIRECTION OF INFORMATION RESOURCES

In response to its concern over inadequate management of information resources in Federal agencies, the Congress enacted the Paperwork Reduction Act of 1980 (Public Law 96-511) to improve the management of these resources within the executive branch of the Government. In response to the act, DOT designated a senior official to be responsible for information resources. In turn, he has delegated to DOT's Office of Information Systems and Telecommunications Policy (OISTP) the responsibility for carrying out the mandates of the act departmentwide.

FAA, as a subunit of the DOT, is responsible for managing its information resources consistent with the act's objectives. To discharge these responsibilities, FAA

--designated the Associate Administrator for Administration as its high-level official for information management;

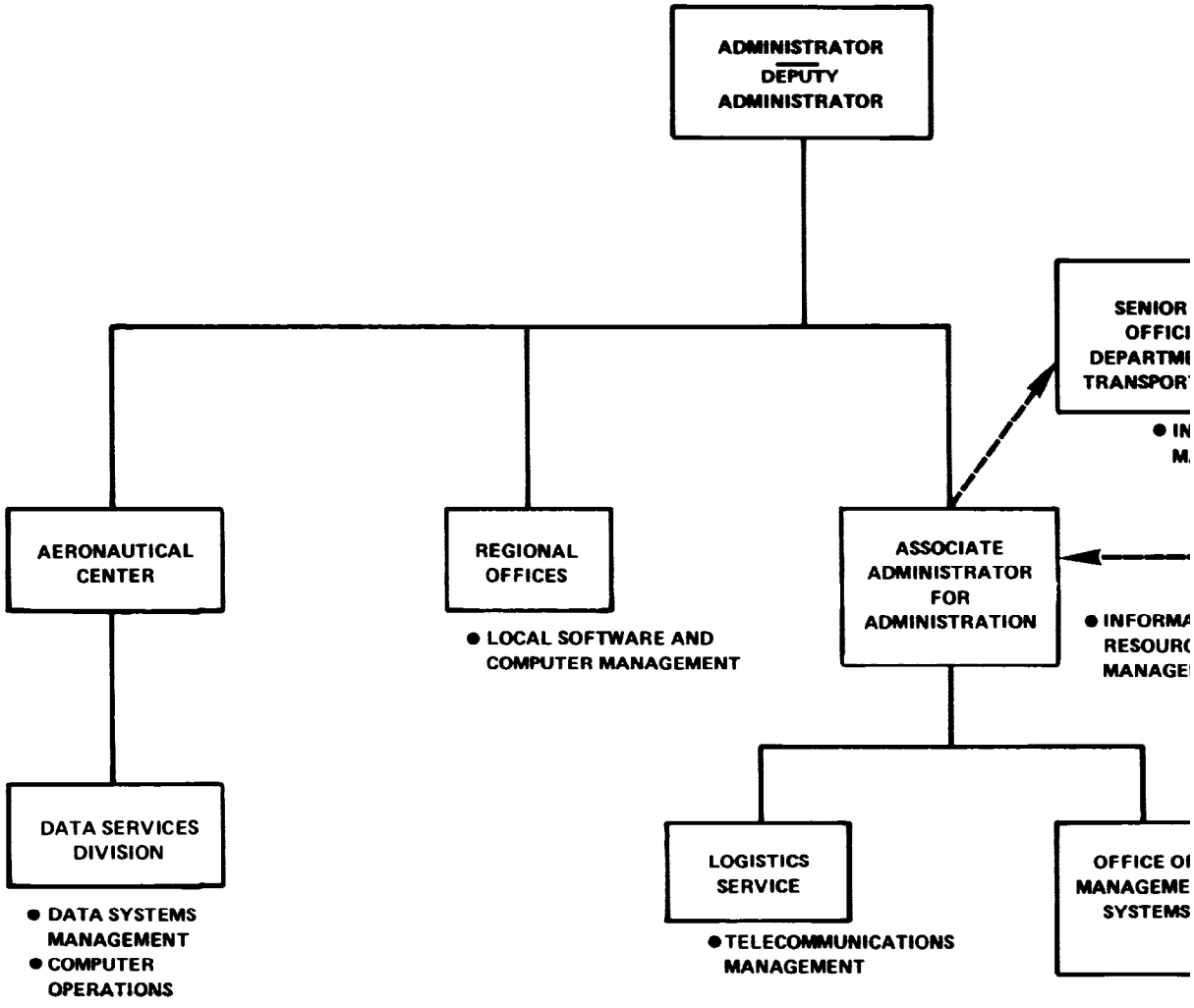
--retained its existing Information Systems Review Committee, with the Associate Administrator for Administration as its chairman, to provide top management oversight and involvement in decisions relating to the review and approval of hardware procurement and software development projects; and

--retained its existing Office of Management Systems, which over time had assumed responsibility for many information resource management functions. (As indicated on the organization chart on p. 8, the Director of that office reports to the Associate Administrator for Administration.)

However, FAA's organizational structure has hampered its effectiveness in managing information resources as intended under the act. As shown in the organizational chart on page 8, FAA's high-level official, the Associate Administrator for Administration, does not directly supervise important information resource management activities. The Chief, Data Services Division, for example, who reports to the Director of the Aeronautical Center in a separate organizational branch of FAA, supervises over one-third of FAA's administrative information resource management staff and is responsible for in-house software systems development and operation of FAA's central computer facility. This arrangement makes it difficult for the Associate Administrator for Administration to coordinate these activities with those for which he is directly responsible.

A further complicating factor is the assignment of software management functions to the Informations Systems Review Committee. While the Associate Administrator for Administration chairs this committee, its part-time role limits the effectiveness of its input on important decisions that need to be addressed on a

## FAA'S ORGANIZATION FOR INFORMATION RESOURCE MANA



full-time basis. This problem is discussed further in chapter 3 of this report.

Finally, the delegation of authority from the Associate Administrator for Administration to the Director of the Office of Management Systems is not clear. The Director is carrying out information resource functions, including aspects of software management, without a mandate clearly spelling out his responsibilities to do so. Accountability for information resource functions needs to be clarified. This clarification would also serve to identify responsibilities remaining with the Associate Administrator and make it possible to assess whether this Administrator can reasonably be expected to carry out his responsibilities for information resource management along with his many other functions, including budget, personnel, labor relations, space management, and accounting. The burden on the Associate Administrator could be increased further, and become a far greater concern, to the extent that this official is also assigned information resource management responsibilities on FAA's mission side with regard to automation of air traffic control and communications.

Because responsibilities for managing information resources are dispersed within FAA, key functions are not being fully carried out. FAA, for example, has not performed in-depth reviews of hardware acquisition specifications, established and enforced standards for software development projects, or developed comprehensive plans for meeting agencywide information requirements. FAA could reduce these problems by clarifying and integrating its management structure for information resources.

## CONCLUSIONS

FAA's planning for automated management functions has not adequately identified and evaluated its need for administrative ADP resources. Given its wide-ranging and interrelated information requirements, FAA needs to analyze its total information requirements in a comprehensive and unified fashion to provide a basis for preparing a long-range plan for directing all resources efficiently and effectively. Instead, FAA is directing its resources on a case-by-case basis for individual software development projects and is relying on an incomplete software base to determine hardware acquisition needs.

To improve its planning and other information resource management activities, FAA needs to place greater emphasis on carrying out the objectives of the Paperwork Reduction Act related to ADP management and planning functions. Toward this end, FAA needs to restructure responsibility for all information resource management activities so that key functions are less dispersed. The head of a single central office should have under his or her control a comprehensive FAA planning process for information resources used to address administrative functions and oversee software development and hardware acquisitions carried out in accordance with the resulting plans.

## RECOMMENDATIONS

We recommend that the Secretary of Transportation direct FAA to:

--Implement a comprehensive planning process for information resources, including ADP. This process should provide a mechanism to (1) define information requirements on an agencywide basis and (2) establish objectives, strategies, and priorities for these requirements.

--Strengthen and integrate its management structure for information resources by placing responsibility for information resource management under the control of a single high-level official and by creating clear lines of authority to any other official to whom aspects of information management are delegated.

# CHAPTER 3

## IMPROVED SOFTWARE MANAGEMENT IS NEEDED TO REDUCE DEVELOPMENT AND OPERATING COSTS

FAA's administrative software systems have not met information needs at reasonable development and operating costs. We found that software project management in some projects resulted in wasted resources, protracted development schedules, and related management and technical problems. We also found that software projects did not adhere to FAA's automated data system orders that promote administrative software development practices.

FAA has recognized the need for sound management of its software development projects and has established regional review committees and a top-level management committee to provide project direction. This latter committee, known as the Information Systems Review Committee (ISRC), is comprised of six Associate Administrators. It has been assigned a management and oversight role with respect to hardware acquisitions and software development efforts. We found that the committee's review of proposed administrative software projects coming before it sometimes overlooked critical aspects of the proposal and did not consistently hold the proposing unit to FAA's existing standards for project approval. While the committee has a potentially valuable strategic planning and broad overview role, our review showed that direction and oversight of project management needs to be intensified. Because the committee functions on a part-time basis, we believe that its current project monitoring and management role should be assigned to a management office able to provide continuous direction and oversight of agency information resources management efforts.

### MANAGEMENT OF SOFTWARE NEEDS IMPROVEMENT

The large inventory of FAA's software systems for administrative purposes represents a significant investment of staff resources and funds to initiate, develop, and operate the systems. For example, actual and estimated costs to process changes to FAA's existing Aircraft Management Information System in fiscal years 1981 and 1982 exceeded $100,000 per fiscal year. Because of the importance and magnitude of software systems, strong central direction and oversight is needed. We found that FAA has not provided sufficient management direction in the preparation of requirements analysis, feasibility studies, cost-benefit analyses, and related front end planning activities. Further, FAA has not enforced software management standards to carry out these activities. Our review of projects showed that the current project management approach hampers FAA's efforts to plan, develop, and manage software activities in a consistent and uniform manner.

The authority and responsibility over software systems are shared by a review committee, the Office of Management Systems,

other offices, and individuals. As a result, no single office is held accountable for all software management functions and FAA is not effectively providing uniform and overall management direction for individual software projects and agencywide software functions.

Requirements identification and definition

Requirements identification and definition is the cornerstone of software system development because the user's requirements for automated information are identified in this phase. The output from the analysis is a statement of information requirements that become inputs to the system design process. Requirements should be sufficiently defined in this stage so that subsequent refinements do not materially affect project schedules or costs. In the projects we reviewed, this standard was not consistently applied or achieved.

The Air Traffic Controller Health Information System project is one example that demonstrates the effects of not following software development standards. The user division, which had management responsibility for the software project in the early stages, did not perform a thorough analysis and definition of its information needs because its staff believed that its needs were well known, making a rigorous study unnecessary. In July 1979, therefore, FAA prepared a feasibility study which showed that an existing automated medical system used at a Baltimore, Maryland, hospital could be adopted with relatively minor modifications. Based on this study, the ISRC approved the request to modify the existing system. However, by May 1981, after expending more than $200,000 for modifications, FAA determined that the system could not meet its needs because it was a clinically oriented pediatrics system for diagnostic work rather than a data capture and analysis system needed by FAA. The contract was subsequently amended to provide more than $200,000 in additional funding to systematically define information requirements and develop a new system. In this instance, FAA did not enforce a policy objective contained in FAA Order 1370.52A calling for an information requirements study to precede the feasibility analysis because it believed a full analysis was unnecessary. However, longstanding information systems development principles, which are validated by examples such as this, hold that information system requirements can rarely be adequately defined by intuitive judgments such as the user division made in this case. Therefore, FAA should adhere to its policy calling for an analysis of information requirements.

