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Report to the Chairman, Subcommittee
on Transportation and Related Agencies,
Committee on Appropriations, House of
Representatives

January 1993

AIR TRAFFIC CONTROL

Justifications for Capital Investments Need Strengthening



148415

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**Resources, Community, and
Economic Development Division**

B-250994

January 14, 1993

The Honorable Bob Carr
Chairman, Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

In 1981 the Federal Aviation Administration (FAA) launched a major effort—now called the Capital Investment Plan—to modernize air traffic control (ATC) by acquiring new systems that are designed to enhance the safety and efficiency of air travel. While acquiring these new systems, FAA has encountered serious problems in cost growth and performance as well as schedule delays. We previously reported that a factor contributing to acquisition problems was that FAA did not prepare mission need statements for any of its major acquisitions as required by Office of Management and Budget (OMB) guidance.¹ A mission need statement should justify the need for an investment, clearly stating what the purpose of the investment is, how it will meet the agency's needs, and what risks are involved. While not guaranteeing a successful acquisition, mission need statements are intended to provide a sound basis for investment decisions.

FAA reformed its acquisition process in February 1991 by requiring a mission need statement for all new system acquisitions in the Capital Investment Plan. This report examines FAA's process for developing mission need statements. More specifically, we determined (1) whether mission need statements contained evidence to support the need for new investments and (2) whether the statements were based on analyses of current performance of ATC systems.

Results in Brief

FAA has taken a positive step in improving its acquisition management planning by requiring mission need statements for its acquisitions. Additionally, FAA has increased its scrutiny of these statements. As a result, some mission need statements were disapproved and others were withdrawn.

¹Aviation Acquisition: Further Changes Needed in FAA's Management and Budgeting Practices (GAO/RCED-91-159, July 29, 1991).

Nevertheless, despite FAA's progress, many mission need statements do not support the need for capital investments. For example, the 25 mission need statements we examined listed 110 deficiencies in the ATC system, which could cost \$5 billion in new investments to fix. Nearly 60 percent of the deficiencies were merely assertions that the project could improve capacity or safety and should be acquired. They contained no qualitative or quantitative information explaining what performance problem was to be fixed, such as the extent of maintenance problems with the current system or the extent to which a new investment could be expected to reduce delays or maintenance expense. Moreover, the statements were seldom based on analyses of performance, which would have measured how well current systems are performing, identified areas most in need of improvement, and helped to set priorities for capital investments. Such analyses should be the beginning point of the acquisition process.

Three factors have contributed to FAA's mission need statements not being supported. First, although FAA has improved its acquisition policies, the agency's acquisition order and instructions for mission need statements still do not require an analysis of current performance as the starting point in the acquisition process. Second, FAA's data bases, which contain potentially useful support, are not easy to access. Third, FAA program officials who prepared the statements had little incentive to spend the time and effort required to support the needs because FAA's acquisition officials approved many statements that did not have support.

Background

FAA's Capital Investment Plan is a \$32 billion program to ensure the safe and efficient flow of air traffic—the agency's fundamental mission. Each acquisition of a new radar, communications equipment, data processing system, or facility in this plan is intended to improve FAA's performance in one or more of 30 mission areas. (App. I contains a list of these mission areas.)

OMB's Circular A-109 establishes the principal process federal agencies are to use when acquiring major systems. To avoid common acquisition problems, Circular A-109 requires top-level agency management to review the acquisition at four key decision points. Approval of a mission need statement is the first decision point. In this statement, an agency must demonstrate that it is not capable of fulfilling its mission with its current systems or that it can accomplish needed improvements by taking advantage of technological innovation. The agency must assign a relative priority to each mission need and revalidate mission need statements at

each subsequent key decision point in the course of the acquisition. (Further explanation of Circular A-109 and its key decision points is contained in app. II.)

FAA requires that all new system acquisitions in the Capital Investment Plan have approved mission need statements before they can be included in the agency's budget. FAA's order on major system acquisitions elaborates on what a mission need statement should document: (1) the mission or need that a program is intended to meet, (2) the inability of the agency to fulfill the need with its current assets, (3) the consequences for the agency's mission if the need is not met, and (4) the planned approach for meeting the need. According to FAA's guidelines for mission need statements, "all unsupported assertions of need are of no value" and unsupported statements "will be rejected." Consequently, FAA directs program officials to support mission need statements with analysis, research, and validated projections, such as air traffic estimates and/or analysis of the limitations of current systems. This information should be included with the statements as appendixes. While not guaranteeing a successful acquisition, mission need statements are intended to provide a sound basis for investment decisions. FAA's Acquisition Review Committee, which consists of senior FAA officials, is responsible for reviewing all mission need statements at each key decision point.

OMB directs agencies to base mission need statements on the results of a "mission analysis"—defined in Circular A-109 as a continuous analysis of the current and forecasted mission capabilities, technological opportunities, overall priorities, and resources. The mission need statement can then result from mission analysis if the analysis determines that a performance shortfall, need, or opportunity exists.

Mission Need Statements Received Increased Attention but Seldom Supported Need for Capital Investments

Although FAA gave increased attention to its mission need statements, the statements we examined seldom contained evidence to support the need for new investments. In addition, FAA did not use its data resources to prepare many statements.

