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Report to the Subcommittee on Transportation, Committee on Appropriations, House of Representatives

December 1987

AIR TRAFFIC CONTROL

FAA Should Avoid Duplication in Procuring a Traffic Management System

GAO/IMTEC-88-8

GAO

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

Information Management and
Technology Division

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December 22, 1987

The Honorable William Lehman
Chairman, Subcommittee on
Transportation
Committee on Appropriations
House of Representatives

The Honorable Lawrence Coughlin
Ranking Minority Member
Subcommittee on Transportation
Committee on Appropriations
House of Representatives

In your October 1, 1985, letter you requested that we monitor and periodically report on the Federal Aviation Administration's (FAA) progress in implementing its $16 billion national airspace program. (See Appendix I.) As agreed with your office, this report focuses on FAA's efforts to enhance and modernize its Traffic Management System.

FAA intends to use the Traffic Management System to better manage traffic delays and balance air traffic controller work loads. Traffic delays, which were up 20 percent in 1986 compared to 1985, remained high in 1987. These delays have resulted in increasing dissatisfaction among the airlines and the traveling public. Also, because of deregulation, air traffic has grown to record levels and is expected to continue to grow. Increasingly competitive scheduling and hub and spoke[1] operations have created peak air traffic periods placing extra demands on the air traffic control system.

Congressional hearings have recently focused attention on the urgency of achieving a solution to reduce air traffic delays and balance air traffic controller work loads. FAA believes that a modernized Traffic Management System would increase the use of airspace, minimize delays, and balance controller work load without compromising safety. FAA has been conducting duplicate development efforts to upgrade and modernize its Traffic Management System. One program had an estimated cost of about $12 million and the other about $18 million. These efforts were directed toward the same objective, and, although pursuing different

[1]Hubbing and spoking is the practice of clustering airline operations around a major airport. Numerous flights are scheduled to arrive at a hub airport within a relatively short time frame. Passengers, arriving from a variety of destinations, change planes and continue on the next leg—or spoke—of their flight.

system architectural approaches, they were incurring duplicate software development costs and might have resulted in the acquisition of two separate sets of hardware to operate the Traffic Management System. FAA officials said this situation may have occurred because the tw development efforts were not being coordinated.

At the completion of our audit work in May 1987, the Program Manag for one of the development efforts advised us that a study was underway to eliminate duplicative software development and that a decisior had been made not to procure a computer for one of the systems. Addi tionally, FAA has used a prototype of one of the systems to assist in ma aging the increase in air traffic during the summer of 1987. We believe that by continuing to closely review these development efforts for unnecessary duplication, FAA can assure that the two efforts are totall integrated and expeditiously completed. Because FAA is taking this action, we are not making recommendations at this time.

Objectives, Scope, and Methodology

Our objective was to assess FAA's efforts to acquire a new automated system designed to improve the flow of air traffic and to improve traf management. To obtain information for this report, we met with officials of the Traffic Management System project office and traffic management representatives in the Air Traffic Operations Service and the Traffic Flow Management Branch in FAA headquarters in Washington, D.C. We also met with traffic management representatives at the Air Route Traffic Control Center in Leesburg, Virginia, and the Air Traffic Control Tower at Dulles International Airport near Herndon, Virginia. For information on a planned computer acquisition, we met with repre sentatives of Computer Sciences Corporation and FAA's Technical Center, both in Pomona, New Jersey. We reviewed FAA contract and co respondence files and analyzed project management and requirements studies prepared by FAA and various contractors. Our review was conducted according to generally accepted government auditing standards We performed our review between July 1986 and May 1987.

Flow Control as a Traffic Management Strategy

Flow control is a procedure used to manage the overall flow of air traf fic rather than to control the flight of individual aircraft. For example, traffic managers working through air traffic controllers will (1) direct the flow of traffic around severe weather systems, (2) reroute traffic t avoid congested space, (3) arrange traffic in an orderly sequence for arrival at congested airports, and (4) hold traffic on the ground when conditions warrant.

