        The Federal Aviation Administration's (FAA's)
procedures for planning, approving, and managing the proposed
acquisition of minicomputers and related development activities
were reviewed, and FAA management practices were compared with
Government-wide guidance for managing, acquiring, and using
computer systems. The FAA has made limited progress in
effectively managing the design, development, and operation of
its information systems, and the agency has no strong, central
authority and responsibility for directing these efforts.
Findings/Conclusions: The FAA's system development efforts have
been hampered by weaknesses in top management direction and
control and continual change of basic system concepts after
substantial design and development work has been completed.
Recommended approval of system design and development activities
has been based on inaccurate, incomplete, or unsupportable
cost-benefit information. As a result, expenditures continue to
be made for systems which have not been shown to be necessary or
cost-effective, prolonged development cycles continue to be
incurred, and the costs for developing new information systems
continue to exceed original cost estimates. The agency's request
for leasing 8 to 14 minicomputers was formulated without
adequate consideration of: a formal long-range plan for the
computer systems, quantification of benefits, functional or user
requirements, and costs of alternatives. The justification for
the proposed minicomputer acquisition was based in part on two
major financial systems which are being redesigned.
Recommendations: The Administrator of the FAA should give central
authority and responsibility for managing computer-based
information systems to a headquarters office. This would:
improve control of computer-based information systems' planning
and development efforts, ensure that limited resources are
allocated to developing information systems which best support
the organization's basic missions, and assure that an

informative and complete set of functional specifications is the
basis for acquiring new computer systems. (RRS)

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REPORT BY THE RELEASED 4/21/78

Comptroller General

OF THE UNITED STATES

Strong Centralized Management Needed In Computer-Based Information Systems

The House Government Operations Committee requested that GAO evaluate the Federal Aviation Administration's proposed acquisition of 14 minicomputers. This acquisition was proposed without adequately considering

- --a formal long-range plan for Federal Aviation Administration computer systems,

- --quantification of benefits,

- --functional or user requirements, and

- --costs of alternatives.

The agency has not yet established strong, centralized management over the planning and development of computer-based information systems. This has resulted in (1) prolonged system development cycles, (2) significant cost overruns, and (3) unnecessary or non-cost-effective system development efforts.

The Administrator, Federal Aviation Administration, should centralize authority and responsibility for managing computer-based information systems to improve control.

LCD-78-105
MAY 22, 1978

B-164497(1)

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

Dear Mr. Chairman:

On June 1, 1977, your office requested that we review
the justification for the planned procurement of regional
minicomputers by the Federal Aviation Administration. We
expanded our review of the agency's computer systems devel-
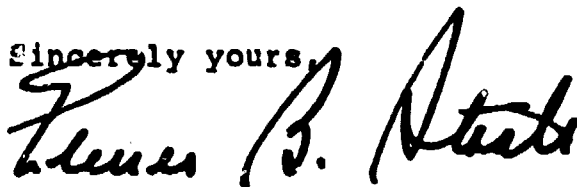opment, which was underway, to accommodate this request.

We have previously reported on proposed procurements
for computer systems by this agency. The first report to the
Congress was entitled, "Improved Planning and Management of
Information Systems Development Needed" (LCD-74-118, Aug 1C,
1975). In our subsequent letter to the Secretary of Trans-
portation, dated April 29, 1976, we said that a proposed
third large-scale computer was not needed at the Aeronautical
Center in Oklahoma City. As a result of this letter, the
Federal Aviation Administration withdrew its request to ac-
quire the third computer.

As requested by your office, we did not take the addi-
tional time needed to obtain written agency comments. The
matters covered in the report, however, were discussed with
with agency officials.

During this review we have worked closely with your
office. The advice and assistance provided were most
helpful in analyzing computer procurements. If you desire,
we could brief you on the overall results of our evaluations
of the important computer system planning issues affecting
the agency.

As arranged with your office, we are sending a copy of this report to the Secretary of Transportation. We plan no further distribution until 30 days from the date of the report. At that time, we will send copies to interested parties and make copies available to others upon request.

