

GAO

Report to the Legislation and National Security Subcommittee, Committee on Government Operations, House of Representatives



March 1990

DEFENSE ACQUISITION

GAO's Study of the Department of Defense's Acquisition Process Recommends ADP Acquisitions

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**Information Management and
Technology Division**

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The Honorable John Conyers, Jr.
Chairman, Legislation
and National Security Subcommittee
Committee on Government Operations
House of Representatives

The Honorable Frank Horton
Ranking Minority Member,
Legislation and National Security Subcommittee
Committee on Government Operations
House of Representatives

In response to your request, this report discusses weaknesses in the Department of the Air Force's requirements-setting process for automated data processing system acquisitions. Air Force regulations clearly state that system requirements should be defined and alternative solutions evaluated before recommending the acquisition of a system. However, the Air Force has not followed these regulations. This failure indicates a lack of commitment to the process and a lack of appreciation for its criticality. As arranged with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of this letter. At that time, we will send copies to the Director, Office of Management and Budget; the Secretary of Defense; and other interested parties. This report was prepared under the direction of Samuel W. Bowlin, Director for Defense and Security Information Systems, who may be reached at (202) 275-4649. Other major contributors are listed in appendix III.

A handwritten signature in black ink that reads 'Ralph V. Carlone'.

Ralph V. Carlone
Assistant Comptroller General

Executive Summary

Purpose

Many defense systems are too expensive, take too long to develop, and use obsolete technology. An increasingly important part of Department of Defense procurement includes automated data processing (ADP) acquisitions; Defense requested almost \$9 billion for ADP resources in fiscal year 1990. GAO reviews of Air Force actions to modernize ADP capability for America's tactical warning and attack assessment system found programs over budget and behind schedule, and systems that did not meet performance requirements. This happened, in part, because the Air Force established requirements that either could not be met or had to be reduced to contain escalating program costs.

The Subcommittee on Legislation and National Security, House Committee on Government Operations, requested this report. Concerned that inadequately defined requirements and a lack of evaluations of alternative solutions could have led to these acquisition problems, GAO evaluated seven ongoing or proposed ADP or ADP-supported system acquisitions to determine whether the Air Force (1) thoroughly defines system requirements and (2) evaluates alternative solutions before recommending ADP system acquisitions.

Background

Acquisition programs are initiated to satisfy specific mission needs or deficiencies that inhibit or prevent a military command from carrying out a mission. The Air Force establishes system requirements to overcome the deficiencies and satisfy the needs.

After the using Air Force command identifies a need, it proposes a solution that supplies preliminary requirements. The Air Force command responsible for acquiring new systems evaluates the need and alternative solutions and estimates the likely cost and time necessary to acquire the most feasible solution. After incorporating this information and data from other commands, the using command recommends an acquisition approach, which then competes for funding with other Air Force needs. The information generated by this process is the basis for system approval by Air Force and Defense officials, as well as decisions on the system's funding and timetable.

Results in Brief

Air Force regulations clearly state that system requirements should be defined and alternative solutions evaluated before it recommends the acquisition of a system and competes it for funding in the Department of Defense budget process. Furthermore, major independent commissions have echoed this same point since the early 1970s and have put Defense

on notice that failure to do so will result in cost increases, schedule delays, and performance problems. Simply put, the Air Force has not followed its regulations or heeded this advice. For the seven ADP or ADP-supported systems GAO reviewed, with an estimated development cost of over \$4.5 billion, the Air Force prematurely recommended acquisition. In three cases, initial system requirements had not been adequately defined or were continually changed; in four cases, alternative solutions had not been evaluated.

The failure of the Air Force to take action to implement its regulations indicates a lack of commitment to the process and a lack of appreciation for its criticality. Until this is done, future ADP system acquisitions can be expected to encounter cost growth and schedule delays. For example, three ongoing acquisitions discussed in this report will be at least 7 years behind schedule and collectively, almost \$900 million over their original cost estimates. In this time of budget constraints, the Air Force cannot afford to initiate ADP acquisitions without both solidifying system requirements and evaluating alternative solutions, in order to firmly establish a system's technical approach, design, and cost.

Principal Findings

Requirements Definition

System requirements are not sufficiently defined when the Air Force recommends an acquisition approach. This causes Air Force officials to make assumptions when identifying a solution and estimating the cost to satisfy the identified need. Such uncertainty results in performance, cost, and schedule estimates that are often meaningless.

For example, in 1988 an Air Force task force found that the baseline requirements were continually changing for its Command and Control Segment program—a new satellite command and control system that has been under development since 1981 and was to be completed in 1985. According to the task force chairman, the lack of stable baseline requirements directly contributed to the system's cost, schedule, and technical problems. In October 1989, the Air Force reported that the system would not be fully operational until 1993.