Increased Attention Given

In its updated acquisition policies and orders, FAA has acknowledged the importance of mission need statements for managing acquisition projects and focused attention on improving the process for generating these statements. One improvement was requiring that statements be sponsored and submitted by operational units at FAA that actually require or utilize the system—such as Air Traffic—instead of by design engineers, who may be familiar with the new systems FAA is developing but not with the need for them. FAA also encouraged cooperation among several offices that have access to supporting information and established formal training for those who prepare the statements.

According to several officials we spoke to, the FAA Acquisition Review Committee has intensified its scrutiny of mission need statements during the approval process in the past year. As a result, of the 100 mission need statements reviewed as of August 1992, the Committee had rejected 4 and had combined 12 with those of related projects. In addition, 18 statements were withdrawn by the originators because they believed that they could not substantiate the needs to the Committee's satisfaction, according to FAA's Acquisition Executive.

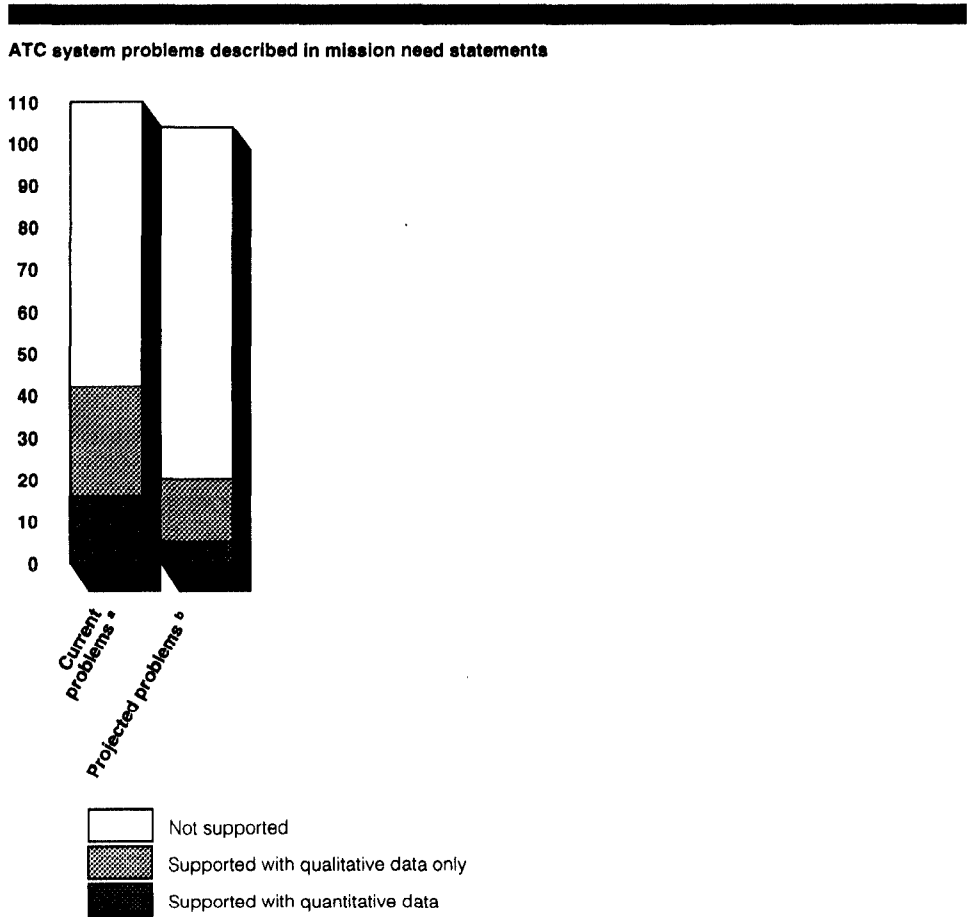
Support Is Seldom Provided

Nevertheless, many of the 25 mission need statements we examined—which identified the need for FAA to spend up to \$5 billion on new systems—contained only assertions of need that were unsupported by facts.² For example, one statement asserted that “catastrophic consequences” could result and maintenance costs would “escalate” if a new communications system was not acquired, but the statement did not provide any supporting information. Other statements did contain qualitative or quantitative support. Qualitative support consisted of some nonquantitative analysis or documentation. For example, one statement included a memorandum from a field airway facilities manager verifying that the current radar display systems were becoming difficult to maintain. Quantitative support described a problem in measurable terms. For example, one statement cited the projected financial costs to the flying public from delays and reduced safety if a new weather system was not installed. Quantitative support was usually the strongest because it was the least subjective, the easiest to validate, and the least vulnerable to conflicting interpretation.

²Our sample consisted of 25 of the 76 mission need statements that were approved by FAA as of August 1992 for fiscal year 1994 funding.

As shown in figure 1, the 25 mission need statements we examined listed 110 deficiencies or current problems with the ATC system. FAA contended that these deficiencies have adverse effects on FAA's operations, such as driving up operating costs or threatening air traffic safety and capacity. Sixty-eight (62 percent) of the deficiencies listed in these statements were not supported with either qualitative or quantitative evidence. Instead, all 68 deficiencies were supported only by assertions that modernization projects were needed, for example, to improve capacity and safety or to reduce operating costs. Only 16 (15 percent) of the deficiencies were supported by a quantitative measurement of the current system's performance. For example, 22 statements said insufficient system capacity was a problem that warranted acquiring new systems; yet only 7 of these statements provided any data showing the extent of the capacity problem, such as the number or duration of delays that have occurred or will occur with the existing system.