Sincerely yours,

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT
TO THE HOUSE COMMITTEE ON
GOVERNMENT OPERATIONS

STRONG CENTRALIZED MANAGEMENT
NEEDED IN COMPUTER-BASED
INFORMATION SYSTEMS

D I G E S T

The Federal Aviation Administration has made
limited progress in effectively managing t ?
design, development, and operation of its in-
formation systems. The agency has no strong,
central authority and responsibility for
directing these efforts. Further improvements
are needed.

The agency's system development efforts have
been hampered by

--weaknesses in top management direction and
  control (see pp. 3, 5, 6, and 13);

--recommended approval of system design and
  development activities based on inaccurate,
  incomplete, or unsupportable cost-benefit
  information (see pp. 6 and 1?); and

--continual change of basic system concepts
  after substantial design and development
  work has been completed. (See pp. 7 and 8.)

As a result, expenditures continue to be made
for systems which the agency has not shown to
be necessary or cost-effective, prolonged de-
velopment cycles continue to be incurred, and
the costs for developing new management in-
formation systems continue to substantially
exceed original cost estimates. (See p. 13.)

In addition, the Federal Aviation Adminis-
tration requested authority to lease a
third IBM 370/155 computer on the basis that
existing computer resources could not handle
impending management information systems.
However, prior to this request, the agency
had neither critically examined the feasi-
bility of augmenting existing computers,
nor adequately monitored new system develop-
ment activities to identify significant slip-
pages in anticipated development cycles.
(See pp. 8 and 9.)

Tear Sheet. Upon removal, the report
cover date should be noted hereon.

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LCD-78-105

The agency's request for leasing 8 to 14 mini-computers was formulated without adequately considering

--a formal long-range plan for their computer systems (see pp. 14 and 15),

--quantification of benefits (see p. 11),

--functional or user requirements (see p. 16), and

--costs of alternatives. (See pp. 11 and 12.)

Further, the justification for the proposed minicomputer acquisition was based, in part, upon two major financial systems--the Uniform Accounting and Uniform Payroll Systems--which are being redesigned.

Because of inadequate long-range planning by the agency, these two systems could require a major redesign effort or, at least, another software conversion would be necessary to implement these two applications on the proposed minicomputers. (See p. 18.)

RECOMMENDATION

We recommend that the Administrator, Federal Aviation Administration, give central authority and responsibility for managing computer-based information systems to a headquarters office.

This would:

--Improve control over its computer-based information systems' planning and development efforts. (See p. 18.)

--Make sure that such limited resources as money and manpower are allocated to developing information systems which best support the organization's basic missions. (See p. 19.)

--Assure that an informative and complete set of functional specifications is the basis for acquiring new computer systems. (See p. 19.)

Implementing this recommendation will provide
the Federal Aviation Administration with the
capability to shorten its system development
cycles, reduce cost overruns, and develop in-
formation systems that are needed and cost
effective.

As requested by the House Committee on Govern-
ment Operations, additional time was not
taken to obtain written agency comments.

Contents

ABBREVIATIONS

CPU   central processing unit

DBMS   data base management system

FAA   Federal Aviation Administration

GAO   General Accounting Office

CHAPTER 1

INTRODUCTION

In August 1975, we reported to the Congress 1/ that the Federal Aviation Administration (FAA) needed to improve its planning and management control over the approval and development of its management information systems to

--shorten prolonged system development cycles,

--reduce cost overruns,

--prevent the premature acquisition of costly or unneeded equipment, and

--initiate system development efforts that would satisfy the demands placed upon them for essential information.

In an April 21, 1976, letter to the Secretary of Transportation, we showed that a proposed third large-scale computer was not needed at the Aeronautical Center in Oklahoma City, because FAA had not thoroughly evaluated the availability of its existing computers to process known and future information requirements. As a result of this letter, FAA withdrew its request to acquire the third computer.

Because of problems experienced by FAA in managing its computer resources, on June 1, 1977, the House Committee on Government Operations requested us to evaluate FAA's proposed acquisition of 14 minicomputers. We were requested to ascertain whether the proposed procurement was, in effect, a substitution for an additional large-scale computer that was to be installed in the agency's Aeronautical Center at Oklahoma City.