The Air Traffic Operational Error Deviation Information System project is an example that illustrates the effect of not adequately managing the requirements analysis process. In August 1979, at the request of the Air Traffic Service, an analyst reviewed and evaluated the potential for improving the existing system. According to the analyst, the project was not reviewed by the ISRC because the Office of Management Systems classified it as a system

modification project rather than a system development project. (FAA policy does not require committee approval of system modification projects.) We found, however, that FAA revised the basic data collection form which, in effect, changed the system requirements. In March 1980 the Office of Management Systems awarded the first of two contracts for a formal system requirements analysis and feasibility study. The resulting three studies consisted of:

--An October 1980 study of system requirements and feasibility, costing $61,000.

--A July 1981 study to develop a system design proposal using an in-house minicomputer, costing $31,000.

--A December 1981 study to examine the feasibility of using the DOT Computer Center and develop a system design proposal for that alternative, costing $18,000.

After the first of these three studies, the Office of Management Systems reclassified the system as a major new development project and submitted it to the ISRC for review and approval in February 1981. By this time project costs had already been incurred. Ultimately, the Office of Management Systems decided against implementing the contractor's two proposed designs. It determined that (1) the Air Traffic Service was still unable to define and articulate its information requirements and (2) the complexity of the design proposals far exceeded the Air Traffic Service's requirements to the extent they were known.

## Feasibility studies and cost-benefit analyses

Feasibility studies and cost-benefit analyses are closely associated with requirements analysis. One of their objectives is to establish that the identified requirements can be satisfied with existing technology or knowledge. Another purpose is to develop reasonable alternatives for meeting the requirements and to compare estimated costs with the value of the expected benefits.

Our review shows that FAA needs to improve its management of these studies and analyses. For example, a cost-benefit analysis of FAA's Energy Management Information System was only partially completed. Although FAA spent an estimated $60,000 for the initial requirements and feasibility studies, including cost-benefit analysis, no quantifiable benefits have been established for the new approved automated system. Without quantifying the benefits, FAA is not in a position to determine whether the selected system alternative would yield the greatest benefits.

Another example that illustrates the effect of an incomplete cost-benefit analysis is the development of the Instrument Approach Procedures Automation System (IAPA). A cost-benefit study prepared by a contractor did not contain estimates of items costing over $1 million. These costs were identified by the Office of Management

Systems several months after the study was received from the contractor. These costs include

--$398,800 for the predevelopmental portion of the study;

--$200,000 for software development of the Terminal Enroute Procedures System, a system which prescribes standardized methods in designing instrument flight procedures;

--$198,100 for leasing minicomputers and terminals during the development phase;

--$71,800 for computer hardware training and postimplementation evaluations;

--$66,200 for software modifications required to convert the contractor-developed software to FAA's computer; and

--$100,000 for project management time and travel expenses.

FAA's evaluation which disclosed these errors occurred several months after a contract was awarded to proceed with development. We found that the ISRC had only considered the contractor's executive summary of its cost-benefit study which did not disclose the basis for total costs. Although we are not in a position to state whether the final decision would have been changed, the ISRC should have obtained the contractor's detailed analysis of costs and benefits and should have had the analysis reviewed by the Office of Management Systems.

Cost collection and control

Accurate and complete cost collection is fundamental to making management decisions on whether to continue, terminate, or make changes to development projects. Our review shows that FAA's project managers generally did not have cost information readily available and, even when they obtained the information at our request, it varied greatly from project to project in terms of accuracy and completeness.

We found, for example, that virtually no cost data was available for the Energy Management Information System project. Although we located one document in the project manager's file that showed a cost of $60,000, support for this figure did not exist in the official project file. Further, the project manager told us that it would be impossible to reconstruct expenditures for the project.

Inadequate cost control procedures were also used in automating FAA's Uniform Accounting System (UAS). In October 1980 FAA estimated that one-time costs to design, develop, and implement UAS would total about $5.2 million, with design and development costs alone accounting for about $2.2 million. The UAS project manager, however, told us in December 1981 that FAA had not tracked

cumulative costs against its initial estimates and that complete estimates of actual costs would be difficult to produce.

We also found that FAA's Order 1370.52A requiring cost data to be reported for management review is unclear. The order requires that a quarterly project cost report be prepared for those projects subject to a monthly status reporting requirement. The order, however, does not specify how or by whom the cost information will be reviewed. Moreover, in practice the order calling for this requirement is not uniformally enforced. For example, we were told that monthly cost reporting is currently required for only 4 of the approximately 18 ongoing system development projects.

The Chief of the Data Systems Management Division told us in September 1982 that the project manager on each project is responsible for tracking costs and that the cost review process follows the general project review procedures established by the project manager's organizational element. He said that the Office of Management Systems, which provides project managers for most system development projects, reviewed project costs at the office director level on a monthly basis and that all projects were included in this review. Nevertheless, our review showed that FAA has not developed a standard, systematic approach for ensuring that all costs are collected and consistently reviewed for every project.

## CONCLUSIONS

The problems illustrated by the examples cited in this chapter demonstrate that FAA needs to strengthen fundamental elements of systems development project management. Several of the projects we reviewed had a history of inadequacies in requirements analysis, feasibility studies, cost-benefit analysis, and cost collection and control. We believe that these problems could be avoided if FAA strengthened its management direction and control by shifting software management responsibilities from the committee to a central management office. The committee has an appropriate role in periodically reviewing projects for consistency in meeting the needs of various interests reflected in committee membership and could be retained for that purpose. However, this committee cannot and should not be expected to provide continuous management direction for all software activities, primarily because its part-time role limits the effectiveness of its input on important decisions that need to be addressed on a full-time basis. We believe that an office of the type recommended in chapter 2 could provide the continuous management direction and control. This office should also be responsible for establishing and enforcing standards for project management and reviewing work performed on individual software projects.

## RECOMMENDATIONS

We recommend that the Secretary of Transportation direct FAA to:

--Shift software management responsibilities from the Information Systems Review Committee to a central office of the type we recommend in chapter 2.

--Require user organizations to prepare a thorough analysis of requirements, feasible alternatives, and cost-benefits as a basis for approving software development projects.

--Implement standard cost collection and control procedures for software projects and establish a control mechanism to trigger management reviews of high-cost variances.

## CHAPTER 4

## ALTERNATIVES IN FAA HARDWARE ACQUISITIONS HAVE NOT BEEN FULLY CONSIDERED

On April 20, 1982, we issued an interim report 1/ addressing, among other issues, FAA's plan to procure computers for its Aeronautical Center, located in Oklahoma City, Oklahoma, and its regional offices, at an estimated cost of about $24 million. In that report we stated that FAA's procurement actions should be canceled because they would result in excess capacity at the Aeronautical Center and the regions. Based on our report the House and Senate Appropriations Committees denied $1.65 million in fiscal year 1983 funds for the Aeronautical Center procurement. The Congress did, however, approve FAA's request that it be permitted to reprogram fiscal year 1983 funds from other sources to lease, rather than purchase, a computer for its Aeronautical Center.

On June 23, 1982, DOT forwarded a letter to the Chairman of the House Government Operations Committee in response to our report and included FAA's detailed comments on our recommendations. We evaluated these comments and in a July 1982 briefing informed the House Appropriations Committee that this evaluation did not lead us to change our views on the matters discussed in our April 20, 1982, report. We also stated that the agency's response does not justify the need for additional computer capacity at the Aeronautical Center. Our detailed response to the FAA and DOT comments is provided in appendix II.

Our April 1982 report also discussed DOT's consideration of options to the Aeronautical Center procurement, including the alternative of shifting part of the data processing workload of the Aeronautical Center to the Department's Transportation Computer Center (TCC) located in Washington, D.C.

The other procurement, calling for minicomputers in FAA's regional offices, is continuing as planned. FAA expects to complete the installation of these minicomputers in the near future. Because no significant changes have occurred with respect to the regional computer procurement since the discussion of it in our April report, we do not address it in detail in this chapter. Our position, the agencies' comments, and our evaluation of their comments are contained in appendix II.

To place these two procurements in perspective, we note that the control of DOT's total administrative computer capacity will shift dramatically. Previously, TCC housed (under DOT's control) about 80 percent of DOT's combined administrative computer capacity.

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1/"Examination of the Federal Aviation Administration's Plan for the National Airspace System--Interim Report," AFMD-82-66, Apr. 20, 1982.

After the regional and Aeronautical Center procurements have been completed, the total amount of administrative computer capacity available within DOT will have more than doubled. Further, FAA will have assumed control of approximately two-thirds of DOT's total administrative computer capacity. Our review disclosed that DOT's planning has not kept pace with or accounted for this shift in computer resource control and accountability.

## DOT'S REVIEW OF THE AERONAUTICAL CENTER PROCUREMENT

Under the Paperwork Reduction Act and Office of Management and Budget directives, DOT is responsible for guiding agency planning efforts and coordinating information resource management on a departmentwide basis. While DOT has allowed FAA to manage its own ADP resources, it retained responsibility for approving FAA's major ADP procurements.

While our April 1982 report on the need for additional computer capacity at FAA's Aeronautical Center was in preparation, DOT completed a study of the option of having FAA shift part of the Aeronautical Center's workload to TCC. DOT's study concluded that the option of shifting FAA workload to TCC was not feasible. Our review of the study, however, raises questions about whether DOT fully evaluated this option in light of the short time available for the study and the limited information available to DOT at that time.

TCC is a large computer facility that has two high-capacity computer systems. These computer systems service DOT's constituent agencies on a demand basis, and the associated costs are allocated to the user. TCC has significant unused capacity. The FAA has its own central facility at the Aeronautical Center and rarely uses the computer systems at TCC.

Our review of DOT's study showed that its analyses of costs and benefits and the quality of its results were constrained by the short time available for the study. We discussed DOT's approach to the study with the Chief of the Management Systems Division of DOT's Office of Information Systems and Telecommunications Policy and with senior computer analysts who prepared the study. These officials told us that the imminence of the procurement action did not allow sufficient time to consider other alternatives which may have proven more cost effective from a long-term departmentwide perspective. The analysts told us that the short time frame precluded a substantive review of the study's underlying assumptions and analyses. Because of the importance of this procurement, we believe that DOT should have performed a more complete analysis of feasible alternatives before proceeding with FAA's procurement actions.

Our review further indicated that DOT based its study on information of doubtful validity supplied by TCC, with the result that TCC's workload projections were overstated. TCC based its

analysis on unvalidated requirements and a series of estimates based on limited information. For example, TCC based its estimates of workload growth in the next 2 years on rough projections of user demand, workload that had not been approved for transfer to TCC, and workload that included inactive software projects. In making these estimates, TCC projected that workload resulting from using a data base management system would quadruple in the next 2 years. This increase would account for 59 percent of TCC's identified 1983 daytime or prime shift increase and about 41 percent of its total 1983 increase. TCC's data base management system, however, was still being tested at the time of the study and the utilization rate was projected based on TCC's expectations. Consequently, DOT's current decisions to process future workload on the TCC computers are constrained by speculative projections and incomplete analysis of future workload requirements.

TCC also projected that its workload would increase when the Federal Railroad Administration transferred workload to TCC, workload that is currently processed by commercial timesharing services. However, the projections were not based on approved transfers. Moreover, TCC ultimately received a very small segment of the projected workload. TCC's rough estimates of the resource requirements for this workload accounted for about 11 percent of TCC's total projected increase for 1983. However, the Chief of DOT's ADP Management Systems Division told us in May 1982 that the Federal Railroad Administration had not approved the workload for transfer and was still analyzing other alternatives. Also, the Federal Railroad Administration analyst responsible for assessing the proposed transfer told us that three of the seven systems proposed for transfer (representing 17 percent of the projected workload) were inactive and, therefore, would not represent a valid processing requirement for TCC. Subsequently, the Federal Railroad Adminstration decided to transfer only one of the systems to TCC. This system represented one-fourth of TCC's original workload estimate for the Federal Railroad Administration in 1983.

To compensate for DOT's uncertainty in its workload estimates, TCC projected a 5-percent overall workload growth in the first year, 10-percent in the second year, and 15-percent in each of the next 2 years. These estimates were based on prior analyses of TCC workload patterns, workload yet to be converted from an older computer system at TCC, and the general experience of TCC's technical staff. Such estimates are highly speculative and are inadequate for decisionmaking on current and future computer requirements.