Figure 1: Level of Support in 25 Mission Need Statements



^aCurrent problems are those described in the “Deficiencies of Current Assets” section of the mission need statements.

^bProjected problems are those described in the “Impacts of Disapproving Acquisition” section of the mission need statements.

Figure 1 also shows a serious absence of support for projected problems described in the “Impacts of Disapproving Acquisition” section of the statements, which describes potential problems in ATC system performance and cost if no action is taken. The 25 mission need statements we reviewed listed 104 potential problems. Eighty-four (81 percent) of these problems were not supported with either quantitative or qualitative evidence. Only five (5 percent) were supported by quantitative evidence.

Data Resources Were Not Used to Support Many Mission Need Statements

FAA has extensive data resources that it could use to support its mission need statements by demonstrating that needs are compelling enough to justify major capital investments. A recent FAA survey indicated that the agency currently maintains or has access to many national, regional, and facility-level data bases with extensive information on the agency's operations. These data bases contain information on safety, capacity, cost, maintainability, and labor efficiency.

However, for the 25 mission need statements we reviewed, FAA seldom took advantage of its data resources to measure its current and projected ATC system problems. For example, 16 of the statements cited safety problems. However, only three of those were supported with safety data, such as the number of pilot or controller errors that have occurred or could be expected to occur without a new system. Only 4 of the 16 statements citing high operating expenses as a problem provided current or projected cost data, such as the cost of staffing, electricity, and spare parts required to keep the current systems and facilities running.

ATC system users—controllers, pilots, technicians, and others—can also be a source of important data about system operations and needs. Yet only 3 of the 25 mission need statements incorporated any organized user input, such as survey results. For example, the mission need statement for the Aviation Weather Products Generator, asserts, but does not support, the position that pilots do not have confidence in en-route weather warnings and often ignore them.

Acquisition Decisions Were Not Based on Mission Analysis

Few of the mission need statements we reviewed were based on an analysis of performance in FAA's various mission areas. According to OMB guidance, mission analysis is a crucial beginning point in the acquisition management process and a precursor to the mission need statement. When FAA has not conducted mission analysis, it has exposed itself to future cost, schedule, and performance problems with new systems.

Mission Need Statements Were Not Based on Mission Analysis

OMB Circular A-109, as well as management experts in the private sector, emphasize the importance of an ongoing analysis that measures performance in an organization's mission areas to document problems before making large capital investments. Major U.S. aerospace companies have put this concept of mission analysis into practice, basing capital improvement projects on the results of a needs analysis. In this analysis, these companies measure the performance of a segment of their

operations in terms of factors such as cost, quality, responsiveness, and capacity in order to better understand current operations. By measuring their performance, the companies can target those areas that are most in need of improvement and set priorities for their capital investments. The Department of Defense has also developed a mission analysis process. (App. III describes two mission analysis processes in more detail.)

However, many of the 25 mission need statements we examined were not based on the results of any documented mission analysis. Thirteen of the 25 statements mentioned that some analysis had been done, and 10 of those cited specific information from the analysis. Only seven included the analysis in the statements in an appendix, as FAA required.

Further examination of FAA's process for mission need statements confirmed that FAA seldom analyzed its performance in the ATC mission areas in order to establish needs. We asked cognizant program officials for 16 of the 25 projects we examined to provide any additional analyses used to support their mission need statements. Only 4 of the 16 projects were based on any analysis of current or projected ATC system deficiencies. Nearly all of the other studies either described alternative types of systems that FAA could acquire or defined system specifications—they were system-focused rather than mission-focused. For example, for two proposed communications systems, program officials provided system specifications outlining performance requirements without any analysis of current system performance to demonstrate why the proposed systems were necessary.

Without Mission Analysis, FAA Has Taken Unnecessary Risks

Without thoroughly analyzing the problems that its capital investments are intended to solve, FAA has risked proceeding too quickly into the full-scale development and production phases of its acquisitions. It has also risked not choosing the most appropriate and cost-effective solutions, which can be the result when mission need statements are focused on defining the system to be purchased rather than on analyzing the mission to be accomplished. Such was the case with past acquisitions. For example, FAA spent over \$46 million to develop a prototype Real-Time Weather Processor to provide air traffic controllers with current, accurate weather information. However, FAA did not establish how much faster than the existing system a new system should be to meet controllers' needs. Consequently, the Real-Time Weather Processor was designed to update every 6 to 13 minutes—as much as 6 times more slowly than the current system—according to Air Traffic Requirements officials. In 1991, FAA

suspended this project indefinitely in order to define air traffic controllers' needs.

In another case, FAA did not analyze the needed level of availability for one of its voice communication systems—the Voice Switching and Control System. FAA has exceeded planned costs and schedules by \$1.24 billion and 4 years, in part to achieve a near-perfect 4 seconds of down time per year. This requirement significantly surpasses the capabilities of FAA's current communication system, which has as much as 8 hours of down time per year. Yet FAA did not measure the extent to which the current system's problems caused unacceptable safety risks and delays. FAA also did not determine whether less ambitious improvements, which could have been less time-consuming and expensive to acquire, would have enabled FAA to ensure safe and efficient air travel. Such analysis could have provided FAA management with an early warning of potential problems with the acquisition.