SCOPE OF REVIEW

To respond to this request, we reviewed procedures for planning, approving, and managing the proposed acquisition of minicomputers and related development activities, and compared FAA management practices with Government-wide

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1/"Improved Planning and Management of Information Systems Development Needed," Department of Transportation, Federal Aviation Administration, LCD-74-118, Aug. 18, 1975.

guidance for managing, acquiring, and using computer systems. We discussed the procurement of computer equipment and the development of management information systems with responsible officials of the House Committee on Government Operations; the General Services Administration; FAA Headquarters in Washington, D.C.,; and the FAA Aeronautical Center, Oklahoma City, Oklahoma.

CHAPTER 2

ADDITIONAL COMPUTER CAPACITY

NOT JUSTIFIED

Savings of about $3 million will result from the Federal Aviation Administration's cancellation of a planned large-scale computer acquisition. FAA planned to acquire, in April 1976, a third computer at Oklahoma City similar to the two it has. The purpose of this planned acquisition was to increase its computer capability temporarily, pending later acquisition of more sophisticated equipment. FAA's procurement justification stated that two computers at Oklahoma City were saturated with workload and there was insufficient capacity for planned new management information systems. However, based upon the results of independent computer performance measurements, the computers at Oklahoma City were not saturated. In addition, three of the four new management information systems used as a primary justification for the new workload were not going to be ready before 1979. The fourth system was subsequently canceled.

We advised FAA in April 1976 that, in our opinion, a third computer should not be acquired. In December, FAA canceled its request for a third computer, which resulted in saving about $4.6 million. However, costs of about $1.6 million will be incurred, based on FAA's subsequent decision to acquire additional peripheral equipment to augment its two existing computers. FAA officials approved the augmentation plan in December 1976 on the basis that it would provide sufficient capability for implementing four new information systems that were under development. The plan was approved after FAA canceled its request for a third computer. We believe the augmentation was premature and may not have been necessary, in view of the development status of these four new information systems.

None of these systems planned for use on the augmented computers is likely to be operational until early 1979. FAA has canceled development of one system and delayed development of the other three. During our review, planned dates for implementing the new systems were as follows.

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Information System	Under development since	Implementation schedule	
		Original	Revised
Aircraft Registry	May 1973	Mar. 1976	Canceled Aug. 1976
Uniform Accounting	June 1974	Aug. 1976	Late 1979/ early 1980
Aircraft Management	Oct. 1974	July 1976	Late 1979
Uniform Payroll	Mar. 1969	June 1976	Early 1979/ late 1979

ANALYSIS OF THREE INFORMATION SYSTEMS

We analyzed the Uniform Accounting, Aircraft Management Information, and Uniform Payroll Systems. These three systems illustrate the conditions that result in prolonged development cycles, substantial cost overruns, and in developing systems that are neither necessary nor cost-effective. Most or all of these conditions can be eliminated or minimized with strong centralized management of these projects.

Uniform Accounting System

FAA's attempts to develop an integrated accounting system have resulted in prolonged and uneconomical system development. Development cycles were not monitored, and system costs and benefits were not promptly reassessed by top management when major changes from original estimates occurred. In developing the accounting system, cost overruns and implementation delays became evident in early 1976. But FAA did not start reassessing system costs and benefits until December 1976, after authorized funding was exhausted.

FAA has 10 decentralized accounting offices which have locally prescribed information systems that produce non-uniform management reports. To achieve operating efficiencies in its accounting and related computer system operations, FAA concluded that a centralized accounting system was needed. In June 1974, FAA contracted for the development of a Uniform Accounting System in three phases:

--General accounting.

--Uniform cost accounting.

--Property accounting integrated with the other phases.

An important computer software approach to developing a centralized information system, such as a Uniform Accounting System, is using a data base management system (DBMS). This system provides for access to and control of the data base and its files and records. In addition, DBMS can include the capability to provide the nonprogrammer user with data update and query abilities without having to rely upon a computer programmer for this information. DBMS' major advantage is that the data base can be maintained independently from the application programs or software which do the work. Thus, changes in the data base can be made rapidly and economically without changing the application programs and vice versa. Without using a DBMS, such changes are very costly and inefficient. FAA had been using a DBMS on one of these same computers since 1972.

FAA required that the Uniform Accounting System be responsive to the ever-changing accounting requirements and a DBMS could have been used to meet this need economically and effectively. However, FAA did not specify or identify a DBMS in its contract for designing and developing its Uniform Accounting System.