The national flow control programs that exist today trace their roots to the establishment of the Central Flow Control Facility in FAA headquarters, Washington, D.C., in 1968. In its early role, central flow control assisted en route and terminal facilities with the implementation of airborne delay and rerouting strategies. For example, if an airport could not accept arriving traffic at a normal rate, en route traffic could be slowed down, rerouted, or allowed to circle in an airborne holding pattern. If the condition persisted, traffic in adjacent sectors would be delayed. The central flow control facility would orchestrate this scenario and act as a coordinating link between the affected centers.

The fuel crisis of the 1970's, however, caused airborne holdings to become costly. The effects of the fuel crisis were further compounded by the air traffic controller strike in 1981 and the subsequent firing of more than 11,000 air traffic controllers. Central flow control took on a more significant role in ensuring that the air traffic system was in balance and that safety was not compromised by undue work load on the controllers. In this new role, central flow control's strategy was now aimed at eliminating airborne holdings—an approach that eased demands on the controllers and saved fuel. As a result of this change in strategy, most delays were incurred on the ground at the departure airport.

The government's decision to deregulate the airline industry in 1978 led to the airlines' hubbing and spoking practice, which further aggravated the departure delay problem. In addition, restrictions that had been placed on the number of scheduled flights because of the controllers' strike were lifted in 1984. As a result, the level of air traffic rose significantly, and many major airports began experiencing increased ground delays.

The following are FAA statistics on air traffic delays for recent years.

Table 1: Air Traffic Delays, 1984-1987

Fiscal Year	Average Daily Delays
1984	1,084
1985	921
1986	1,104
1987	1,076

FAA attributes about two-thirds of the delays to weather-related problems. The airline industry contends, however, that traffic delay is aggravated by FAA's flow control strategy of absorbing delays on the ground. In view of an ever-increasing demand on the air traffic control system, the FAA Administrator, in January 1987, made a personal commitment to ensure that FAA meets the challenge ahead. As a result, the Administrator set a goal of 15-percent reduction of delays, based on the projected fiscal year 1987 traffic.

FAA's Existing Traffic Management System

The Traffic Management System consists of a network of traffic management specialists and weather forecasters who, with some automation assistance, provide nationwide management of air traffic flow through the central control facility at FAA headquarters and Traffic Management Units in each of the en route traffic control centers.

The Traffic Management System can best be viewed as an analytical tool used for managing the flow of traffic rather than for separation and control of individual aircraft. Traffic managers in the Central Flow Control Facility can extract lists of flight plan data from the Traffic Management System computer that enable them to plan for, or react to, adverse weather conditions, airport closures, or other events that disrupt a smooth flow of air traffic. Traffic managers in the Central Flow Control Facility maintain telephone communication with traffic managers in the en route centers who use the flight plan data to determine traffic loads and to space aircraft in proper sequences for arrival.

The ultimate goal of traffic management is to organize traffic nationally and locally so that it can be managed by individual facilities safely and without undue stress on the controllers. At the same time, the Traffic Management System must ensure that the air space is used to the fullest extent to meet user requirements and avoid unnecessary delays without compromising safety.

At present, traffic management responsibilities are distributed between the Traffic Management Units in the en route centers and the Central Flow Control Facility in Washington. The Traffic Management Units are responsible for rerouting traffic within the en route center when airspace within individual sectors becomes congested. The Central Flow Control Facility, on the other hand, defines and executes new plans several hours in advance when traffic flow problems are anticipated and/or when multiple facilities are involved. Time and airspace boundaries are the factors that determine who is responsible for traffic management.

Independent of who makes plans and who executes them, there is considerable coordination between Traffic Management Units and the central facility.

Problems and Limitations of the Existing System

According to FAA, the present Traffic Management System's obsolete software cannot meet its requirements or keep pace with an increasing demand on the system. As a result, only a small percentage of total airport and sector data are processed. For example, the system cannot han dle the large volume of traffic messages that must be processed to generate flow advisories and restrictions. FAA states that these messages frequently cause overloads during peak traffic periods, requiring a reduction in the number of sectors and airports being monitored.