Furthermore, without up-to-date measurements of performance problems, FAA has risked not knowing whether its needs have changed and therefore cannot revalidate needs effectively at each key decision point. OMB recognized that the need for new systems can change in the course of an acquisition project, becoming more or less urgent, when it required agencies to revalidate their needs at each decision point. In the case of FAA, new technologies may emerge or traffic levels may change. If FAA proceeds with an acquisition without a meaningful revalidation of needs, it risks overlooking critical system needs or purchasing systems it may not need as much as it did earlier in the acquisition process. For example, in justifying the upgrade of Low Level Wind Shear Alert Systems, FAA did not take into account recent developments in wind shear detection and avoidance when measuring the threat to air safety posed by wind shear. FAA requirements for on-board aircraft detection systems and training for pilots in wind shear avoidance and recovery may have already improved current performance in this mission area, affecting the number of wind shear systems FAA needs to procure.

Finally, without measuring performance before and after implementing a new system, FAA has not determined how much each new system has improved overall ATC system performance. Without this knowledge, FAA risks funding duplicate or ineffective projects over the next few years. FAA has only measured the effect of all the Capital Investment Plan projects collectively on ATC performance. For instance, FAA calculated that implementing these projects reduced air traffic delays by over 40 percent

in 1991. FAA has not, however, measured the improvements achieved by each project individually. For example, FAA deployed 258 Digital Bright Radar Indicator Tower Equipment Systems to help air traffic controllers in towers identify approaching aircraft and sequence them for landing. The agency plans to deploy 130 more of these systems at a cost of up to \$55 million, believing that these new systems will enhance safety and capacity. Yet the mission need statement for this purchase did not cite any measurable benefits in safety and efficiency gained from the original 258 systems.

FAA could have measured the mission area performance before and after installing this tower system by measuring the number of delays and safety-related incidents at each terminal in question. Such analysis would have helped to determine how effective the system was, so that FAA could better determine whether acquiring additional quantities would be capitalizing on past successes or wasting money.

Measuring the success of each acquisition project is especially important for FAA because the agency is implementing many systems that are intended to have the same benefits. For example, of the 25 mission need statements we examined, 16 promise to improve safety and 22 promise to reduce delays. By measuring only the aggregate improvement in these areas from all Capital Investment Plan projects, FAA may have difficulty in determining which projects were the most effective and what projects it should invest in.

Agency Actions Could Better Foster Mission Analysis

Incomplete instructions, inaccessible data, and approval of unsupported mission need statements have contributed to FAA's not performing ongoing mission analysis and to the statements themselves not being supported. First, despite improvements to the agency's acquisition policies, FAA's acquisition order and instructions for the mission need statements still have not stressed the central importance of conducting mission analyses. Circular A-109 directs agencies to begin their acquisitions with a mission analysis. However, FAA's acquisition order depicts the submittal of the statement, not the analysis of the mission area, as the starting point of the agency's acquisition process. This order requires only that assertions of need be supported by "analysis, research, or validated projections." Neither the order nor the instructions for the mission need statements elaborate on this requirement or include any procedures or guidance for conducting a mission analysis before generating mission need statements. Existing instructions make little mention of what types of data analyses

are expected. For example, FAA does not instruct program officials to quantify additional maintenance expenses and increased staffing levels if the acquisition of new equipment is disapproved.

Second, according to many of the program officials we spoke to, it was difficult to locate and collect appropriate data to support their mission need statements. Data reside in a variety of organizations' data bases throughout FAA and the aviation community. For example, to obtain support for a mission need statement to equip air traffic control towers with a new automation system, one program official told us that he would have had to request data on operating costs, delays, aviation activity forecasts, and safety for the towers from at least four headquarters offices and possibly all nine regional offices. Some program officials told us that they often did not know which FAA organization maintained the appropriate data, and several said that the time and effort required to collect and analyze these data discouraged them from doing it.

Although the available data resources are difficult to use, some FAA officials have demonstrated that these resources can be valuable for supporting assertions of need, especially for demonstrating the impacts of disapproving an acquisition. For example, FAA drew on available air traffic forecasts and flight delay data to calculate what it would cost if FAA did not approve the Terminal Air Traffic Control Automation acquisition. The mission need statement for this project projected that if FAA kept the current system, resulting delays would annually cost airlines and passengers from \$880 million in 1995 to over \$5 billion in 2020.

Finally, FAA program officials had little incentive to provide support for mission need statements. Although FAA's Acquisition Review Committee had intensified its scrutiny of mission need statements, it still approved acquisition projects with statements that included little or no supporting analysis or other factual documentation of need. Furthermore, FAA included many of these projects in its fiscal year 1994 budget submission to the Secretary of Transportation. Therefore, program officials had little incentive to spend time or resources to measure performance and establish needs. Many of the program officials we spoke to told us that they did not spend much time analyzing or quantifying the needs because it was not necessary in order to obtain approval from FAA's Acquisition Review Committee. Some officials believed that it was more important just to submit a mission need statement within the time frame FAA had established.