Shortly after the contract was awarded in June 1974, the contractor asked FAA to ascertain whether a DBMS should be included in the design effort. FAA did not identify a DBMS for this purpose until January 27, 1976. As a result, from June 1974 to January 1976, the contractor proceeded with the design effort as though no DBMS existed.

The contractor was to complete all three phases of the Uniform Accounting System by August 31, 1976, at a cost not to exceed approximately $959,000. In February 1976, however, the contractor notified FAA that the completion date for Phase I had slipped 11 months--from May 1976 to April 1977. The contractor reported costs in May 1976 of $692,000, or more than two-thirds of the entire contract's estimated cost, although the work was less than 30 percent complete. In September 1976, the contractor reported that an additional $782,000 would be required to complete development.

Not until December 1976, when expenditures exceeded the stated maximum of approximately $959,000, did FAA begin to reassess the feasibility of continuing the contract. At that time, the contractor advised FAA that completion of Phase I, which is about half of the total development effort, would cost $1.8 million rather than the original estimate of $440,000. We estimate that completing the entire system would

cost about $3 million--more than three times the original estimate. In addition, dates for completing Phases II and III were uncertain.

In January 1977, FAA officials told us they were still reassessing costs and benefits to ascertain whether development of the proposed accounting system should be continued. If FAA had started reassessing the economic feasibility when major deviations from original estimates became evident in early 1976, it would have been able to initiate corrective measures or to terminate further development before committing additional funds to the effort. As of February 1977, FAA had effectively terminated this contractor's effort because there were essentially no more funds for this program.

Aircraft Management
Information System

This system was intended to provide FAA with the information necessary to effectively maintain, operate, and manage its aircraft fleet. The fleet comprises those aircraft which are primarily used by FAA to inspect navigational facilities throughout the United States. Development of the Aircraft Management Information System began in October 1974. The system was scheduled to become operational by July 1976. The total estimated cost for development was $1.5 million.

Although the system design was completed in June 1976, it was not scheduled to become operational until late 1979, about 3 years behind schedule. Stated benefits included

--avoidance of hiring 32 additional personnel at a cost of $440,000 to expand the existing system, and

--reduction of aircraft maintenance costs of $519,000 now incurred with the existing system.

However, these benefits are inaccurate or unfounded. Officials at the FAA Aeronautical Center in Oklahoma City said that expanding the existing system, instead of requiring 32 additional personnel, only requires one or two people. In addition, FAA could not demonstrate, with documentation, how it had calculated the estimated aircraft maintenance savings of $519,000. Thus, FAA has expended about $1.5 million to develop a system which may not produce any savings.

Uniform Payroll System

FAA's efforts to develop a Uniform Payroll System have resulted in both lengthy development cycles and large cost overruns. Changes in design concepts and operational procedures have made contractor development programs, for the most part, inoperable. In July 1976, system development was temporarily suspended, due to slippage in the agency's overall plan and a lack of positive management direction.

Development of the system began in 1969. The original operating concept called for decentralized processing at numerous FAA regional offices, with data being introduced into the system via punchcards. Over a period of years, this original concept evolved into one of centralized processing at the Aeronautical Center, with the regions introducing data via remote computer terminals.

In 1971, FAA contracted for the design and programming of the payroll system. Development was to be completed within 1 year, at a cost of $299,200. Numerous changes in design requirements extended the contract period to 4 years and increased its costs to $909,200. Changes included programming the Fair Labor Standards Act and restoring leave procedures. Although FAA paid an additional $275,000 to complete these tasks, programming was never finished. According to the contractor, FAA was unable to define the operational procedures to be used. Regions were handling these requirements differently, and FAA did not identify and select the uniform operational procedures to be used in designing the new system.

During acceptance testing, FAA found that the contractor's system required special handling to keep it operating and that several procedures consumed excessive computer time. Much of the original punchcard-oriented concept remained in the system's design, resulting in an inability to take full advantage of the processing capabilities of FAA's more modern equipment.

In 1975, at the request of FAA, the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) tested the payroll system to determine the amount of computer resources that might be required for system implementation. FEDSIM is operated by the Department of the Air Force, under authority delegated by the General Services Administration. The simulation center reported difficulty in accomplishing the test due to a lack of available documentation and information on payroll programs. Based on its test results,

FEDSIM recommended that FAA redesign the system and eliminate its punchcard orientation to take full advantage of its modern equipment.