Likewise, FAA claims that the constraints of the existing system impair its ability to introduce numerous automation aids to support new functional advances in traffic management. For example, current traffic management decisions are made on the basis of static data that are available from flight plans filed by commercial airlines and general avia tion aircraft or—when flight plans have not yet been filed—from the Official Airline Guide. According to FAA, the central computer does not have the capacity to process the position messages produced by radar tracking of the aircraft in flight. As a result, traffic management decisions frequently are based on where aircraft are scheduled to be rather than where they actually are.

According to FAA, until the computer capabilities are improved, the Traf fic Management System will not be able to determine in advance and on a real-time basis potential traffic flow problems.

FAA Efforts to Upgrade the Traffic Management System

In July 1983, FAA's Program Engineering and Maintenance Service initiated a phased program to upgrade and expand the Traffic Management System. Computer Sciences Corporation was selected to accomplish the upgrade. The Transportation System Center was selected to assess the capabilities of the communications and work station processors in order to link the Traffic Management System elements together.

Under Phase I, the IBM 9020, the Traffic Management System's central computer, was replaced by an IBM 4341—which was faster and had greater capacity—at the FAA Technical Center in Pomona, New Jersey. Dedicated, two-way, point-to-point data communication lines were

installed between each of the Traffic Management Units and the Techni cal Center. In addition, the central flow facility was provided with computer terminals that interface with the IBM 4341 computer.

These changes enabled traffic managers in the central facility in Washington, D.C., to extract listings that show, for example, all flights scheduled to arrive at a designated airport within a specified time frame. The listings, which are based on the Official Airline Guide or the latest flight plans filed, show the flight identification, type of aircraft, its departure airport, the actual or estimated departure time, the estimated arrival and flight time, and proposed altitude.

These listings permit the central facility to anticipate the volume of air traffic for specified airports, and, if significant delays are projected, to direct that individual aircraft be held on the ground at appropriate departure airports. FAA completed Phase I in December 1983.

In January, 1987, Phase II was in process and was intended to replace the IBM 4341 at the Technical Center with a larger computer capable of processing the in-flight data produced by radar tracking of the aircraft. The Traffic Management Units were to be provided with computer terminals that would enable them to access the central data base for local flow control planning. FAA originally planned to complete Phase II in December 1987; however, Phase II's progress was slow and completion was rescheduled for December 1989. FAA estimated that $22.7 million was needed in fiscal year 1988 to complete Phase II.

A Proposed New Approach to Traffic Management

Concurrent with efforts to upgrade and expand the Traffic Management System, FAA's Systems Engineering Service was working on a research project with the Transportation System Center to define requirements for an advanced Traffic Management System for 1995. About this same time and as part of this project, the Transportation Center—a research unit under the Department of Transportation—acquired computer hard ware for use to support a prototype Traffic Management System, and subsequently began to access traffic management data for use in its research.

In August 1986 the Transportation System Center presented a report to FAA outlining a proposal for an Advanced Traffic Management System that it was developing under contract with FAA's Systems Engineering

Service. The proposal called for an integrated traffic management system to be designed using a distributed hardware architecture—computers located at the traffic centers nationwide—rather than the centralized computer FAA was considering under Phase II of its modernization program. The Transportation System Center contended that the distributed hardware would cost significantly less and could be put into operation sooner than the centralized computer. The centralized computer system was estimated to cost about $18 million and the distributed system about $12 million.

FAA did not act on the recommendations in the Transportation System Center proposal. Rather, in September 1986 the proposal was provided to Computer Sciences Corporation with instructions to consider it in its Phase II study for a replacement computer for the IBM 4341.

The Transportation System Center continued to develop its distributed architecture approach. Using live traffic management data, including the in-flight position messages produced by radar, the Transportation System Center developed a prototype system that provides displays of air traffic in the form of a map with actual flights depicted in miniature. The display shows the location of every aircraft flying over the United States, and allows users to select various geographic boundaries, such as quadrants of the country, en route centers and/or sector boundaries, airports, and special-use airspace. Aircraft can be selected in high- or low-altitude airways, in major jet routes, by departure or arrival airport, or by type of aircraft. Flight plan information, such as flight number, altitude, speed, aircraft type, and directional heading, can be displayed. Different classes of aircraft can be color coded according to departure or arrival airport, aircraft type, or altitude. Current weather patterns can also be displayed.