Conclusions

FAA has taken a positive step to improve its acquisition program by requiring mission need statements for all new system acquisition projects. However, FAA has not supported these statements with analyses of mission performance problems. FAA has not taken advantage of its immense data collection resources to measure the cost and performance of its current systems and pinpoint problem areas that may require a major investment to correct. FAA has also not provided appropriate incentives and guidance or made data resources easily accessible so that officials could support mission need statements.

To make major improvements in its process for developing mission need statements, FAA must change its acquisition paradigm. In the past, the mission need statements focused on which system to purchase. To change, FAA officials will have to reorient their thinking toward first analyzing current performance to identify and demonstrate deficiencies and a need for improved capabilities in its mission areas. Officials throughout FAA have accepted the concept, but the agency has not yet turned the concept into reality.

In the meantime, we are concerned that without well-supported mission need statements, FAA is investing in new systems to solve problems that it has not thoroughly analyzed and defined. Although better mission need statements cannot ensure problem-free acquisitions, poorly defined needs mean a weak foundation for the rest of the steps in FAA's acquisition process. FAA may waste scarce resources in developing systems that are not the most appropriate and cost-effective solutions to its ATC problems.

Recommendations

In order to identify and assess FAA's acquisition needs, the Secretary of Transportation should direct the Administrator, FAA, to

- approve only those mission need statements that are well supported with analytical evidence of current and projected needs and
- revise FAA's guidance on mission need statements to emphasize mission analysis as the starting point for acquisitions.

Agency Comments

We discussed the information contained in this report with FAA's Executive Director for Acquisition and Safety Oversight, as well as with other FAA and Department of Transportation officials involved in developing mission need statements. These officials agreed with our findings. However, they said that we had not adequately recognized recent FAA acquisition

initiatives, such as forming a mission analysis team to review statements submitted for the fiscal year 1995 budget cycle. FAA officials also noted that the agency has a new major acquisition order scheduled to go into effect on January 1, 1993, that addresses our concerns. We noted that these changes occurred after the fiscal year 1994 process we examined. Our subsequent review of the draft order and other recently issued guidance indicates that FAA continues to make improvements in its acquisition process. However, the new guidance depicts the mission analysis team's working after submission of the mission need statement. We continue to believe that mission analysis is a fundamental, ongoing process that should lead to submission of the statements.

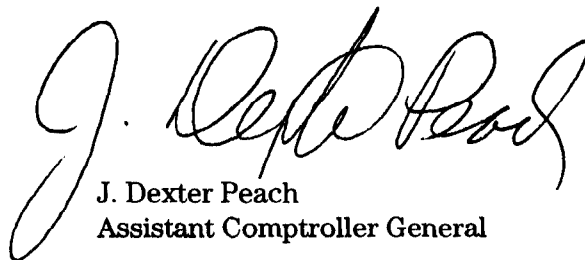
We incorporated, where appropriate, FAA's suggested wording changes to improve the accuracy of our report. As requested, we did not obtain written agency comments on the information presented in this report.

We performed our work from December 1991 through September 1992 in accordance with generally accepted government auditing standards. A detailed description of our scope and methodology is contained in appendix IV.

We are providing copies of this report to interested congressional committees; the Secretary of Transportation; and the Administrator, FAA. We will also make copies available to other interested parties upon request.

This work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who may be reached at (202) 275-1000 if you or your staff have any questions. Other major contributors to this report are listed in appendix V.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

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Abbreviations

ATC	Air Traffic Control
FAA	Federal Aviation Administration
GAO	General Accounting Office
OMB	Office of Management and Budget

FAA's National Airspace System Service Mission Areas

The Federal Aviation Administration (FAA) performs its mission of ensuring safe and efficient air travel through a variety of air traffic control functions. Those 30 functions, or mission areas, are listed below. This information was obtained from the National Airspace System: System Requirements Specification (FAA, Nov. 1991).

Flight Planning

Weather Information (Strategic)
Aeronautical Information (Strategic)
Flow Control and Delay Advisories
Flight Plan Submission and Evaluation

Traffic Control and Airspace Management

Airspace Management
Approach and Departure Sequencing
Aircraft Separation
Control Outside of Independent Surveillance Coverage
Collision Avoidance
Weather Avoidance
Ground and Obstacle Avoidance
In-Flight Emergency Assistance
Search and Rescue
Support of Military Operations
Airport Movement Area Control

Monitoring

Flight Following
Traffic Advisories
Weather Advisories

Navigation

En-Route Navigation
Terminal Navigation
Visual Navigation Aids

Air Defense and Law Enforcement Surveillance

Aircraft Detection and Identification

Communications

Air-Ground Communications
Ground-Ground Interfacility Communications Connectivity
Ground-Ground Communications Capabilities

Maintenance and Support

**Maintenance and Monitoring
Training Support
Testing Support
Facilities
Frequency and Spectrum Engineering**

OMB Circular A-109

In 1976 the Office of Management and Budget (OMB) issued a policy for all executive agencies to follow in managing their acquisition of major systems—OMB Circular A-109. Circular A-109 defines a major system as a program (1) critical to fulfilling an agency's mission, (2) entailing the allocation of relatively large resources, and (3) warranting special management attention. If followed, the procedures in Circular A-109 should reduce the potential for cost increases, schedule delays, and performance deficiencies and avoid the premature commitment of major systems to production.