PLAN TO AUGMENT EXISTING COMPUTERS

After the third computer procurement was canceled, FAA officials decided in August 1976 to augment the two computers presently installed. They had considered the augmentation of existing equipment to be undesirable in December 1975, when they requested the third computer. At that time they believed the existing equipment was nearly saturated due to a very high rate of use of the equipment's central processing units (CPUs). 1/ However, CPU activity was actually lower in December 1975, at the time of request, than it was in August 1976--when FAA decided to augment the existing equipment. While the activity of one computer remained relatively unchanged, CPU activity on the other one had actually increased about 17 percent, as shown below.

Oklahoma City
Prime Shift CPU Activity

	December 1975 request	August 1976 study
	(percent)	
Computer I	60-75	63
Computer II	70	87

An FAA official stated that no CPU utilization chart existed for computer I for 1975, which could show second- and third-shift utilization percentages. However, a CPU utilization chart was provided for computer II for 1975. This chart showed that second- and third-shift CPU utilization ranged between about 25 and 60 percent.

During the period for the August 1976 study, computer I CPU utilization was about 65 percent for the second shift and about 52 percent for the third shift. Computer II CPU utilization was about 53 percent for the second shift and about 36 percent for the third shift.

1/The utilization of the computer's central processing unit is one indicator of computer performance. Utilization is the ratio of time units that the central processing unit is working to the total time units that it has available to work.

FAA's augmentation plan requires installing the following computer equipment:

--Additional processing memory.

--An automated scheduling system.

--An automated tape release system.

--Printers, controllers, disk spindles, and other peripheral devices.

We estimate these components will cost about $1.6 million over a 3-year period. Compared to leasing a third computer for $4.6 million, this alternative would result in about a $3 million savings. The Information Systems Review Committee recommended approval of the augmentation plan in December 1976.

By augmenting the two existing computers, FAA officials estimate that they can implement the three new systems under development at the time of our review--the Uniform Accounting, Uniform Payroll, and Aircraft Management Information Systems. However, because of the prolonged delays in implementing these systems and the questionable status of continuing current development direction of the Uniform Accounting System (see pp. 4 to 6) and the Aircraft Management Information System (see p. 6), we believe this equipment was acquired prematurely and may not be needed. It should be noted that FAA's original justification for this augmentation was based on requirements for four systems, one of which has been canceled. (See pp. 3 and 4.)

CHAPTER 3

MINICOMPUTERS NOT JUSTIFIED

The Federal Aviation Administration planned to lease eight minicomputers in October 1977, with an option to lease six more. Installation was scheduled during 1978. Government guidance pertaining to acquiring computers that are part of a planned data communications network requires a detailed economic analysis of hardware and network alternatives to identify the most cost-effective means of providing computer power to meet an agency's information needs.

APPLICATIONS PLANNED FOR PROCESSING
ON REGIONAL MINICOMPUTERS

Five major computer systems, which are currently operating at the FAA regional level, were used to justify acquiring the minicomputers. They are the Financial Management, Manpower Management, Logistics Management, Facilities Management, and Administrative Management Systems. Installing minicomputers would necessitate converting the existing application software.

The minicomputers will require communications with the central computer facility in Oklahoma City. Provision was made in FAA planning for a communications capability between the proposed minicomputers and a host or central computer. In addition, a minicomputer was to be installed at Oklahoma City to serve as the central location from which all programming development was to be controlled. FAA's concept of centralized control would be supported by using this central minicomputer to provide software which could be compatible and operable at all FAA processing locations.

Two systems of the Financial Management System--the Uniform Accounting and Uniform Payroll Systems--are being redesigned for the existing FAA augmented computer configurations (as discussed in ch. 2). We believe that a major system redesign effort or, at least, another software conversion would be necessary to implement these two applications on the proposed minicomputers.

Unsubstantiated urgency

FAA stated in March 1977 that the urgency of the minicomputer procurement was based, in part, upon the fact that Univac--the firm maintaining regional computers--has served formal notice that they will abandon these services

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by 1980. However, Univac has a contract with FAA for maintenance support of this equipment until 1982. The contract further provides that continued maintenance and support can be negotiated with Univac beyond 1982, if desired by FAA. Thus Univac could not abandon its maintenance without revoking its contract.