In addition to overstating TCC's projected workload, DOT minimized the significance of the excess computer capacity at TCC. TCC's status, as of February 1982, showed that it had over four times the processing capacity of the Aeronautical Center based on machine specifications. At the same time, according to TCC's operating records, less than 20 percent of it's capacity was being utilized. In a March 1982 study prepared for DOT, TCC projected that about 45 percent of its available Central Processing Unit capacity would be unused in 1983. Based on this projection, we

believe the Center's computer capacity is currently adequate for absorbing new FAA workload.

The same study projected that TCC's unused capacity would decrease to about 16 percent by 1986. DOT has used this projection as a basis for concluding that TCC might not be able to handle FAA's workload beginning in 1986. The projection of the 1986 workload for TCC is not, however, a sound reason for rejecting the option of shifting some of the Aeronautical Center's workload to TCC at this time. Shifting the workload could be economical in the interim period during which the current procurement action could be deferred for the Aeronautical Center until a comprehensive requirements analysis is completed. Also, TCC's computer capacity could be expanded in future years to handle increasing FAA workloads either by modifying existing computer equipment or by procuring new equipment or outside computer services if TCC's computer capacity were to approach the generally acceptable utilization level.

We believe that these deficiencies in DOT's study, the lack of time to assess the study's assumptions, the overstatement of TCC's projected workload, and questionable conclusions on TCC's projected excess capacity indicate that DOT did not fully consider the alternative of shifting FAA workload to TCC. Without fully considering this alternative, DOT was not on strong ground in allowing FAA to proceed with the procurement.

## THE ABSENCE OF A DEPARTMENTWIDE COMPUTER CAPACITY AND WORKLOAD MANAGEMENT PROGRAM

We found that because DOT has not established a departmentwide computer capacity and workload management program it had limited information for assessing FAA's major ADP acquisitions. A uniform workload measurement policy and procedure needs to be applied on a departmentwide basis, but the DOT does not have such a policy. Without it, DOT cannot accurately assess FAA's workload information.

Further, DOT needs to know more about the operational compatibility of its various computers. The Chief of DOT's ADP Management Systems Division within the Office of Information Systems and Telecommunications Policy, told us that his goal was to achieve computer operational compatibility within DOT, but that DOT did not have a long-range plan which articulated specific management objectives or a timetable for achieving this goal. Although work on formulating a policy was started in 1981, he said that the study was interrupted because of budget constraints and higher priority projects, such as FAA's air traffic control system planning.

Recently, DOT indicated its intention to take steps to improve departmentwide coordination of computer usage. The Director, Office of Information Systems and Telecommunication Policy, told us that DOT has not had a major role in overseeing information resource management at the agency level. He said that, as of

October 1982, top level DOT management had directed that his office exercise more leadership and direction in this area. We believe that this change in emphasis is a good first step in achieving a coherent information resource management policy. However, the Director told us that he had not prepared a specific program to comply with DOT's directive. In preparing departmentwide policies and programs, DOT needs to provide sufficient scope and specific guidelines for establishing computer capacity and workload management objectives and a timetable for their completion.

We did not analyze the personnel and funding resources needed to enhance DOT's planning efforts. However, we do discuss in this chapter that, with DOT's approval, FAA is expending funds and using staff to acquire computer hardware without adequate planning and justification. We believe that, like FAA, DOT could better utilize its limited staff and funds to develop departmentwide computer capacity and workload management programs, and thus provide a greater level of assurance that planned hardware acquisitions are actually needed.

## CONCLUSIONS

FAA is pursuing the procurement of a new computer for its Aeronautical Center although it has not properly planned for and justified the need for this additional capability. Likewise, DOT has not fully assessed other alternatives for meeting this requirement. Because DOT did not completely review one of the possible alternatives, the need for the procurement cannot be fully justified. In addition, our review shows that DOT needs a computer capacity and workload management program to review its total requirements and capabilities and determine how individual user information needs can best be met. This program should establish a departmentwide system for allocating information resources as well as standards for measuring performance and utilization. It should also require that FAA make use of any suitable computer capacity available elsewhere in DOT before acquiring new capacity of its own.

## RECOMMENDATION

We recommend that the Secretary of Transportation direct the Assistant Secretary for Administration to develop a departmentwide computer capacity and workload management program.

APPENDIX I

JOHN L. BURTON, CALIF., CHAIRMAN
GUNN G. EVANS, MISS.
TED WEISS, N.Y.
PETER A. PEYSER, N.Y.
TOM LANTOS, CALIF.
HENRY A. WAXMAN, CALIF.

NINETY-SEVENTH CONGRESS

# Congress of the United States

## House of Representatives

GOVERNMENT ACTIVITIES AND TRANSPORTATION
SUBCOMMITTEE
OF THE
COMMITTEE ON GOVERNMENT OPERATIONS
RAYBURN HOUSE OFFICE BUILDING, ROOM B-350-A-B
WASHINGTON, D.C. 20515

MARK E. WALKER, PA.
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September 29, 1981

Mr. Milton J. Socolar
Acting Comptroller General
U. S. General Accounting Office
441 G Street N.W.
Washington, D.C. 20548

Dear Mr. Socolar:

The Government Operations Committee's Report on Air Traffic Control Computer Failures, House Report No. 97-137, June 11, 1981, directs that GAO review FAA's planning, management, and acquisition of automated information systems for air traffic control and FAA management purposes. The report, which is based on a study by this subcommittee, also directed GAO to report its findings, conclusions, and recommendations no later than October 1982.

Since the review will encompass areas of concern to both the full committee and this subcommittee, it has been agreed that issues concerning the National Air Space Control System will be reported separately to this subcommittee, and that those concerning automated information systems, information resource management and management information systems, will be reported to the full committee.

Some of the proposed FAA systems of particular concern to the subcommittee are:

Beacon Collision Avoidance System (BCAS), Flight Service Station (FSS) Program, Discrete Address Beacon System (DABS), Microwave Landing System (MLS), Very High Frequency Omni-Range/Tactical Air Navigation System, Airport Surveillance Radar, Approach Landing System Improvements, Air Route Surveillance Radar, Low-Level Wind Shear Alerting System, Voice Switching and Control System, Electronic Tabular Display Sub-system (ETABS), the Air Traffic Control Computer Replacement Program, Air Traffic and Advisory Resolution Service (ATARS), En Route Minimum Safe Altitude Warning (EMSAW), En Route Metering (EMS), Conflict Free Clearances (CRC), Automated Flight Planning (AFP), Integrated Flow Management System (IFMS), and Threat Alert and Collision Avoidance System (TCAS).

(more)

APPENDIX I



Because of the need to ensure the air safety of the traveling public and FAA's demonstrated inability to plan and manage even the simplest of projects, I request that this subcommittee be briefed regularly so that problems needing immediate action can be called to FAA's attention and resolved or, if necessary, hearings held.

The Administrator of FAA has said that his decisions and planning will be made on a national airspace system perspective rather than on a system-by-system basis. I have heard these promises before from other administrators and FAA civil servants. Consequently, I request that your work in the areas of planning, management and acquisition be a broad system type review. I also see that a high level composite report summarizing and including information from all the other reports will be needed by this subcommittee.

We look forward to working with you and your staff on this critical review. With best wishes, I am,

Sincerely,

JOHN L. BURTON
Chairman

JLB:WDG:cm

APPENDIX II

## THE DEPARTMENT OF TRANSPORTATION'S COMMENTS ON OUR APRIL 20, 1982, REPORT AND OUR EVALUATION

At the request of the House Government Operations Committee, on April 20, 1982, we issued an interim report entitled "Examination of the Federal Aviation Administration's plan for the National Airspace System--Interim Report." The report addressed automated systems for air traffic control as well as administrative and management purposes and concluded that two acquisitions--the procurement for administrative purposes of computers for FAA's (1) Aeronautical Center and (2) regional offices--were not adequately based on clearly defined information requirements, evaluation of alternatives, and cost-benefit analyses. The report recommended canceling both procurement actions.

In a letter to the Chairman, House Committee on Government Operations, dated June 23, 1982, DOT disagreed with our recommendation to cancel the Aeronautical Center and regional office computer procurements. In summary, DOT stated that the technical data made available to our auditors did not support our report's findings, conclusions, and recommendations.

Our conclusion was based on a full review of the technical information provided by DOT and FAA and on additional technical data obtained from literature searches, numerous interviews with DOT and FAA staff and management, and other sources. In several instances, as our April 1982 report points out, the technical data provided by FAA to support the procurements' specifications was not supported by data that we could independently verify. The data was not verifiable because the projections made by the agency were not supported by detailed analyses and evaluations. In other instances, our analysis of the data supplied led us to a different conclusion than that reached by FAA. Therefore, we do not agree with DOT's analysis.

We agree that FAA may benefit from more modern computer equipment at its regions and the Aeronautical Center. Our fundamental concern is that the procurement actions DOT and FAA have initiated will have a long-term impact on the management information support available throughout FAA. Consequently, it is important that FAA put the best possible planning into these procurements.

However, we cannot accept DOT's position that FAA has determined its total information requirements. Although FAA has established a framework for planning, specific planning actions have not taken place. FAA's existing information systems have evolved over many years as a result of individual project-by-project planning and implementation. These systems, which form the basis for computer procurements, constitute an extensive grouping of independent software systems and data bases which FAA is now attempting to integrate by adding additional software systems. As a result,

FAA identified the need for a very large computer capability. We believe that FAA needs to step back and review its total information requirements apart from its existing systems before it proceeds with any procurement action. This would help FAA identify opportunities to:

--State its overall information needs in terms of the level of accuracy, completeness, and timeliness.

--Meet information needs not addressed in current requirement documents.

--Minimize redundant software.

--Update old or inefficient procedures and techniques.

DOT also stated that its planning process recognizes the need to consider all of the alternatives suggested in our April 1982 report, as well as others; that FAA's requirements and capabilities are reflected in DOT's plan; and that FAA participated in and contributed to ADP service center workload studies. We agree with DOT's observations. However, DOT's long range planning has not progressed to the point where it provides a basis for addressing the decisions concerning FAA's regional and Aeronautical Center computer procurements. We reviewed DOT's most recent long-range plan, dated June 15, 1982. In general, DOT's plan summarizes available departmentwide ADP resources and specific plans of its individual subunits, including FAA. However, it does not analyze these plans, nor does it provide direction for improving overall ADP resources. DOT's plan recognizes the need to improve its planning process by refining its content and by critically evaluating agency submissions based on a review of the underlying data. These are the same needs we identified in our review.

DOT's entire response is included in the following sections of this appendix. We have also included in this appendix our detailed evaluation of DOT's and FAA's responses.

APPENDIX II

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

Assistant Secretary for Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

JUN - 3 1982

The Honorable Jack Brooks
Chairman, Committee on
Government Operations
House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

This is our final reply to the General Accounting Office (GAO) letter dated April 27, 1982, to the Secretary of Transportation, on the Federal Aviation Administration's (FAA) planning, management, and use of computer technology and related automatic data processing resources. This is in accordance with Section 236 of the Legislative Reorganization Act of 1970.

After review of all the information made available to the auditors, we concluded that the GAO recommendations to cancel the procurements for the FAA regional computer systems and the Aeronautical Center are not supported by the technical data provided to the GAO study team. The enclosure to this letter provides information concerning specific GAO findings and conclusions.

The GAO report further recommended that FAA conduct a comprehensive information requirements analysis. FAA has determined its total administrative information requirements. We will continue to refine our planning process to more specifically delineate identification and prioritization of future software applications.

The final recommendation in the GAO report concerns long-range planning and the consideration of various alternatives for meeting data processing requirements. The Departmental planning process recognizes the need to consider all of the alternatives suggested by GAO, as well as others, in order to effectively utilize data processing and telecommunications capabilities across the Department. FAA's requirements and capabilities are reflected in the plan and FAA has participated in and contributed to Departmental ADP service center workload studies conducted to try to identify viable alternatives for shifting workloads.