In accordance with Circular A-109, agency heads are to evaluate the cost, schedule, and performance of major projects at four critical decision points in their acquisition and validate the need for the projects at each decision point. At each of the four decision points, agency heads are to decide whether the projects are ready to move to the next phase of the acquisition process.

The major system acquisition process under Circular A-109 is divided into five progressive phases. Passage from one phase to another is decided by the agency head. The five phases are (1) mission analysis and identification of mission needs; (2) identification and exploration of alternative design concepts; (3) demonstration of alternative design concepts; (4) full-scale development, test, and evaluation; and (5) full production.

Phase 1: Determine Mission Needs. The acquisition of a major system begins with determining why the system is needed to support the agency's mission. The thinking and planning involved in this phase affect the character, quality, and ultimately the cost of the major system that is procured.

Phase 2: Identify and Explore Alternative Design Concepts. The agency solicits alternative system design concepts that might meet the identified need from a broad base of qualified firms. These firms submit their concepts in a form suitable for preliminary evaluation. The intent is to generate innovation and competition for the best system design to meet the mission need.

Phase 3: Demonstrate Alternative Design Concepts. Once alternative system design concepts are selected, the project is advanced to the demonstration phase. Before awarding a contract for further development, however, the agency must reaffirm its mission needs and project

objectives. An agency head must decide whether to pursue alternative concepts or proceed with a single concept.

Phase 4: Full-Scale Development and Limited Production. Alternative system(s) can enter full-scale development, including limited production, only after the agency's mission needs and program objectives have been reaffirmed and demonstration results verify that the chosen system(s) design concepts are sound. Agency head approval is again required for the project to move into full-scale development and limited production.

Phase 5: Full Production. Before approving a system's entry into full production, the agency head must reaffirm mission needs and program objectives, and system performance should be satisfactorily tested under operational conditions. This operational testing should be conducted independently of the agency's development and user organizations.

Examples of Mission Analysis Processes

The following are two examples of mission analysis processes. These examples are the Price Waterhouse Cost Definition/Factory Modernization Methodology, adopted by many major U.S. corporations, and the Department of Defense's major acquisition process. Both focus on conducting an early "needs analysis," including measuring the elements of an organization's performance before making a commitment to acquire any particular technology. The Department of Defense process is a variation of Circular A-109; the Price Waterhouse process is not.

Price Waterhouse Cost Definition/Factory Modernization Methodology

In January 1984 Price Waterhouse Management Consulting Services published an approach for selecting and managing factory automation projects—now called the Cost Definition/Factory Modernization Methodology. Price Waterhouse has applied this methodology at over 35 companies in the defense and aerospace industries, including Allied-Signal Aerospace Company, General Dynamics, and Texas Instruments, to assess their needs for factory modernization projects. Many of these clients used the methodology to qualify for Department of Defense funds to acquire new manufacturing technology. Price Waterhouse's methodology consists of three phases and is aimed at justifying and managing the acquisition of new technology. It was endorsed by the Department of Defense Systems Management College for use by aerospace and defense contractors for identifying target areas of improvement.¹

Phase I-A: Needs Analysis

A fundamental element of this methodology is a "needs analysis" conducted during the first phase. At this point, the organization should define its current, or "as-is," environment. This entails identifying performance measures (such as costs, quality, responsiveness, and capacity) and gathering sufficient data to be able to completely understand, analyze, and portray the current operations of the organization.

Another important step of the needs analysis is to analyze the as-is environment. This entails establishing performance base lines, identifying the factors that influence performance the most, and determining specific improvement opportunities. By doing this, the organization will identify where, (but not yet how) the greatest benefits will be attained from technology modernization (or other efficiency improvements).

¹As outlined in Managing Quality and Productivity in Aerospace and Defense (Department of Defense Systems Management College, Nov. 1989).

At this point, the organization's management should hold a formal briefing to provide an overview of (1) the as-is environment; (2) improvement opportunities identified; and (3) recommendations for improvement projects to be further conceptualized. All recommendations for improvement projects should be related to the organization's business strategy; an improvement that does not further the strategy should be rejected.

Phase I-B: Development of Improvement/Modernization Plan

After the needs analysis, the organization should develop an improvement/modernization plan. The first step is to prepare conceptual (to be) designs. This step includes considering alternative techniques or technologies to improve the performance, selecting an improvement project, determining the resource and work-flow changes that will result if the project is implemented, preparing revised and projected performance base lines, and preparing preliminary justification analysis for the project.

Next, the organization should develop a facility improvement/modernization plan. During this phase, the organization should determine the facilitywide benefits that will result from the plan and devise a benefits tracking plan. If the plan involves more than one project, the projects should be sequenced according to needs and benefits.

The organization's management should again hold a briefing to provide an overview of (1) the facility improvement/modernization plan, (2) the suggested improvement projects, and (3) the anticipated implementation timing, costs, and benefits. At this point the management should be prepared to make a firm "go/no go" decision on each improvement project and the overall plan.