The Transportation System Center demonstrated its prototype model to traffic management officials in January 1987, and the manager of the Central Flow Control Facility informed us that the prototype system satisfied 85 percent of current requirements. He expects the remaining requirements could be met with development of software designed to predict potential areas of air traffic congestion and delay (referred to as Monitor Alert). FAA used the prototype model to assist in flow management of the increased air traffic during the summer of 1987.

The prototype model was developed under a research and development project. The model was not tested to assure its operational suitability and therefore could not be certified as a fully operational system. To

meet FAA system acquisition requirements, additional security software would have to be developed, the system would have to be thoroughly documented, logistics support, maintenance, and training programs would have to be developed, and extensive operational and shakedown testing would have to be conducted.

The Systems Engineering Service has submitted a plan to acquire additional hardware and adapt the prototype system software to the new hardware. The plan also calls for completion of all software and documentation necessary for system certification. This action was necessary because the hardware at the Transportation System Center will continue to be used for research and development and will not be available to support operational systems.

At the completion of our audit work in May 1987, the prototype model was being used for air traffic management operations in the Central Flow Control Facility. Traffic Management personnel indicated they were satisfied with the performance of the prototype model. Because there is a need for improved automation to balance sector work loads for controllers, at the conclusion of our audit work we suggested expeditious action to complete development and implementation of the distributed system at all Traffic Management Units.

Development Efforts Are Being Integrated

Officials of Air Traffic Operations, the Systems Engineering Service, and the Program Engineering and Maintenance Service are currently discussing the extent of duplication between the advanced Traffic Management System research and development effort and the Phase II development project. It was recognized that software developed by the Transportation System Center for the advanced system directly duplicated software being developed by Computer Sciences Corporation for the Phase II effort. According to agency officials, this duplication may have occurred because the two development efforts were not being coordinated. Agreement was reached that the three services would support a working group to reexamine Phase II requirements and reduce the scope in those areas that were duplicative. A procurement request being processed for the Phase II replacement computer was put on hold until completion of the above study.

Subsequent to this agreement the program manager for Phase II advised us that a decision had been made not to replace the 4341 computer and that FAA would continue to evaluate how the two development efforts could be further integrated. He said that a proposal would be submitted

to the National Airspace System Configuration Control Board outlining FAA's plans for further modernization of the Traffic Management System. He indicated that this proposal would be completed by mid-January 1988.

We support FAA's decision to review the two Traffic Management System development efforts and eliminate those phases that may be duplicative. FAA also agreed to our suggestion that expeditious actions be taken to complete development and implementation of the distributed system at all Traffic Management Units. Because FAA is taking this action, we are not making recommendations at this time.

Agency Comments and Our Evaluation

We requested written comments on a draft of this report from the Department of Transportation. (See Appendix II.) The Department concurs with our principal findings. Also, the Department made technical suggestions and these have been incorporated into the report.

Should you need additional information or have any questions on the contents of this report, please contact Dr. Carl R. Palmer, Associate Director, on 275-4649.

Ralph V. Carlone
Director

Request Letter

Congress of the United States
House of Representatives
Committee on Appropriations
Washington, DC 20515

October 1, 1985

Honorable Charles A. Bowsher
Comptroller General of the United States
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Bowsher:

Recently, the General Accounting Office's Information Management and Technology (IMTEC) Division responded to the Subcommittee's request for a review of the Federal Aviation Administration's efforts to modernize its automated air traffic control system. The two reports issued by IMTEC on the acquisition of the "host" computer system and the development of the Advanced Automated System (AAS) have greatly aided the Subcommittee in this year's mark up.