I am confident that the Department and the FAA followed an effective and correct management process leading to the procurement of both the regional computers and the Aeronautical Center Computer. FAA coordinated closely with the Office of the Seccretary throughout the acquisition process.

APPENDIX II

The detailed information I promised you in my letter of June 1, 1982, is provided in the enclosure. If we can further assist you, please let us know.

Sincerely,

Robert L. Fairman

Enclosure

APPENDIX II

FAA'S COMMENTS ON GAO REPORT

ENTITLED

"EXAMINATION OF THE FEDERAL AVIATION ADMINISTRATION'S

PLAN FOR THE NATIONAL AIRSPACE SYSTEM -- INTERIM REPORT"

Dated April 20, 1982

PROCUREMENT OF COMPUTERS FOR MANAGEMENT

AND ADMINISTRATIVE PURPOSES

APPENDIX II

## EXECUTIVE SUMMARY

The General Accounting Office (GAO) is deferring conclusions and recommendations in the air traffic control area until all field work is completed. This analysis, therefore, only addresses that portion of the report covering the procurement of computers for management and administrative purposes and top management's involvement therein (appendixes VI and VII of the report).

The report states that FAA's actions to procure new computer systems for management and administrative purposes at its Mike Monroney Aeronautical Center (AAC) and regional offices were not properly planned, justified, or managed. GAO recommends that the procurements be cancelled. The FAA analysis develops the substantive issues raised by GAO through compilation of the detailed GAO statements dispersed throughout its report. As FAA sees them, the issues are as follows:

Issue 1. Improper Specifications/Sizing Technique Used

Issue 2. Benchmarking Not Conducted

Issue 3. Information Requirements Not Fully Defined

Issue 4. Excessive Capacity Being Acquired

Issue 5. FAA Did Not Explore Alternatives

Issue 6. Inadequate Top Management Involvement in Steering Committee

Issue 7. Individual Software Projects Have Fragmented Management

Issue 8. Cost/Benefit Studies are Not Always Made

Each issue is analyzed separately showing first the GAO comments, then the FAA response, including specific responses on the AAC and regional computer replacements when appropriate.

In summary, we find no valid basis for the GAO's findings, conclusions, and recommendations. For the most part, we found the detailed GAO statements to be incomplete and incorrect. In this respect, the GAO comments are not supported by the technical data FAA gave to the GAO. The report contains misinterpretations and omissions of data. In addition, the GAO comments and conclusions appear to contradict earlier GAO reports, existing Federal Procurement Regulations (FPRs), Federal Information Processing Standards, Office of Management and Budget (OMB) guidance, as well as industry standards and practices.

ANALYSIS OF GENERAL ACCOUNTING OFFICE (GAO) COMMENTS ON PROCUREMENT OF COMPUTERS FOR MANAGEMENT AND ADMINISTRATIVE PURPOSES

ISSUE 1: Improper Specifications/Sizing Technique Used

GAO Comments:

Comments Concerning Mike Monroney Aeronautical Center (AAC) Central Processing Unit (CPU) Replacement:

1. Federal Aviation Administration (FAA) unrealistically projected future system workload. The Request for Proposals (RFP) specifies a mandatory processing requirement of 10 to 13 million instructions per second (MIPS) to process workload during the 8-year life cycle. (Page 49)

2. Numerous studies in industry publications have proved that MIPS ratings lack reliability because, instead of measuring throughput (processing efficiency of a total system configuration), they merely measure the internal speed of the CPU. (Page 50)

Comments Concerning Regional Replacement Computer Systems:

3. FAA did not specify a processing requirement in its RFP for these systems. (Page 52)

4. Only the processing capability of the CPU was not specified. (Page 53)

Response: Federal Procurement Regulations (FPRs) 1-4.1109-10 state that functional specifications are the preferred method of expressing agency requirements and these regulations (1-4.1109-11) also allow use of equipment performance specifications. Further, even though these acquisitions are outside the scope of Office of Management and Budget (OMB) Circular A-109, Major Systems Acquisition, it is in the spirit of A-109 to use functional specifications to foster contractor innovation in meeting Government requirements.

GAO Evaluation: FAA's exclusive use of equipment performance specifications rather than functional specifications resulted in an improper specification and sizing technique for the Aeronautical Center and regional office procurements. The essential point is not whether equipment specifications are allowed, as FAA asserts, but that Federal Procurement Regulations do not intend that equipment specifications be substituted for functional specifications for such procurements. Functional specifications define the ADP mission needs to be satisfied. These needs are described in such terms as data output and its intended uses, data input, data files and record content, volumes of data, processing frequencies, and desired timing. Equipment performance specifications, on the other hand, describe minimum user output requirements in such terms as the amount of data to be stored in computer memory or processed within a given time, and the number of lines that must be printed over a given time. Equipment specifications also include operational reliability, supplemented with hardware factors such as computing speed, magnetic tape read and write speed, and printer speed.

APPENDIX II

Government regulations provide clear guidance in the use of various specifications for computer acquisitions. For example, Federal Procurement Regulations, FPR 1-4.1102-13, states:

> "* * * when applied to the functional specifications, [equipment performance specifications] provide a quantitative measure of the operating time and capacity required to process the applications [or software systems] involved on that equipment."

Additional Government criteria is set forth in Federal Procurement Regulations, FPR 1-4.1109-10, which states:

> "* * * The functional specification may be augmented with equipment characteristics and elements of performance when necessary to reflect the user's needs."

These criteria are underscored by FPR 1-4.1109-11, which states:

> "If functional specifications cannot be used to describe the user's complete requirement, other types set forth below may be used. * * *
>
> (a) Equipment performance specifications * * *;" (Emphasis supplied.)

According to Federal Procurement Regulations, FAA should have stated its needs in the form of functional specifications and added equipment specifications to complete the description of its needs. Federal regulations intend that agency officials will conduct sufficient planning and analysis to define functional requirements.

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Aeronautical Center. For the AAC CPU acquisition, GAO's basic contention is that MIPS is not a proper sizing tool. This contention is not correct when you qualify the use of MIPS to a certain class of CPUs. In the FAA's case, the use of MIPS is very prudent as we are talking about an International Business Machine (IBM) code compatible CPU specifying the number of channels, channel speed, memory size, operating system, and peripheral devices. These specifics make the use of MIPS a very exacting sizing technique. Also, the sizing of present and future workload in MIPS becomes a very reliable methodology because of the IBM code-compatible factor.

As further proof of these statements, all major vendors bidding on the computer solicitation have submitted MIPS rates. These MIPS rates are taken as a standard within the IBM code-compatible market. The table on page 51 of the GAO study, extracted from an industry publication, supports this contention. If MIPS were not a standard in this area, FAA would have had extreme difficulty dealing with vendors during the technical evaluations. Concerning GAO's claim that "numerous studies in industry publications have proven that MIPS ratings lack reliability," FAA has not been able to find such studies that say MIPS are unreliable for IBM code-compatible CPU's using identical operating software, channels, and peripheral devices.

GAO Evaluation: We do not agree that FAA used the proper sizing tool for the Aeronautical Center computer acquisition. FAA is correct that computer processor speed is a reasonably precise tool when confined to a particular class of central processing units (CPU's), but its use was not appropriate in this case. IBM code compatible CPU's are not in a particular or single class because the internal machine architectures among IBM and IBM-compatible mainframe manufacturers vary considerably.

Although vendors submitted processor speed ratings to satisfy FAA's mandatory bid requirement, this fact does not indicate that industry advocates the use of this sizing tool. Using equipment performance specifications which include the number of channels, channel speed, and memory size may constrain competition because these equipment factors can influence computer processing and throughput. By specifying these equipment items, FAA may have precluded vendors from bidding certain computer systems which could outperform those offered at a lower cost. The use of equipment specifications such as processor speed is not a standard Federal procurement practice as implied by FAA.

APPENDIX II

Regional Computers. Since a totally new system, including CPU, peripherals, etc., was being acquired for the regions, only those detail specifications were used by FAA which were known to be limiting factors for getting the automatic data processing (ADP) work done in time. As examples, items such as printer speed in lines per minute are based on present and projected printed output and present printer capacity. Terminal data input keystroke rates stated are those needed for our employees to get time and attendance records, etc., keyed in on time.

Also, because this one system is replacing multiple systems, each of which processes a separate function, the system must be capable of processing all functions concurrently. The broadest competition and the greatest likelihood of acquiring the correct equipment are obtained by allowing industry to respond to such functional requirements rather than by specifying characteristics.

GAO Evaluation: FAA's approach to the regional computer acquisition, which relied on detailed equipment performance specifications, pointedly illustrates the extent improper specifications and sizing techniques were employed in its procurements. Even though the procurement was for complete hardware systems including peripheral equipment, FAA provided prospective bidders with an exhaustive list of peripheral equipment specifications. Further, these specifications required that ADP and word processing functions be satisfied by a single type of computer system. Specifications for these two types of processing should have been stated in functional terms.

FAA could have, for example, specified the volume of information to be printed rather than the printer speed in terms of lines per minute. Also, FAA could have stated its volume of data to be stored rather than state the disk drive unit's minimum storage capacity, as it did in its RFP.

Restricted competition usually results in higher costs to the Government. The reliance on equipment performance specifications may have restricted competition by precluding bidders from offering more efficient means of providing the services which FAA needs. For example, FAA's requirement that ADP and word processing functions be satisfied by a single type of system precluded potentially lower cost alternatives employing separate or connected systems dedicated to these different functions. This single-system specification led vendors to bid much more powerful CPU's than may have otherwise been required.

ISSUE 2: Benchmarking Not Conducted

GAO Comments:

Comments of a General Nature:

1. Benchmarks, the use of which is widespread throughout Government and industry as a valuable tool in assessing computer system performance, are not being employed in either procurement. (Page 47)

Comments Concerning the AAC CPU Replacement:

1. FAA may be excluding less costly systems with equal capability to process its administrative workload because the benchmark process is not being used. (Page 49)

2. By excluding a benchmark from the procurement process, FAA may be procuring a computer system which is not properly matched to its information processing requirements. Benchmarking is a standard industry method. (Page 50)

Comments Concerning Regional Replacement Computers:

1. By specifying an operational capability demonstration (OCD) in its RFP, FAA precluded the use of a benchmark in evaluating CPUs which vendors bid. (Page 53)

2. Benchmarks are widely used throughout Government and industry. (Page 53)

3. A comparison of the measurement techniques of a benchmark versus OCD. (Page 53)

4. Interpreting performance becomes a judgment call of the FAA. (Page 53)

5. OCD, using subjective judgment, was employed in evaluating CPUs bid by the vendors. (Page 53)

6. Vendors are proposing systems against an unknown standard. (Page 53)

7. FAA evaluates the proposed systems against a subjective standard. (Page 53)

8. Unlikely to select the same computer under an OCD as would be selected under a benchmark process. (Page 53)

Response: As a matter of record, the GAO report (AFMD-81-104) dated October 2, 1981, and entitled "Non-Federal Computer Acquisition Practices Provide Useful Information for Streamlining Federal Methods" found that 15 of 18 industry sources queried did not commonly use benchmark testing to select computer equipment and that little value was placed on benchmarking techniques by industry. Nevertheless, benchmark testing is required for computer system acquisition in the Government.

GAO Evaluation: FAA did not require benchmark tests for its computer procurements. Benchmarking is taking a representative sample of processing workload (the benchmark) and determining the length of time a proposed computer system requires

to process this workload. By contrast, an operational capability demonstration involves specific software systems that are not representative of the total system workload. It shows only that the specific software can be processed on a computer system, but its results cannot be extended to imply similar computer performance for the software workload in total.

Benchmarking is a very valuable tool that can save considerable resources by insuring that systems can provide a specific throughput. As our October 1981 report points out, industry sources generally replaced computers through a negotiated process with their current vendors. Therefore, many industry procurements were actually upgrades within a vendor's current line of computers. In such cases, there is a higher degree of confidence than there would be if a different vendor's products were being evaluated. But, as noted in the report, many industry sources did use a limited form of benchmarking even in these instances to identify new equipment options and to gauge price/performance ratios.