Department of Transportation and FAA representatives conceded on July 8, 1977, at a meeting with representatives from the House Committee on Government Operations and GAO, that there is no basis for their stated position that Univac would abandon its services by 1980.

Insufficient cost-benefit analysis

We believe that the cost-benefit analysis prepared to support the minicomputer procurement was incomplete and inaccurate. FAA's cost-benefit analysis identified a "total life cycle system cost" of about $4.9 million for the preferred alternative. Anticipated benefits were not quantified in monetary terms.

In our August 1975 report to the Congress on FAA, we referred to Federal Manag ent Circular 74-5, dated July 30, 1974, which states that specific and measurable improvements expected through automation should be shown with their costs. The purpose of this guidance is to help management decide if the system being studied is justified from a cost-benefit standpoint.

Although FAA planned for the minicomputers to communicate with the central computer facility in Oklahoma City, the $4.9 million estimate did not include central computer system costs. We believe that including costs associated with the central computers would produce a more comprehensive life-cycle cost, and we conveyed this belief to FAA officials.

At the request of the House Committee on Government Operations, FAA recomputed life-cycle costs for the proposed minicomputer procurement and related central computer alternatives. We reviewed the life-cycle cost estimates in this new set of computations to determine their reasonableness.

FAA considered two options for operating the Oklahoma City facility. One option is a type of decentralized or partially distributed system and the other is a totally centralized system. They estimated a life-cycle cost of

$17.5 million for the decentralized system and $23.9 million for the centralized version.

The $17.5 and $23.9 million figures could be sub-stantially understated. The costs of operation and software maintenance were not included by FAA. The FAA component costs consisted of: (1) computer hardware, (2) terminals, (3) peripheral equipment, (4) communications, (5) conversion, (6) site preparation, and (7) training.

In analyzing projected life-cycle costs for another proposed agencywide computer system, 1/ we concluded that operating costs (operating   personnel and software mainte-nance) should be included   evaluating computer system alternatives. In that instance, operating personnel and software maintenance costs accounted for approximately half the system's total life cycle. While in the case of the FAA system these costs may not fall in the same ratio, it is possible that FAA total life-cycle costs would be considerably greater than $17.5 and $23.9 million. As previously indicated, benefits had not been quantified.

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1/"A Proposed Automated Tax Administration System for Internal Revenue Service--An Evaluation of Costs and Benefits," LCD-76-114, Nov. 23, 1976.

CHAPTER 4

PLANNING AND MANAGING

INFORMATION SYSTEMS DEVELOPMENT

Since our 1975 report the Federal Aviation Administration has established new policies and regulations for developing management information systems. However, our review of four major systems development projects used for justifying the proposed Oklahoma City procurement disclosed that these policies have not been effectively implemented. (See pp. 3 to 8.) FAA management approved the systems development projects based on inaccurate or unsupported cost information, and initiated system development efforts before adequately defining operational concepts. As a result, prolonged development cycles, cost overruns, and the initiation of development efforts that are not needed or cost-effective continue. Costs of developing new management information systems originally estimated at $3 million are now expected to exceed $7 million, and systems originally planned for implementation in 1976 are now expected to be implemented in 1979 or 1980.

The new procedures apparently have not adequately provided for monitoring development cycles and reassessing system justification by top management when major changes affecting cost-benefit estimates occur. Such procedures are required to prevent continued development of uneconomical or unneeded systems.

FAA management does not always assign project responsibility and authority to a single office. For example, the FAA accounting organization is designated as the coordinator or project manager for the Uniform Accounting System, which is scheduled for implementation in late 1979 or early 1980. However, our review of the project management for this system suggested that the accounting organization deferred to the FAA management systems organization on such technical matters as computer software, which are vital to system success. Thus, FAA apparently allowed the coordinator to delegate decisions on technical issues that could have a major impact on project success. We believe that the project manager should fully understand all issues for which he is responsible, including computer software technical issues.