The Subcommittee intends to continue to rely on GAO to provide objective analyses of FAA's $12 billion national airspace program. Based on concerns raised in both reports, we request that IMTEC continue its review of FAA's AAS and related programs. Specifically, the Subcommittee is interested in IMTEC's observations concerning the soundness of FAA's AAS investment decision from a technical, economic and managerial perspective, including the soundness of FAA's benefit/cost analysis for the AAS. In that an effective implementation of the "host" computer program is essential to any future transition to the AAS, the Subcommittee is also interested in GAO's observations on FAA's efforts to test and implement the "host" including an assessment of whether performance testing is being conducted as promised to the Subcommittee. The Subcommittee requests that GAO provide its observations on the above issues by June 1, 1986. We may also request the GAO to testify on these subjects during our fiscal year 1987 budget hearings.

The Subcommittee is also interested about how FAA plans to integrate recently identified user requirements for communications, navigation and surveillance (CNS) systems. Specifically, the Subcommittee is concerned as to what degree FAA's advanced system will be able to accommodate these requirements in a timely and cost-effective manner and what additional funding will be needed to satisfy these requirements. We request that GAO initiate a survey to begin exploring this issue including FAA's planned investment in CNS systems. Based on the results of the survey, the Subcommittee may request further review of FAA's investment in CNS technology.

We have been very pleased with the cooperation and quality of work provided by your staff on this important multi-year program and hope that your special efforts in this regard will continue.

Sincerely,

Lawrence Coughlin
Ranking Minority Member
Subcommittee on Transportation and
Related Agencies Appropriations

William Lehman
Chairman, Subcommittee on
Transportation and Related
Agencies Appropriations

Agency Comments

U.S. Department of Transportation

Assistant Secretary
for Administration

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

OCT 27

Mr. J. Dexter Peach
Assistant Comptroller General
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

Enclosed are two copies of the Department of Transportation's comments concerning the U.S. General Accounting Office draft report entitled, "Air Traffic Control: FAA Should Avoid Duplication in Procuring a Traffic Management System."

Thank you for the opportunity to review this report. If you have any questions concerning our reply, please call Bill Wood on 366-5145.

Sincerely,

Jon H. Seymour

Jon H. Seymour

Enclosures

Department of Transportation Reply to

General Accounting Office Draft Report

Entitled: Air Traffic Control: FAA Should

Avoid Duplication in Procuring a Traffic

Management System

The General Accounting Office (GAO) draft report states that the Federal Aviation Administration (FAA) has been conducting duplicate development efforts to upgrade and modernize the Traffic Management System, which is used to better manage traffic delays and balance air traffic controller workloads. According to GAO, one of these efforts had an estimated cost of $8 million, while the other was estimated at $23 million.

GAO states that according to FAA officials, this situation may have occurred because of a lack of coordination between the two efforts which might have resulted in the acquisition of two separate sets of hardware to operate the Traffic Management System. It also reports that a study was underway at the FAA to look at eliminating this duplication. Additionally, according to the report, FAA decided not to procure a computer for one of the systems, and to use a prototype of the second system to assist in managing the anticipated increase in air traffic activity during the summer of 1987. Because of the actions already taken by the FAA and the agency's continuing review of the Traffic Management System development effort, GAO did not make any recommendations in the report.

The Department concurs with GAO's principal findings. Two separate organizations within the FAA work on aspects of the Traffic Management System; one to upgrade the current operational system, and the other, a research and development effort, to meet major changes needed for the System for the Year 2000. In this regard, the FAA, through a work group, has identified duplicate development efforts and has taken action to eliminate this duplication and properly integrate the development efforts. The FAA complex which has responsibility for both projects is currently undergoing a reorganization. When this reorganization is completed, procedures will be established to prevent a recurrence of this situation. In addition, we have the following comments to add to further clarify certain facts in the report.

The figures of $8 million and $23 million as listed in the report for the costs of the duplicate development efforts should be revised to $12 million and $18 million, respectively. These are the amounts cited in the Transportation Systems Center (TSC) study also referenced in the report.

Paragraph 1 on page 10 of the report should state that additionally the TSC was selected to implement communications and work station processors to tie together the Traffic Management System elements.

The date listed on the bottom of page 12 of the report for when the TSC proposal was provided to Computer Sciences Corporation should be changed from early 1987 to September 1986.

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