Federal procurement guidance states that benchmark testing is desirable but not required. Despite higher costs, benchmarking is desirable because:

--It is a fair and unbiased test of a vendor's proposed system.

--It allows an agency to model its workload for system testing.

--The benchmark test is repeatable within acceptable limits across vendor lines.

Because of internal equipment differences, switching to computers from another series within the same vendor's product line or from another vendor offering a computer with a higher processor speed rating is risky. Without some form of benchmarking FAA could be acquiring equipment that has slower throughput of its workload than the computer it is replacing.

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Regional Computers. Benchmark testing was carried out for the regional replacement in accordance with the FPR (1-4. 1109), Federal Property Management Regulations (101-36), and the National Bureau of Standards "Guidelines for Benchmarking ADP Systems in the Competitive Procurement Environment" (FIPS Publication 42-1). These are the organizations authorized by Public Law 89-306 to issue such regulations, standards and definitions, GAO definitions not withstanding.

The RFP provided to GAO for their study clearly defined objective standards that must be met by the system running the QCD. Industry had no trouble understanding these standards and were able to demonstrate the ability of their proposed systems to meet the standards. Use of a benchmark as defined by GAO would have had no effect on vendor selection unless a vendor failed and was eliminated from competition, which is no more likely than with an OCD.

Aeronautical Center. Benchmarking was not conducted for the AAC procurement because an IBM software code-compatible replacement for only the CPU (not a computer system) is being acquired. A code compatible procurement was justified on the basis of a General Services Administration (GSA) study which showed the estimated code conversion cost to be greater than the purchase cost for a new CPU. The performance measurement techniques for IBM compatible equipment are standardized and available as part of the manufacturers' technical information. The GAO table on page 51 of the report showing "MIPS" ratings is witness to this situation. In this circumstance, benchmarks provide no new, additional, or useful information germane to selection of CPUs.

GAO Evaluation: FAA's responses do not justify its decision not to conduct benchmarking for the regional and Aeronautical Center computer procurements. With respect to the regional computer procurement, we believe that FAA's characterization of its operational capability demonstration as a benchmark is misleading. National Bureau of Standards' FIPS PUB 42-1, "Guidelines for Benchmarking ADP Systems in the Competitive Procurement Environment," which defines benchmarking, states that the term "benchmarking" for the purposes of the guidelines means specifically

> "* * * a user-witnessed running of a group (mix) of programs representative of the user's predicted workload on a vendor's proposed computer system in order to validate system performance."

The publication further states that

> "Another type of demonstration that is frequently called 'benchmarking,' more properly should be referred to as either a capability demonstration or a functional demonstration."

Therefore, we disagree with FAA's contention that the operational capability demonstration technique, which it used to evaluate the procurement, qualifies as a benchmark within the meaning of the regulations cited.

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FAA's assertion that its operational capability demonstration provided an objective standard for evaluating system performance is also misleading, because the results of an operational capability demonstration cannot be projected beyond the software processed in the test. Therefore, an operational capability demonstration may be objective with respect to specific software systems, but it does not attain the same level of confidence as a benchmark, which is representative of the total workload to be processed.

For the Aeronautical Center computer procurement, we disagree with FAA's use of processor speed criteria to evaluate computer performance without first carefully evaluating the use of a benchmark. The Director of the Aeronautical Center computer facility told us that a benchmark was not used because he believes the processor speed criteria met his needs. However, the variability of internal architecture among IBM code-compatible machines and the uniqueness of individual workloads are good arguments for considering benchmarking over processor speed criteria even in the case of code-compatible equipment purchases such as this. We do not believe the Government's interests are served by dismissing the use of benchmarking, a valuable evaluation tool, without thorough overriding justification.

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ISSUE 3: Information Requirements Not Fully Defined

GAO Comments:

1. Information requirements have not been fully defined. (Page 6)

2. At the heart of the problem is FAA's lack of a comprehensive information requirements definition. (Page 47)

3. Without detailed knowledge of both current and future software applications, it is not possible to economically procure responsive hardware systems. (Page 47)

4. OMB Circular A-109 specifically directs that procurements be based on valid information requirements. (Page 48)

5. FAA needs to determine its total information requirements. (Page 48)

6. More than three and one-half years have passed making the statistics too old to adequately justify a procurement. (Page 53)

7. FAA did not consider alternatives to regional processing because of the lack of comprehensive information requirements. (Page 55)

8. The core of the problem is that FAA has not comprehensively defined its information requirements. (Page 56)

9. Without detailed knowledge of current and future processing workload, it is not possible to optimize the sizing and distribution of information processing resources. (Page 56)

Response: GAO has placed great emphasis on this one issue. Its theme throughout the report is that FAA does not have comprehensive and detailed knowledge of its information requirements and, without this knowledge, it is impractical to do proper planning or effective procurement of ADP resources.

The true issue is to what level of comprehension and detail is information requirement definition possible and most importantly, reasonable? GAO implies that information requirements for the agency should be fully identified to detailed specifications for the life cycle of the equipment (8 years). When considering the leadtime required to accommodate approvals, delegation of procurement authority, preparation of specifications and the procurement process, this time period is expanded to a minimum period of 10 years.

The main focus of GAO's criticism is that the information requirements identified in 1978 and 1979 did not include details through 1990 and are not correct today. GAO further states that because the requirements are not currently correct the original specifications are too old to adequately justify a procurement. The inference is that FAA should have revised its requirements and specifications during the procurement process. The nature of the competitive procurement process is such that we must freeze our requirements as specifications in a solicitation document (RFP) and evaluate offeror responses against the specifications and criteria stated in the document.

While the requirements were modified during the freeze period, FAA has continued to monitor the long-term needs. The RFP specifications and criteria have been reviewed to determine that they would still lead to a compatible and economical solution. To further provide for the uncertainties of the future, the regional computers are modularly expandable when and if required.

GAO alleges that FAA has not determined its total information requirements to provide efficient and effective ADP support. In April 1977 when FAA originally requested a delegation of procurement authority (DPA) from GSA, the House of Representatives' Committee on Government Operations (Brooks' Committee) requested additional information concerning the proposed replacement for the regional computers. As a consequence, GSA withheld granting a DPA. FAA and the Office of the Secretary of Transportation (OST) met with a committee staff member on numerous occasions to discuss the details of the procurement.

The committee requested GAO to review the procurement package. As a result of GAO's review, the committee asked FAA for a more detailed long-range plan and suggested Department of Agriculture's (USDA) Long-Range Plan as a model. In March 1979, FAA submitted to the committee a Management Information ADP Support Plan, patterned after USDA's plan, which included requirements analysis supporting the regional computer replacement. Although committee response was promised, none was received; consequently, a DPA was requested from GSA in May 1979.

In accordance with GSA and Brooks' Committee informal agreement, GSA granted a DPA in July 1979 when no objections were voiced by the committee. FAA's long-range plan, the Management Information ADP Support Plan, was developed to provide long-term guidance and justification for the ADP facilities needed to support FAA's mission. The document in updated form was also included in the justification package submitted with FAA's request for DPA from GSA for the AAC replacement. It has been updated as changes occur and is now titled "Management Information ADP Concepts and Support Plan for the 1980's." However, the basic guidance and policy have not been changed.

GAO's reference to OMB Circular A-109 is not appropriate. Both procurements are well below the threshold for A-109 application; however, it could be argued that A-109 principles do apply. In any event there is no reference in A-109 to "valid information requirements" but rather is stated as "accomplish system acquisition planning, built on analysis of agency missions, which implies appropriate resource allocations resulting from clear articulation of agency mission needs." (Page 4, para. 7e., A-109).

In summary, known information requirements applicable to the individual procurements were detailed in a manner that expressed existing processes and near-term applications developments in great detail while those beyond 3-4 years were increasingly less detailed. Additionally, modular expansion capability was specified in both instances as a safeguard against the unknown. Detailed information analysis is summarized at a higher level and in a collective form where it is updated at least annually. The summary level of detail is sufficient for ADP management and reflects a level of resource expenditure commensurate with the expected benefits. When major ADP hardware expenditures are projected, detailed specifications are again assembled as part of the justification and specification processes.

The chronology set forth in the attachment documents events associated with the procurement of the regional replacement computers.

GAO Evaluation: We disagree that FAA has fully or adequately defined its information requirements. Our review showed that FAA has not achieved a reasonable level of comprehension and detail in information requirements definition as evidenced by the following. FAA

--based its equipment specifications on operating requirements of the existing software systems and data bases that may be obsolete, inefficient, redundant, or inadequate;

--based its equipment specifications on additional software systems designed to tie together or integrate with current or older systems and thereby perpetuate any problems that do exist; and

--added into its workload calculations the processing of two systems under development when its normal workload growth calculations already accounted for this new workload.

Our experience in reviewing similar large-scale projects leads us to believe that FAA is taking an unacceptably high risk of poor results without conducting comprehensive requirements planning.

It is both practicable and reasonable for FAA to define its comprehensive information requirements for management purposes. This effort is not overwhelming. Essentially, it would require that FAA document what information FAA needs to collect and produce, who needs to use the information, and how accurate and timely it needs to be. These general information requirements are independent of specific manual and automated information systems and change relatively little over time. FAA can then analyze these requirements and set priorities on needed software applications for development.

FAA's contemplated migration to an interactive computing environment makes it even more imperative that total information requirements, including potential software system interactions, be defined as precisely as possible. If software is developed without considering other applications with which information must be exchanged, software system interactions will be difficult and expensive to achieve, at best, and use inordinate amounts of CPU time.

We disagree that FAA's Management Information ADP Concepts and Support Plan for the 1980's satisfies the need for comprehensive requirements planning. We reviewed the plan and found that, while it does establish a framework for comprehensive requirements planning, it does not contain the overall information requirements analysis outlined above.

We consider both procurements, as well as FAA's future software developments for the resulting systems, as a single activity because their objectives are closely related. FAA has established this relationship. FAA justifies the Aeronautical Center computer procurement on the basis that greater processing capability is needed for national software systems. However, our review showed that substantial national system workload will also be processed on the new regional computers. To illustrate this point, we found that the Director of Management Systems in a June 8, 1982, memorandum to FAA's Region and Center Directors requested comments on a proposed administrative requirement that "No more than 10 percent of regional computer capacity would be used for local systems." In the final order (FAA 1370.52A), the requirement states that "The management of local ADP operations will give priority to support of national systems, but will guarantee a minimum 10 % of the processing capacity for support to local systems."

In this context, OMB Circular A-109 applies because the dollar threshold is exceeded. Moreover, as FAA has already pointed out, the spirit of OMB Circular A-109 is relevant even in cases where its specific thresholds are not exceeded. In this regard, the "clear articulation of agency mission needs" can only be properly accomplished by describing these needs in terms of comprehensive information requirements through the process described above.