Phase II: Detailed Design and Phase III: Implementation

For improvement and modernization projects that do not involve "off-the-shelf" techniques or hardware and software, it may be necessary to do further design detailing how the improvement is intended to function. This task could include the preparation of requirements specifications, issuance of and request for proposals, evaluation of vendor responses, prototyping, and reconfirmation of the benefits analysis. For those improvement projects that do involve available techniques or hardware and software, it is often possible to proceed directly to implementation. Implementation includes user-training programs, installation of the hardware/software or technique, development of

physical and systems controls, possible organizational changes, possible physical relocations, and monitoring of the benefits achieved.

Department of Defense's Acquisition Process

The Department of Defense has a multiphased approach to acquisition that basically conforms to the Circular A-109 requirements. A program reaches a milestone decision point at the end of each phase, at which time it is subject to considerable review by Defense management.

An important step in this acquisition process actually occurs prior to the initial acquisition phase, when Defense components determine mission needs. This activity represents a considerable amount of formal data collection and analysis. Two essential pre-acquisition analyses used to identify and define mission needs are the threat assessment and the mission area analysis. The threat assessment, validated by the Defense Intelligence Agency at each milestone, characterizes the current and projected military threat that needs to be countered. The mission area analysis, also regularly updated, assesses the ability of existing military forces to counter that threat and identifies any deficiencies. Defense provides standard report formats and instructions for conducting these analyses.

The results of these analyses form the basis of the mission need statement, the primary document for initiating the first acquisition review (milestone 0). In addition to the mission and threat analyses, the mission need statement should describe the pertinent Defense Planning Guidance elements, nonmaterial solutions to fulfill the mission need, potential material alternatives, and possible constraints to fulfilling the need. The mission need statement must not specify any particular system or include an evaluation of potential material alternatives.

At milestone 0, Defense management validates the mission need, assigns a priority to the need, and directs the appropriate departments or agencies to study a minimum set of alternatives for meeting the need. A new system might not be acquired at all, if nonmaterial solutions—such as changes in doctrine, operational concepts, tactics, training, or organization—are deemed capable of satisfying the need.

Under this process, Defense does not initiate an actual acquisition project until after milestone I, when management has considered the results of the alternatives studies. At milestone I and every subsequent milestone review, Defense management considers validated threat projections,

life-cycle costs, cost-performance-schedule trade-offs, affordability constraints, and risk management. Defense management determines whether the proposed performance objectives and thresholds of the project satisfy the need. It also provides recommendations on proposed cost-performance-schedule trade-offs on the basis of affordability, technological constraints, interoperability, and overall program progress.

Scope and Methodology

To evaluate the adequacy of FAA's process for developing mission need statements, we selected 25 such statements from the fiscal year 1994 budget cycle for in-depth analysis from among the 76 statements that were fully approved by FAA as of August 1992. The sample consisted of mission need statements that had been initially approved by FAA's Acquisition Review Committee as of February 20, 1992. We subsequently excluded from this sample those statements that FAA had not formally approved by June 15, 1992, those for which FAA did not request fiscal year 1994 funding, and those whose program officials were consistently unavailable to us at the time of our review. We analyzed the statements in our sample using FAA's criteria for mission need statements as well as criteria we developed. To determine whether mission need statements were based on any analyses that were not included with the statements, we interviewed officials for 16 of the 25 acquisition projects, selected at random, and obtained and reviewed all supporting documentation they could provide.

We examined the mission need statements for the following projects. We also interviewed program officials for those projects marked with an asterisk:

- Aeronautical Data Link
- Alaskan National Airspace System Interfacility Communications System*
- Aircraft Fleet Modernization Flight Inspection System*
- Aircraft Related Equipment
- Aviation Weather Products Generator
- Display Channel Complex Rehost*
- Digital Bright Radar Indicator Tower Equipment*
- En-Route Software Development and Support II*
- Enhanced Terminal Voice Switching*
- Field Maintenance Support Contract
- Flight Service Automation System Computer Replacement*
- Integrated Terminal Weather System
- Instrument Landing System and Visual Nav aids Engineering and Support
- Low Level Windshear Alert System Upgrade*
- Meteorologist Weather Processor II*
- Oceanic System Development and Support
- On-Site Simulation Based Training System*
- Precision Runway Monitoring*
- Radio Control Equipment*
- Recovery Communications Project*
- Terminal Air Traffic Control Automation*
- Terminal Enhanced Weather System*

- Terminal Radar Digitization, Replacement, and Establishment*
- Terminal Software Development
- Terminal Voice Switching Replacement

To review FAA's mission need statement process, we gathered information from officials involved in the process throughout FAA. We interviewed and obtained documentation from officials reporting to the Executive Director for System Development, including officials from the National Airspace System Program Management Service, the System Engineering Service, the Operations Research Service, and program managers from the Automation, Communications, Navigation and Landing, Surveillance, and Weather and Flight Service Systems program offices. We also interviewed and obtained documentation from program sponsors and other officials reporting to the Executive Director for System Operations, including officials from the Systems Maintenance Service and the Air Traffic Plans and Requirements Service. To determine how FAA analyzes and validates mission need statements, we interviewed and obtained pertinent documentation from officials in the Office of the Executive Director for Acquisition and Safety Oversight and the Office of Acquisition Policy and Oversight. To document the relationship between the budget process and mission need statements analysis, we interviewed and obtained pertinent documentation from officials mentioned above as well as from members of the Capital Investment Plan Resource Allocation Subcommittee, focusing on the fiscal year 1994 budget process.