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LONG-RANGE PLANNING
SHOULD BE FORMALIZED

There is little formal long-range planning at the head-
quarters level for FAA management information systems. Frag-
ments of a plan exist, which primarily address current and
projected computer system projects. These projects are iden-
tified in the FAA Data Systems, Equipment, and Services (DS_S)
Plan (1370.50A). However, virtually no relationship is es-
tablished by FAA between the above plan, the development and
operation of information systems, and how they will support
the organization's objectives.

The Department of Transportation provides a policy for
determining the need for acquiring, augmenting, and developing
ing computer system resources (DOT-1370.9). This policy re-
quires that management develop information system applications
which contribute most to the support of the organization's
objectives, mission accomplishment, and productivity. A
complete and accurate cost-benefit analysis is intended
to assist in selecting the most cost-effective means of
meeting the organization's information requirements. We
believe this is a good statement of policy objectives. Each
of these objectives requires a thorough analysis and deter-
mination of basic information requirements, which can be
used to develop a long-range plan.

Development of a formal long-range plan is a recog-
nized method of achieving the best use of resources over
the long run. In addition, it represents a commitment, on
the part of management, to act and provides for the phased
development of information systems within approved resource
levels.

The canceled interim procurement at Oklahoma City and
the proposed regional minicomputer procurement are inter-
related and would normally be reviewed in relation to a
formal long-range plan. However, since only fragments of
a plan exist in FAA, we were unable to determine how well
these procurements would support FAA's organizational ob-
jectives and missions.

During our review, FAA formed a group in headquarters
to develop a data collection plan as a first step in imple-
menting a long-range plan. This could be an improvement
in FAA procedures.

The House Committee on Government Operations has recommended in H. Rept. 94-1746 (Oct. 1, 1976) that Federal user agencies be required to develop long-range plans governing computer system needs and equipment expectations based upon realistic utilization reviews. According to the Committee, these plans must be based upon a user agency's projected missions and programs for a period of 5 or more years, and not merely an estimate of future computer system needs which are divorced from the agency's mission and program needs.

The Committee has stated that if an agency plans effectively, the computer system resources to be acquired should fully support the agency's missions and programs for the plan's duration and should minimize the necessity for interim upgrades, add-ons, and replacement systems. Establishing computer system requirements when a plan is developed is not meant to imply, however, that all hardware and software must be procured at the plan's initiation. Instead of acquiring unneeded capacity in the short run, contracts can be awarded which call for phased equipment installation over a period of years.

FAA plans for computer resources at Oklahoma City and minicomputers for the regions should have been developed as part of the long-range planning approach recommended by the Committee. This approach would have increased the probability of effectively supporting FAA's objectives, mission accomplishment, and productivity.

FUNCTIONAL SPECIFICATIONS

Computers and related equipment should, according to the Committee, be procured on a fully competitive basis. One means of insuring competition, when soliciting bid proposals from vendors, is the use of functional rather than the more restrictive hardware specifications. Functional specifications allow the vendor to configure the hardware so that it will meet management's information requirements. Hardware specifications contain equipment operating characteristics. Using equipment operating characteristics when soliciting bids tends to inhibit free and open competition. Such specifications are directed at identifying the equipment's internal operating characteristics rather than the use to which it will be put.

For this reason, the Committee has recommended that computer equipment be generally procured competitively, using functional rather than hardware specifications.

FAA's proposed procurement of minicomputers is an example of using hardware rather than functional specifications. In this instance, FAA identified the equipment they desired to lease--minicomputers--before defining detailed information that the equipment would process. Equipment that meets predetermined hardware specifications is of little value if it does not provide sufficient processing capability to handle known and anticipated workloads. Using hardware rather than functional specifications frequently results in acquiring equipment that is either too small or too large to process current and anticipated future workloads.

Using functional specifications helps to eliminate this problem and when prepared in uniformity with a long-range plan, reasonably assures that those applications which contribute most to supporting the organization's objectives, mission, and productivity are given priority.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

CONCLUSIONS

Further improvements are needed in FAA's planning and management of the approval and development of computer-based management information systems and its processes for acquiring computer systems. While our review confirmed that new system development procedures have been established, we found that such procedures had not been effectively implemented.