ISSUE 4: Excessive Capacity Being Acquired

GAO Comments:

Comments of a General Nature:

1. Inaccurate workload projections were used to substantiate more powerful computers than actually required or no workload analysis was performed at all. (Page 47)

Comments Concerning AAC CPU Replacement:

1. The requested replacement computer will nearly quadruple the present processing power. (Page 48)

2. It is likely to result in an underutilized and uneconomical computer system. (Page 49)

3. FAA developed processing requirements based on inaccurate workload projections rather than a comprehensive requirements analysis. (Page 49)

4. FAA inaccurately projected a 10-percent annual growth in current applications workload. (Page 49)

5. FAA compounded this inaccurate projection over the 8-year life cycle. (Page 49)

6. FAA overestimated processing requirements for future software applications. (Page 49)

7. Only two large systems with similar processing requirements are planned for implementation during the next 4 years. (Page 50)

8. Projected MIPS requirements for these two large systems are overstated. (Page 50)

9. The Director of AAC directed the staff to "take the high road" in estimating processing requirements for these applications because the methodology used double counts some workloads. (Page 50)

10. FAA expects considerable underutilization at AAC after the procurement is completed. (Page 55)

Comments Concerning Regional Replacement Computer Systems:

1. FAA is basing its selection of a new computer system on outdated workload statistics because regional workloads have decreased and will continue to do so. (Page 52)

2. Given the AAC large mainframes, the only mandatory functions for any region are data entry and remote job entry. (Page 52)

3. Batch processing decreased substantially, on an average of 31 percent, and was expected to decrease even further. (Page 54)

4. Excess batch processing capability is very likely to be procured because FAA did not monitor regional batch processing workload. (Page 54)

5. Reduction in regional batch processing workloads were not considered. (Page 55)

6. The ratio of 40 to 1 relative processing power used in the study would be 150 to 1 based on the AAC RFP. (Page 55)

Response: The FAA Management Information ADP Support Plan of February 1979 sets forth guidance for development of ADP resources needed to support FAA mission needs. It recognizes the criticality of making ADP support available to the operating staffs in the hundreds of FAA field offices. Only with such support can FAA continue to carry out an increasing workload in an environment where total staff available is not increasing to keep pace with new work assignments but is in fact decreasing.

The support plan also recognizes similar trends in the industry which are also related to the decreasing cost of ADP equipment in relationship to people costs. To provide broader access to information files by nondata processing staff, "user friendly" techniques must be employed. This includes use of data base management systems software, communications software, and other generalized software modules which require greater computer resources to process.

In tests conducted at AAC using a modern data base system and a user-friendly language (ADABAS/ NATURAL), CPU resource usage doubled. However, application development cycle times and costs were reduced by factors of 5 to 7. The traditional "batch processing" is diminishing slowly as "on-line" processing takes up the greater portion of the computer capacity.

In summary, many more people will be accessing the computers and they are not data processing oriented so the new computers hardware and software capabilities are required to satisfy FAA mission needs.

GAO Evaluation: FAA is correct that data base management systems can increase CPU usage for a given result while reducing application development cycle time and costs significantly. However, the general reasoning contained in this FAA response does not justify any specific processing capability, and, in fact, could justify virtually any level of capability FAA desired to attain.

The conclusions of our April 1982 report were based on our findings concerning the status of existing software systems and FAA's methodology for extrapolating from its existing software systems and ongoing software development projects to its computer procurement specifications. While we agree that modern computer systems will benefit FAA, we do not agree that FAA has performed sufficient analysis to establish whether it is acquiring an appropriate amount of computer capacity.

Regional Computers. To produce a solicitation document, it is necessary to "freeze" FAA requirements at a point in time. The regional workload data FAA presented in the justification package for the regional replacement systems was used as a base for the initial construction of the RFP. After review by the regions, modifications were made to the specifications in the RFP to reflect changes to the processing mix which had occurred between 1978, the data collection period, and 1980 when the RFP was developed. Subsequently, after presolicitation review by industry, additional changes were made to clarify FAA needs and to broaden competition. Since issuance of the RFP, all changes in the mode of processing and the more definitive requirements on future processing needs have been monitored. The RFP has been reviewed as each requirement refinement surfaced to determine that the RFP continued to accurately respond to FAA needs.

The possibility of using the AAC mainframe for regional batch processing work was examined and rejected due to the greater cost to process regional work at AAC, the lack of software compatibility and problems posed by staffing and training support for both IBM compatible (AAC) and non-IBM compatible processes in the small regional staffs. Case studies were included in the justification package which addressed the comparative costs of doing batch work at the regions or at AAC. GAO has challenged the data, e.g., the 40 to 1 relative processing power used in these studies and fails to acknowledge that the data reflects the size and capabilities of the AAC CPUs at the time of the study. GAO's comparison of relative capabilities reflect the more recent AAC replacement CPU sizing which was based on other workload. Nevertheless, the result was valid when first done and remains valid. Regional batch processing is most economically processed on the regional computer.

As the table on page 54 reflects, there has been a net decrease in the batch work processed on the Spectra 70/35 computers. An examination of the data shows that the decrease was caused largely by the centralization of payroll processing. In two of the three examples, the decrease in payroll and accounting batch processing exceeds the net total batch processing decrease showing that there was an increase in batch processing in other functional areas. The GAO presentation does not show all the table data provided them by FAA. The missing data shows an increase in processing on the Four Phase device counter balancing the decreases on the Spectra 70/35. This is due to the transition to data edit processing to the Four Phase data entry machine and the use of its limited communications capabilities, not available on the Spectra 70/35, for receipt and subsequent printing of batch output.

What GAO does not recognize is that the size of the regional processing system is driven by the number of regional terminal users, local and remote to the regional office where the computer system resides, not by the batch processing workload. An examination of the RFP and a review of the FAA Management Information ADP Support Plan clearly show a large number of terminals being acquired and the uses to be made of these terminals. It is incorrect to believe that transmitting all data to and from these terminals to the distant AAC could be less costly then using a local regional processor.

GAO Evaluation: We do not agree that FAA's projections, which simply represent existing computer terminal inventories, represent valid new system requirements. The question of whether FAA is acquiring excess capacity is best addressed by reviewing FAA's document "Projections for Computer Terminals Planned for Agencywide Installation," August 7, 1981, to determine FAA's basis for the projections. We found that FAA had not comprehensively reviewed or assessed its terminal requirements and, in fact, had to conduct a special study to compile an inventory of existing terminals and their location.

These terminals had been placed over time to accommodate individual user requests as software applications were implemented. The FAA staff analyst told us that no assessment of terminal utilization had been made in preparing the inventory. Without such an assessment, identification of underutilized or unneeded terminals is not possible. Therefore, FAA's reliance on existing terminal use to "drive" the size of its regional computers is very likely resulting in the acquisition of excess capacity.

By stating that it must freeze its requirements as specifications in a solicitation document at a point in time, FAA is not recognizing its responsibility to adequately plan for future information requirements. The purpose of a long-range plan is to identify future information requirements and project the resulting functional processing requirements. We found, however, that FAA does not have a long-range plan based on a comprehensive requirements analysis that estimates its future needs.

Aeronautical Center. Processing requirements were based on detailed workload analysis performed by the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) plus projected major system implementations. Also taken into consideration was the use of high-level languages, Data Base Management System (DBMS), and user-friendly languages. These three state-of-the-art software systems greatly increase CPU usage, but at the same time, significantly reduce personnel development costs, future maintenance costs, and provide the user with a flexible data system. Even though such information was outlined in the AAC Computer Replacement Study, June 1981, GAO did not comment on the use of such software and the impact on CPU resources.

The GAO contention is that a 10-percent growth rate is not representative of future year activities and that the addition of new major systems workload on top of the 10-percent growth rate, in particular the Uniform Accounting System (UAS) and the Logistics and Inventory System (LIS), inflates workload statistics. Actual computer usage data proves otherwise. In the past 6 months (September 1981 through February 1982), the growth has been 9.5 percent over the comparable period a year prior. Several months have seen over 15-percent increases. This growth has been during a period when no new major systems have been implemented.

GAO did not contact major data base users, such as the Personnel Management Information System (PMIS) central control in FAA headquarters, to ascertain the impact of limited CPU resources on their ability to accomplish workload. Major PMIS changes/upgrades have been deferred because of limited CPU resources. The same suppression of workload growth has occurred in other functional areas.

GAO does not mention that the two systems, UAS and LIS, will use DBMSs and user-friendly languages. This software requires more CPU resources than the older less flexible systems implemented during the past years. UAS and LIS are each independently, conservatively projected to be larger CPU resource users than the combined requirements of the four new applications implemented in the 1977-1980 time period referenced by GAO.

As mentioned earlier, greater CPU resources are mandatory for the future to ensure higher priced resources, such as telecommunications, personnel, and peripheral devices, are efficiently utilized.

On page 50, GAO indicates that the Director of AAC stated that "the total processing requirements in the RFP are overstated based on available data because the methodology used double counts some workload." This statement is incorrect for two reasons: (1) GAO auditors did not meet with the Director of AAC; and (2) if GAO is referring to statements made by the Chief, Data Services Division, the following is what he told GAO. Because of the size and CPU usage of the UAS and LIS, they cannot be accommodated within the 10-to-12 percent growth rate. Further, these two systems use modern data base software which places a disproportionate workload on the system. As a result, the one-time size of these two systems was placed into their respective workload years. This approach is not "double counting" and only reflects prudent planning.

Regarding the GAO statement that FAA expects considerable underutilization at AAC after the procurement is completed, it can be said that we don't expect to run the machines at the existing 90-to-100 percent CPU capacity. When old processors are replaced with new processors, some additional capacity is needed for training and conversion work (MVT to MVS) over that for the processing of the existing workload. During the period of time before new workload is fully developed and implemented on the new computer, there will be some reserve capacity available. Prudent management calls for acquiring capacity to accommodate growth in the next 4 years so as to not continually be disrupting operations by upgrading and reprocuring computer systems.

GAO Evaluation: The data gathered during our review demonstrates that FAA is acquiring excessive computer capacity at the Aeronautical Center. We agree that modern computer systems will benefit FAA and that our review was not designed to identify and evaluate potential applications for the new computers. However, during our review we did assess FAA's analysis of its future requirements. We found that FAA had not sufficiently analyzed its information requirements to provide a basis for projecting with reasonable accuracy its need for new software applications and data bases and evaluating its existing systems. Contrary to FAA's claim, available data does not support its projected requirement as discussed below.

FAA's method of using the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) study results inflated its workload projections. The study supports the use of a 10-percent growth rate for future workload through 1982 based on a trend analysis. In projecting the study's results beyond 1982, FAA added to the 10-percent growth rate the projected impact of introducing new system and data bases. Based on our analysis of workload being processed by FAA during the time FEDSIM conducted its study, this methodology inflates the resulting projections because the 10-percent growth rate calculated by FEDSIM already includes the impact of introducing new systems. Our review showed that four major new systems were introduced during the time period studied by FEDSIM. Since FEDSIM measured overall trends, these systems influenced the trend projection in the same way as processing growth in existing systems. We found that processing growth due to existing systems alone was only 2.5 percent.

FAA's methodology for projecting FEDSIM's results beyond 1982 is flawed in two respects:

--Since the 10-percent projection already includes the impact of adding major new systems, adding additional impact for new systems double counts some workload. FAA should have either (1) projected a 10-percent growth without further additions for new workload beyond 1982 or (2) projected only the 2.5-percent growth due to data expansion in existing systems while adding the impact of specific new systems.

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--The 10-percent projection may not be valid beyond 1982 because FAA is projecting the introduction of only two major new systems during the subsequent 4 years, whereas it introduced four such systems during the test period.

To further elaborate on these points, we found that the processing requirements given for the two new systems, the Logistics and Inventory System (LIS) and the Uniform Accounting System (UAS), were overstated based on FAA knowledge about them. When we asked the chief of the Logistics and Training System's Branch, Data Services Division, about the basis for the LIS workload projections, he told us that he did not have data or supporting analysis for the figures. He said that the figures were initial estimates and were not based on any specific system design.

With respect to the UAS, we found that FAA had developed much more detailed projections of overall system workload but that some of the workload projected for the Aeronautical Center may actually be processed on regional computers.

We reviewed the data supplied us by the Chief, Data Services Division showing a 9.5-percent workload growth rate for the 6 months September 1981 to February 1982 compared to the 6 months September 1980 to February 1981. We find the data inconclusive since the data collection period included 2 very high growth months and a steady 3-month decline in growth rate from a high of 19.0 percent for November to a low of 2.4 percent for February.

FAA is correct that our conversation was with the Chief of the Data Services Division. The conversation covered a wide range of issues surrounding FAA's workload estimates for the Aeronautical Center computers. The essence of the conversation was that several allowances had been made for uncertainties that existed in FAA's workload projections and to provide for adequate computer capacity up to 10 years in the future. He said that these allowances would tend to overstate the projections, and he said that FAA's method of projecting future workload resulted in some double counting of workload.