We also gathered information about other organizations' needs determination processes. Information about the Department of Defense acquisition process was obtained from Department of Defense directives and guidance on major acquisitions and mission area analysis. We also conducted research into accepted management practices with regard to acquisitions in the private sector. We interviewed representatives of Price Waterhouse, Office of Government Services, in Washington, D.C., to obtain information on private sector experiences with justifying and managing modernization projects.

We gathered information about FAA's data resources from various sources, including FAA's Information Technology Architecture and Data Management Division, the Office of Aviation Policy and Plans, the Office of Aviation Safety Analysis, and several other FAA offices that maintain major data bases. We also obtained a list of FAA's major data bases from a publication of the National Research Council Transportation Research Board.

**Appendix IV
Scope and Methodology**

We conducted our work from December 1991 through September 1992 in accordance with generally accepted government auditing standards.

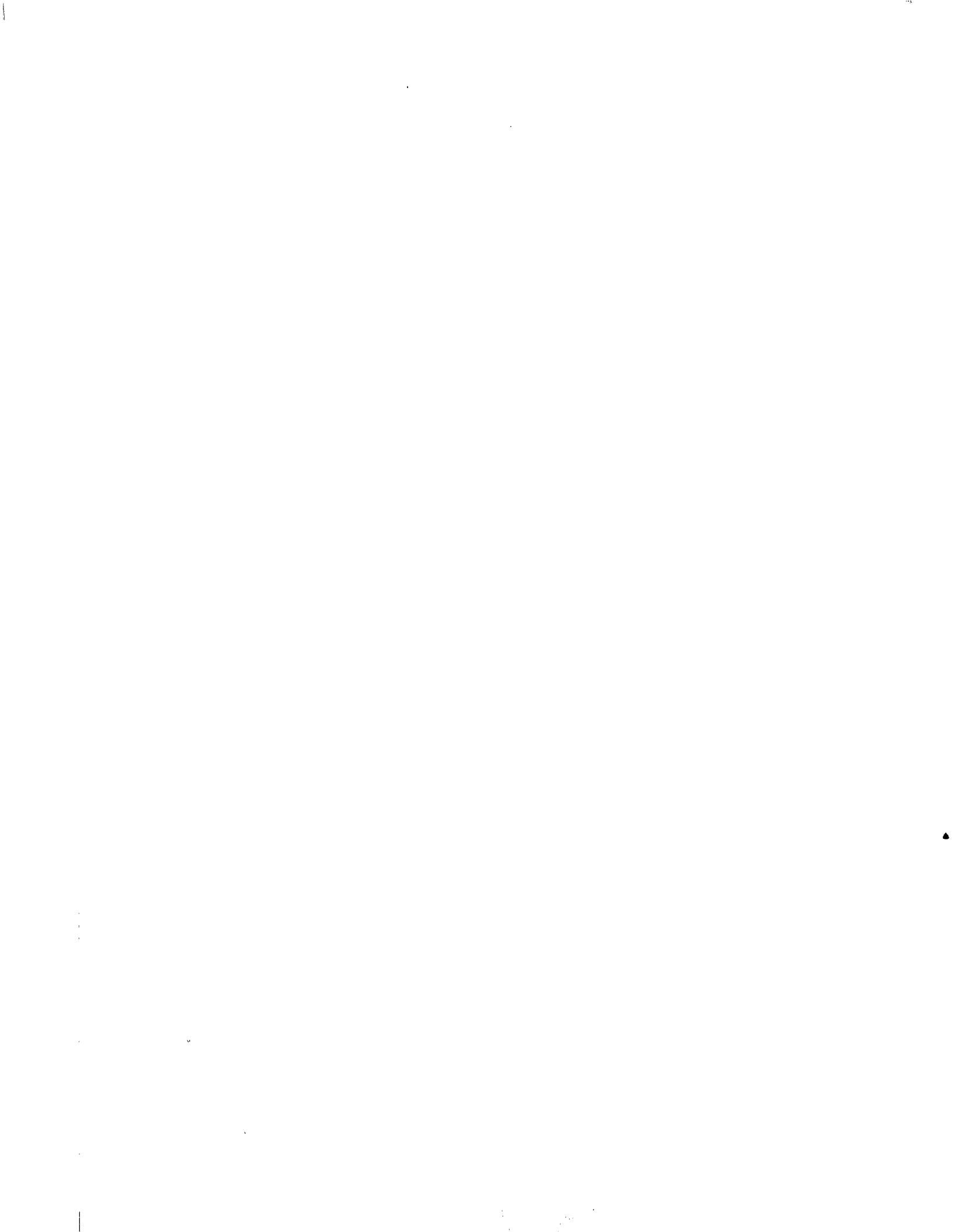
Major Contributors to This Report

Resources,
Community, and
Economic
Development
Division, Washington,
D.C.

Robert E. Levin, Assistant Director
Robert D. Wurster, Assignment Manager
Scott W. Weaver, Staff Evaluator

Atlanta Regional
Office

Ray B. Bush, Evaluator-in-Charge
James B. Michels, Site Senior
Deena DeVane, Staff Evaluator



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