A computer-based information system should provide management with the information needed to assist in guiding an organization toward accomplishing its predetermined objectives or missions. (See p. 14.) A formal long-range plan encompassing the information needs of the organization as a whole serves as a foundation for the design, development, and operation of information systems which assist management in achieving those objectives and missions. Such a plan also represents a commitment to act, by management, which is essential, because developing and using computer-based information systems is a lengthy, time-consuming, and costly endeavor. The lack of long-range planning for developing such systems has been noted by the House Committee on Government Operations as a major deficiency in the Federal computer system procurement programs. This condition is evident at FAA.

FAA system development efforts have been hampered by

--weaknesses in top management direction and control;

--approval of system design and development activities based on inaccurate, incomplete, or unsupportable cost-benefit information; and

--changes in basic system concepts after substantial design and development work has been completed.

As a result, expenditures continue to be made for systems which FAA has not shown to be necessary or cost-effective, prolonged development cycles continue to be incurred, and costs for developing new management information systems continue to substantially exceed original estimates.

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In addition, FAA requested authority to lease a third IBM 370/155 computer on the basis that existing computer resources could not handle impending management information systems. However, prior to this request, FAA had not critically examined the feasibility of augmenting existing computers, and had not adequately monitored new system development activities to identify significant slippages in anticipated development cycles.

The FAA request for leasing 8 to 14 minicomputers was formulated without adequately considering

--a formal long-range plan for FAA computer systems,

--quantification of benefits,

--functional or user requirements, and

--costs of alternatives.

In addition to the House Committee on Government Operations' concern for formal long-range planning, the Committee has also noted that not using functional specifications is another major deficiency in Federal computer system procurement programs. This condition is evidenced above in the proposed minicomputer procurement, because FAA specified minicomputers rather than functional or user needs for a certain information processing capability.

Further, the justification for the proposed minicomputer acquisition was based, in part, upon two major financial systems--the Uniform Accounting and Uniform Payroll Systems--which are currently being redesigned.

Because of inadequate FAA long-range planning, these two systems could require a major redesign effort or, at least, another software conversion would be ne ssary to implement these two applications on the propc ed minicomputers.

RECOMMENDATION

We recommend that the Secretary of Transportation direct the Administrator, FAA, to give central authority and responsibility for managing computer-based information systems to a headquarters office. The purpose of centralizing this responsibility is to provide FAA with:

--Improved control over its computer-based information
   systems' planning and development efforts. This

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responsibility includes preparing and implementing a long-range plan, which provides a phased approach for meeting the organization's information requirements.

--Assurance that such limited resources as money and manpower are allocated to developing information systems which best support the organization's basic missions--namely, those activities which foster aviation safety, promote civil aviation and a national system of airports, use navigable airspace efficiently, and provide a common system of air traffic control and air navigation for both civilian and military aircraft.

--Assurance that an informative and complete set of functional specifications is the basis for acquiring new computer systems, including data entry and communications equipment.

Implementing this recommendation will provide FAA with the capability to shorten its system development cycles, reduce cost overruns, and develop information systems that are needed and cost-effective.

PRINCIPAL DEPARTMENT OF TRANSPORTATION OFFICIALS

RESPONSIBLE FOR ADMINISTERING ACTIVITIES

DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
SECRETARY OF TRANSPORTATION:		
Brock Adams	Jan. 1977	Present
William T. Coleman, Jr.	Mar. 1975	Jan. 1977
Claude S. Brinegar	Feb. 1973	Feb. 1975
John A. Volpe	Jan. 1969	Feb. 1973
Alan S. Boyd	Jan. 1967	Dec. 1968
FEDERAL AVIATION ADMINISTRATION:		
Langhorne M. Bond	May 1977	Present
Quentin S. Taylor (acting)	Apr. 1977	May 1977
James L. McLucas	Nov. 1975	Mar. 1977
James E. Dow (acting)	Apr. 1975	Nov. 1975
Alexander P. Butterfield	Mar. 1973	Mar. 1975
John H. Shaffer	Mar. 1969	Mar. 1973
David D. Thomas (acting)	Aug. 1968	Mar. 1969
Gen. William F. McKee	July 1965	July 1968
DIRECTOR, AERONAUTICAL CENTER:		
Thomas .. Creswell	Sept. 1973	Present
Alfred L. Coulter	Aug. 1970	Sept. 1973
Christopher B. Walk, Jr. (acting)	Mar. 1970	Aug. 1970
W. Lloyd Lane	Oct. 1965	Mar. 1970

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