ISSUE 5: FAA Did Not Explore Alternatives

GAO Comments:

Comments of a General Nature:

1. Alternatives were not considered. (Page 6)

2. Alternatives, such as shifting workload and using different distributions of processing resources which offer considerable potential savings, have not been considered. (Page 48)

3. Treats AAC and regions separately. (Page 48)

Comments Concerning Regional Replacement Computer Systems:

1. Regional computers may not be needed. (Page 4)

2. Did not consider alternatives which might forestall procurement or reduce its cost. (Page 52)

3. Batch processing could be accomplished through local processors or at AAC by remote job entry (RJE). (Page 52)

4. Study of alternative to use AAC for central processing in lieu of purchasing regional computers attributed processing cost of $500 per hour for AAC. However, AAC will be vastly underutilized for several years. Study which didn't consider local personnel cost for second shift batch processing and telecommunications costs was incorrect as batch processing could be transmitted during slack periods on existing lines. (Page 55)

5. Batch processing for regions could be performed at AAC forestalling regional procurement and permitting the Spectra 70/35s and IBM 1401 to be surplused. (Page 55)

Comments Concerning AAC CPU Replacement:

1. Less costly alternative to AAC replacement exists. (Pages 4 and 47)

2. FAA didn't examine viable alternatives. (Page 49)

3. Little or no coordination between Department of Transportation (DOT) and FAA resulted in lost opportunities. (Page 51)

4. DOT and FAA did not discuss or study Transportation Computer Center (TCC) and AAC consolidation or moving a CPU from TCC to AAC. (Page 51)

Response:

Regional Computers. The implication that AAC central processing was not considered as an alternative to the regional replacement is not correct. This alternative was explored in the original justification package and is acknowledged by GAO on page 55 when they question the validity of some cost assumptions made in the 1979 study. There appears to be some confusion on GAO's part which may have been created by the regional computer contract award being made at the same time GAO was requested to supply an interim

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report. The closeness of these two events apparently did not permit GAO to revise an earlier approach that GAO was endorsing; i.e., defer the regional computer buy, purchase the AAC replacement computer, and then use the alleged excess capacity at AAC to process the regional batch processing needs. This concept is apparently the basis for the statement that FAA did not consider alternatives which might forestall procurement of the regional computers or could reduce its cost.

This approach is also supported in GAO's statements by its assumption that the only mandatory ADP functions for regions are data entry and RJE, given central processing is available at AAC (Page 52). This approach does not take into account such requirements as information turnaround time, on-line access, and local and remote terminal support.

When the original justification study for regional computers was performed in 1978, the centralized processing option was discarded in favor of replacing the regional equipment. Assumptions used in studying the alternative ($500 per hour processing, no second shift, and telecommunications cost) were valid and are still valid. These assumptions were predicated on the existing AAC processing capability and obviously were not based on projected AAC capability, post-replacement, as did GAO. The management decision then was not to replace and/or upgrade AAC's capability to centralize all regional processing as it was determined that this option would not satisfy FAA's requirements and was not economical. This decision remains valid. Also, AAC's capability was nearly saturated as early as 1978 and there was no excess capability to be used for regional requirements. This remains true today and in the interim period, 1978 to 1982, AAC has augmented its two IBM 370/155s with a leased IBM 4341 in order to accommodate the workload growth which was accurately predicted by FAA.

GAO Evaluation: We do not agree that FAA's analysis of the centralized processing option was an adequate exploration of that alternative. Our review showed that FAA did not take into account the forseeable increase in computer capacity at the Aeronautical Center. This oversight led FAA to a different conclusion than it might have reached if it had anticipated capacity at the center. In addition, we note that the objectives of the regional and Aeronautical Center computers are substantially the same--to process national system workload as opposed to local or regional system workload. Although workload for national systems is originating in the regions, the common objective argues for unified planning of the systems. Therefore, FAA's decision to exclude the future capability of the Aeronautical Center computers is not justified. Our evaluation of the Aeronautical Center procurement response is included below.

Aeronautical Center. GAO's statements revolve around the point that FAA and OST did not coordinate their efforts and did not consider available capacity at both facilities. In the original justification study which was submitted to OST and GSA, several means of utilizing TCC's resources were examined. One alternative examined the feasibility of moving large software applications to TCC in lieu of upgrading AAC. Also considered was using TCC for software development by remote terminals at AAC. In both cases it was determined that projected FAA requirements were of the magnitude and timeliness that neither alternative (or both alternatives) would preclude the necessity of increasing the resources at AAC through replacement.

**At that time, while TCC had limited reserve capacity, it was heavily involved in converting from one operating software system to another (MVT to MVS). The conversion consumed significant TCC resources, and once completed, anticipated growth within DOT was expected to quickly fill the void. In face of the recent economic downturn, anticipated growth within DOT was less than expected which resulted in larger than anticipated TCC capacity temporarily becoming available. In view of this, FAA and OST again examined the alternative of shifting software applications or hardware between sites and also examined the possibility of decreasing the replacement specification for the AAC computers. This study, Oklahoma City Computer Center Acquisition (dated 3/25/82), reaffirmed the need to continue with the AAC replacement as originally anticipated. GAO was aware of the study while in progress and also received a copy of the completed study.**

GAO Evaluation: We disagree that FAA adequately explored alternatives for using the Transportation Computer Center (TCC). Our review of one alternative in the FAA's study, "FAA/Mike Monroney Aeronautical Center Computer Replacement Study," June 1981, disclosed the following analysis of the option to share resources.

> "Use is being made of the TCC in Washington, D.C. where applicable programs and/or systems are processed on TCC equipment. However, TCC is not sized to assume the present or future workload of the Data Services Division."

FAA's analysis, as quoted above, does not adequately address the facts existing at that time. In June 1981, TCC had two modern computers with a combined processing power nearly equal to the size FAA was requesting for the Aeronautical Center.

TCC's operating statistics show that it operated at less than 30 percent capacity throughout 1981 when the conversion from one type of operating software system to another was taking place. These statistics prompted our questions about the TCC option.

DOT did not begin a study of processing Aeronautical Center workload at TCC until February 11, 1982, when the Assistant Secretary for Administration directed the study. The study was completed on March 25, 1982, during final preparation of our April report. Although DOT concluded that workload could not be cost-effectively transferred to TCC, we found several deficiencies in DOT's study. For example, our review showed that DOT overstated the costs of shifting workload by assuming that Aeronautical Center personnel were required onsite at the TCC. Since application software personnel do not have access to computer rooms at TCC now, the extra costs attributed to these personnel should have been excluded. Further problems with this study are described in chapter 4 of this report.

APPENDIX II

Comments of a General Nature. The statement that FAA has treated AAC and the regions separately is incorrect. The general principles employed by FAA and reflected in FAA's Management Information ADP Support Plan are that AAC will be primarily used for large processing applications and as the host for data information that is required by two or more geographically separated organizations. The regional computers will be used to support the local management needs and to provide support to the regional field facilities. Each software application, while in the requirements and feasibility stage, is examined for the applicability and the economies of operation in a centralized, decentralized, or combination mode. In addition, hardware procurements are considered in the same light, as well as consideration of TCC, and other Government resources.

GAO Evaluation: The facts cited by FAA and the actions taken by FAA in the regional and Aeronautical Center computer procurements support our conclusion that it has treated these procurements separately. FAA has defined regional and Aeronautical Center processing requirements separately and has not included potential improvements in the Aeronautical Center computer system.

In its response to issue 3 above, FAA took exception to our citation of criteria in OMB Circular A-109 because it said that the two procurements were separate and neither met the dollar threshold for applying Circular A-109.

We agree that FAA's Management Information ADP Support Plan provides a framework for planning its acquisition needs. We disagree, however, that FAA has adequately implemented the concepts embodied in the plan. Our review of the plan disclosed that judgments concerning workload planning were made without a comprehensive analysis of its agencywide information requirements. Because FAA has not determined the information needs it refers to in the plan, it has not satisfied one of its major planning objectives.

FAA's statement "Each software application, while in the requirements and feasibility stage, is examined for the applicability and the economics of operation in a centralized, decentralized, or combination mode" further reinforces this point. As stated in chapter 2 of this report, our review showed that project-by-project requirements planning, such as indicated by this statement, by itself, is not meeting FAA's planning needs.

ISSUE 6: Inadequate Top Management Involvement In Steering Committee

GAO Comment:

We also found that the Chairman of the Information Systems Review Committee (ISRC) has delegated the authority to the Director of Management Systems to decide when and if the Chairman should attend meetings. (Page 61)

Response: The formal Delegation of Review and Approval Authority issued by the Chairman to the Director of Management Systems on May 4, 1976, is limited to only those automated data system development projects that meet all of the following criteria:

1. The project is progressing generally within the bounds of the schedule and resource estimates contained in the latest approved Data Systems, Equipment and Services (DSES) Plan.

2. Approval of the project does not entail a request for a reprogramming action or a reallocation of funds that will adversely affect another approved project.

3. The project is not undergoing a significant change in direction, nor is there a recommendation that such a change take place.

During the first 5 years of the ISRC process, there were only seven meetings chaired by the Director of Management Systems under the above stated delegation of authority. In each case, all three of the above criteria were met.

GAO Comment:

"Associate Administrators including the chairman are absent most of the time." (Page 61)

Response: At least 1 week in advance of each ISRC meeting, an announcement containing the purpose, highlights of, and decision sought is distributed to each of the Associate Administrators. On extremely large or highly complex projects, "decision papers" are customarily attached. This enables the Associates to select the most knowledgeable individuals to either accompany or represent them. This advance notice is provided to allow ample time for the Associate to convey his position to his representative. Also, the Associate Administrator in charge of the program area is almost always in attendance when his area is being discussed. Following each ISRC meeting, the minutes, along with copies of the presentation material, are sent to each Associate and all other interested parties.

The Chairman has personally attended 84 percent (36 of 43) of the ISRC meetings conducted between 1975 and the end of 1981. the timeframe examined by GAO. This attendance record is in direct conflict with GAO's statement "absent most of the time."

GAO Evaluation: We do not agree that FAA has provided for adequate top management involvement in the Information Systems Review Committee (ISRC). We believe that the decisions reached at those meetings can have a substantial impact on the outcome of the projects, and that attendance of top management is essential if the committee's purpose is to be served.

Our review of the official minutes showed poor attendance at these seven meetings involving key project and agencywide planning milestones. We believe that the full committee should review such projects even when FAA's criteria are met. Specifically:

--in five of the seven meetings, the ISRC reviewed a feasibility study and a course of action for system development was approved, and

--in the remaining two of the seven meetings, the ISRC approved a new Data Systems, Equipment, and Services Plan (DSES) containing in one case 5 and the other 12 new projects. In one of these meetings the Director also approved the development phase of a major DSES project. (The minutes, however, did reflect that in some cases project funding required specific subsequent approval of the Associate Administrator for Administration even through ISRC approval had been given.)

Chapters 2 and 3 of this report also discuss the need for FAA to strengthen its oversight and direction of ADP projects.

We agree that the ISRC does not work in complete isolation. We disagree, however, that staff work and decision papers are acceptable substitutes for the personal involvement of ISRC members. Representation by program officials provides technical expertise at these meetings but does not provide for the high-level review and dialogue that FAA intended for the ISRC. This is especially true in reviews of the DSES plan. Of the nine ISRC meetings from 1976 to 1981 that were held to review the DSES, only one was attended by associate administrators other than the chairman.

FAA is correct that the statement in our report concerning the chairman did not properly represent his involvement in the ISRC. The statement should have read "With the exception of the chairman, associate administrators are absent most of the time."

GAO Comment:

"Inadequate and incomplete presentations of proposed new systems are rarely questioned." (Page 61)

Response: The Chairman of the ISRC has rejected many proposed new systems as being either inadequate or incomplete. In certain cases, once the presentations were refined, ISRC approval has followed. Examples are: Aeromedical Certification Exemptions and Waivers, Accident/Incident Information System, Air Traffic Controller Health Information System, and the UAS, to name but a few. Because the development process involves the scrutiny of the Associate Administrator for Administration who functions as the Chairman of the ISRC, and because the ISRC is composed of all the Associate Administrators who provide advice and counsel, much staff work precedes each ISRC meeting. It is through these efforts that most issues, conflicts, and problems are resolved. It should also be noted that the minutes of each ISRC meeting are a condensation of the salient points presented and discussed and are not intended to be a verbatim report of the text and comments made.

GAO Comment:

"ISRC reviews of approved development projects usually result in extension of development milestones and additional funding." (Page 61)

Response: This comment appears to conflict with the previous comment. Extensions of development milestones and requests for additional funding are often a result of additional effort imposed by the Chairman of the ISRC when he "questions" or requests additional information before rendering a "top management" decision. In other instances, funding may only be approved for the amount of effort required to complete the requirements analysis and feasibility study at which time the ISRC Chairman determines the future of the project. Initial dates and funding estimates are for planning purposes. As refinements are made, better estimates become available. If approved, the system proposal/design phases require additional funding. Development milestones are often extended to permit flexibility in responding to changing priorities, many of which are imposed by outside factors, such as the fiscal year 1982 funding austerity which cut off overtime and travel. In addition, limitations on employment ceilings and reductions in staffing tend to result in extensions to milestones and increased costs.

GAO Evaluation: We do not agree that the ISRC's and the chairman's oversight of FAA's software development projects has reflected adequate or complete top management involvement. However, our review of several software development projects was still ongoing when we issued our April 1982 report. Hence, we were unable to discuss all our evidence at the time and correspondingly reserved final judgment on these points. The results of our completed review confirmed our preliminary findings and are reported in chapter 3 of this report. We found several management deficiencies in the projects we reviewed. The deficiencies remained after the ISRC had completed its review of the projects. We conclude, therefore, that FAA's oversight and direction needs to be more effective than that provided by the committee.

APPENDIX II

ISSUE 7: **Individual Software Projects Have Fragmented Management**

GAO Comment:

**"Individual development projects generally have two or three managers instead of a single project manager. * * * The obvious disadvantage to this system is that it is highly fragmented." (Pages 61 and 62)**

Response: **Each development project has only one program manager. The responsibilities of each program manager are formally documented and agreed to in a written charter. The program manager is often assisted by representatives from each of the participating organizations who represent the interests of the user and the software developer/operator. This arrangement has proven to be beneficial in the development of such programs as the Uniform Payroll System, its subsequent expansion to include the majority of the DOT, and the UAS scheduled to become operational later this year.**

GAO Evaluation: Our review of the projects verified that FAA generally designates a project manager in writing and assigns that individual responsibility for developing systems. However, in many instances the designated project manager did not have direct control of most project resources. Many of FAA's software systems are developed by the technical staff at the Aeronautical Center. Aeronautical Center managers, who supervise the technical staff, report through their own chain of command and are not placed under the overall project manager. Their obligation to the overall project manager is thus more advisory than functional.

From our review, we could not conclude that the overall project managers had firm control of the projects for which they had responsibility. We found, for example, that the overall project managers did not have accurate information on project costs. In some cases, they told us they did not have sufficient data to compile that information. In other cases, they were able to compile estimates of overall project costs as a special effort to comply with our requests. In chapter 3 of this report, we discuss the need for FAA to strengthen its project management.

ISSUE 8: Cost Benefit Studies Are Not Always Conducted

GAO COMMENT:

"We found cost/benefit analyses, specifically required by DOT and FAA regulations, were not conducted for the Enforcement Information System, Energy Management Information System, and Operational Error/Deviation Information System." (Page 62)

Response: In April 1979, the FAA Administrator published a new enforcement policy designed to standardize all enforcement activities, provide for more expeditious prosecution of violators, increase the timeliness of enforcement information, and increase the field work force productivity. This policy is currently being accommodated using a computer located at the Flight Standards National Field Office in Oklahoma City, and is dependent on use of the U.S. Postal Service for transmitting data back and forth between the users and those responsible for maintenance of the national data base. A test transmitting enforcement data electronically is currently being conducted in one regional office in order to better assess costs and benefits. Based on the outcome of the test, the Enforcement Information System automation proposal will be presented to the ISRC, including a cost/benefit study, at which time a decision will be made on further development and implementation.

A feasibility study including a cost/benefit analysis was conducted for the Energy Management Information System (EMIS) and completed in September 1980. Development of EMIS as a separate system was recently withdrawn from the approved agency ADP development plan, before it entered into the active development phase, and is now planned to be incorporated in the development of the National Maintenance Management System.

All contractor proposed alternatives for the Operational Error/Deviation Information System were analyzed in a feasibility study and were rejected as being too costly for the benefits to be derived. A less costly approach was developed in-house and was presented to, and approved by, the Chairman of the ISRC in February 1981.

GAO Evaluation: We do not believe that the circumstances FAA cites in its response justify its not conducting cost-benefit studies in these cases.

With respect to the Enforcement Information System, we do not agree that initiation of a test lessens the importance of a cost-benefit analysis based on the best available information. According to ISRC minutes, on February 28, 1980, the chairman of the ISRC approved "* * * proceeding with the development of the Enforcement Information System." The project had four phases: (1) initial computerized system on a headquarters computer, (2) data base copied and stored on commercial time-sharing service, (3) electronic transfer of data between the headquarters computer and the Aeronautical Center computer, and (4) a field office demonstration test. The estimated cost of the four phases was $360,000. This represents a significant investment considering that the cost-benefits of the overall project, estimated in the ISRC minutes to have total one-time costs of over $4 million, had not been evaluated.

According to the minutes, the system's development was justified based on the FAA Administrator's commitment to strengthen and improve FAA's safety compliance and enforcement program. We agree that this is a worthwhile and important goal to pursue. We believe, however, that the cost-benefits of specific approaches to achieving the Administrator's objectives should be evaluated.

The feasibility study for the Energy Management Information System did not analyze quantified benefits of the proposed system and the other options evaluated. Therefore, it does not meet accepted criteria for cost-benefit analysis, which are that benefits should be quantified to the extent practicable. At a minimum, FAA had the estimated costs of the alternatives to serve as a starting point. It is also usually practicable to quantify the costs of manual processing that will be avoided by automating the system. We note that one alternative had similar estimated development and operating costs to the selected alternative and that another option had substantially lower estimated costs compared with the one selected. According to the study, the latter alternative was rejected because it did not provide for "a national consolidation process for meeting the information and analytical requirements at the national level." The study, however, did not contain an estimate of the benefits of such a process.

As FAA notes, all contractor alternatives for the Operational Error/Deviation Information System were rejected as too costly and a less costly in-house approach was pursued. We found there was no cost-benefit analysis, including quantification of benefits, of the alternative finally selected.

APPENDIX II

Attachment

Chronology of Replacing the Computer Facilities at the Regional Offices

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| March 1976 | Start of project to replace regional ADP equipment (i.e., Spectra 70/35 computers). |
| September 1976 | Contract started to develop specifications. |
| March 1977 | Procurement package (justification study and specifications) to OST. |
| April 1977 | OST approves and sends to GSA for procurement action. |
| May 1977 | House Committee on Government Operations (Brooks' Committee) asked for a copy of package and for FAA to defer action. |
| June 1977 | Brooks' Committee asked GAO to review package. |
| July 1977 | Brooks' Committee staff asked FAA for heavy elaboration of long-range plans. |
| July 1977 to March 1978 | GAO/FAA meetings to elaborate (1) justification, and (2) long-range plans. |
| April 1978 | GSA closes file on procurement action based on the Congressional review. FAA commences new effort to document justification and long-range plans. |
| May 22, 1978 | GAO Report, "Strong Centralized Management Needed in Computer-Based Information Systems" was critical of FAA's replacement action. |
| July 18, 1978 | OST/FAA response to GAO report. |
| February 1, 1979 | A new "FAA Management Information ADP Support Plan" completed. |
| February 2, 1979 | The Associate Administrator for Administration approves plan. |
| March 5, 1979 | OST review of new plan. Informal delivery of package to Brooks' Committee; response promised on four occasions but none received. |
| May 23, 1979 | Submitted Agency Procurement Request (APR) to GSA. |
| June 11, 1979 | GSA submitted APR and Plan to Brooks' Committee. |
| July 7, 1979 | GSA issued a delegation of procurement authority (DPA) to FAA. |
| November 1979 | Selection Plan (SP) forwarded for management approval. |

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| February 1980 | GSA (Region 3) completed initial review of RFP. |
| March 1980 | SP forwarded to DOT. |
| March 1980 | RFP reviewed by regions and centers. |
| April 1980 | RFP updated for latest regional and national requirements. RFP issued to industry for presolicitation review. |
| May 26, 1980 | Industry presolicitation review completed. |
| June 18, 1980 | Agency Procurement Plan (APP) and SP approved. Procurement Request (PR) processed. |
| July 3, 1980 | Source Evaluation Board (SEB) structured. |
| August 28, 1980 | Final RFP drafted/SEB approval obtained. |
| October 28, 1980 | RFP issued. |
| December 23, 1980 | RFP closed. |
| December 24, 1980 to January 8, 1981 | Contracting Officer (CO) reviewed proposals for completeness and separated pricing material from technical materials. |
| January 8 to 12, 1981 | Chairperson, Technical Team, reviewed proposals to verify completeness and to develop the Technical Team's approach to be taken to review each proposal. Arrangements were made to have the Technical Team meet in Washington. |
| January 13 to 16, 1981 | The Technical Team reviewed proposals, developed initial understanding of systems and components proposed, and developed technical queries. |
| January 19 to 23, 1981 | FAA equipment technical experts were acquired to respond to technical queries made by the Technical Team. |
| January 26 to 29, 1981 | Technical Team reconvened, completed detail reviews and analysis of proposals, and developed a list of questions to pose to offerors to clarify specific items in their proposals. |
| February 3, 1981 | Results of technical review and requests for clarifications from offerors forwarded to the CO. |
| February 4 to March 4, 1981 | The questions on technical clarifications were reviewed and reformulated by the CO and Legal Counsel. |
| March 5, 1981 | Offerors were requested to provide clarification to their technical proposals by March 16. |

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| March 16, 1981 | Offerors provided clarification/responses to questions posed in the March 5 letter. |
| March 16 to April 6, 1981 | Offeror responses were reviewed and analyzed by the Technical Team Chairperson and members of the SEB. A decision was made that two proposals appear to be technically qualified. Preliminary costing was developed. |
| April 8, 1981 | The Technical Team's report was presented to the SEB. The SEB accepted the technical reports. SEB took actions to direct that letters be sent to offerors whose proposals were deemed not acceptable. |
| April 10, 1981 | Preliminary cost reviews were completed and reported to the Chairperson, SEB. |
| April 20, 1981 | SEB members were given presentations of proposals by technically qualified offerors, and deficiencies were discussed. |
| April 27, 1981 | Offerors submitted changed pages to their proposals to clarify their offerings. |
| April 27 to May 7, 1981 | Offeror proposals with changed pages inserted were reviewed for continued technical qualification. Cost proposals were again reviewed by the Cost Team. |
| May 8 to 13, 1981 | The SEB report of findings was drafted. |
| May 13, 1981 | SEB met to review the cost report and the draft report of findings for submission to the Source Selecting Official (SSO). |
| May 15, 1981 | SEB findings for competitive range determination were finalized and delivered to the SSO. |
| September 14, 1981 | Competitive range determined by SSO. |
| November 19, 1981 | OCD completed with one offeror. |
| January 7, 1982 | OCD completed with second offeror. |
| February 26, 1982 | Negotiations completed/best and finals offers analyzed. |
| March 5, 1982 | Final Report for source selection by SSO. |
| March 23, 1982 | Final source selection by SSO. |
| April 5, 1982 | Preaward survey/subcontract plan/Congressional clearance/contract award. |

APPENDIX II

Future

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| June 1982 | Delivery of first equipment. |
| March 1990 | Contract completion. |

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