Evaluation of Alternative Solutions

The acquiring command does not always evaluate alternative solutions to ensure that the selected approach is achievable, affordable, maintainable, and flexible enough to incorporate technological advances. For example, in its Space Defense Operations Center 4 acquisition, the Air Force did not evaluate alternative solutions to meeting a major system requirement to control different levels of classified data, even though this security requirement had not been achieved in any comparable system. The contractor experienced problems in building a system to this requirement because of both the software complexity and the difficulty in attaining satisfactory system performance, given the extra processing needed to run software with extensive security features built into it. Ultimately, the contractor did not meet either the security requirement or other critical system performance needs. As a result, although the system was to be operational in 1988, the Air Force now estimates it will not be fully operational until 1994; the current cost estimate is \$576 million—double the original estimate.

Recommendations

GAO recommends that the Secretary of the Air Force quickly take action to implement its regulations established to assure that system requirements are adequately defined and alternative solutions are evaluated before approving and recommending acquisitions. As part of this effort, the Secretary should pull back and reassess currently proposed ADP acquisitions competing for funding within the Department of Defense where requirements and alternative solutions have not been adequately defined and considered. The four proposed ADP acquisitions that GAO discusses in this report should be specifically pulled back and included in this reassessment.

Agency Comments

GAO requested official agency comments on a draft of this report from the Department of Defense. While official written comments have not been provided, GAO met with agency officials to verify data presented in the report and has made revisions where appropriate.

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Abbreviations

ADP	Automated Data Processing
BMEWS	Ballistic Missile Early Warning System
GAO	General Accounting Office
IMTEC	Information Management And Technology Division
SON	statement of operational need

Introduction

We have been consistently reporting on Defense weapon and automated data processing (ADP) systems that are behind schedule, significantly over budget, and often fail to perform as intended. We are not alone. According to the President's Blue Ribbon Commission on Defense Management,¹ too many defense systems cost too much, take too long to develop, and, by the time they are developed, incorporate obsolete technology. ADP acquisitions are an increasingly important part of Department of Defense acquisitions—in fiscal year 1990 Defense requested \$8.7 billion for such systems. Examples cited by the Commission report included acquisition problems experienced by all the military departments, including the Department of the Air Force, the subject of this report.

It is commonly recognized that ADP system design and development problems occur throughout the acquisition cycle. Many problems begin early in the acquisition process because detailed requirements to meet specified needs have not been developed. Establishing system requirements is a significant step in the acquisition process because requirements are the blueprint system developers use to design and develop systems. The cost, schedule, and performance problems we identified during reviews of our nation's tactical warning and attack assessment system modernization were caused, in part, because the Air Force had established requirements that either could not be met or had to be reduced to lower system acquisition costs.² This review focuses on seven ongoing or proposed ADP or ADP-supported system acquisitions to determine if the problems we noted during our earlier reviews could be caused by the Air Force's procedures for setting requirements and evaluating alternative solutions.

Air Force's System Acquisition Process

The acquisition of Air Force systems is complex and involved, and generally is accomplished in five phases: (1) concept formulation, (2) demonstration and validation, (3) full-scale engineering and development, (4) full-rate production and initial deployment, and (5) operations support. (These phases are discussed in app. I.) The Air Force initiates an

¹A Formula for Action: A Report to the President on Defense Acquisition, The President's Blue Ribbon Commission on Defense Management, April 1986.

²Space Defense: Management and Technical Problems Delay Operations Center Acquisition (GAO/IMTEC-89-18, Apr. 20, 1989) and Attack Warning: NORAD's Communications System Segment Replacement Program Should Be Reassessed (GAO/IMTEC-89-1, Nov. 30, 1988).

acquisition to satisfy a specific mission need. A need is defined as a deficiency that inhibits or prevents the Air Force from carrying out a mission. Deficiencies typically result from threat changes, redefinition of assigned tasks in response to shifts in national security policy, or deterioration in operational performance of older systems. A need could also result from technological advances that would enable the Air Force to more effectively or efficiently carry out a mission. Requirements are the overall system features and performance levels identified to satisfy a need. Air Force needs, and the requirements to meet those needs, can be identified by the Department of Defense, Joint Chiefs of Staff, Air Force Headquarters, and individual Air Force commands.

The success of Air Force acquisitions can be affected by many factors, including some that are out of the Air Force's control. For example, a budget cut may result in eliminating or modifying requirements after an acquisition has been initiated. Also, a change in the threat could result in adding requirements that increase the cost of an acquisition. However, successful acquisitions also depend on setting clear and attainable requirements and evaluating alternatives early in the procurement process. As discussed in the following section, inadequately defined requirements and prematurely selected solutions contribute to cost increases, lengthy system development, and systems that do not meet their identified needs.

Prior Studies Cite Problems With Evaluating Alternatives and Establishing Requirements

In 1972, a Commission on Government Procurement study group reported³ that the requirements determination and the initial acquisition planning process are accomplished prior to the significant involvement of Executive Branch top management and are accomplished in an unstructured manner, to the detriment of the major system acquisition process. As a result, there is no way top management can effectively evaluate acquisition alternatives with respect to concept, risk, and schedule.

Further, in its summary report, the Commission⁴ noted that establishing needs and goals for a new acquisition program is one of the most vital and potentially fruitful areas for improving system acquisition, and that both defense and civilian programs have suffered when well-defined

³Final Report, Study Group #12—Major Systems Acquisition, System Requirements Determination and Initial Acquisition Planning, Volume II, For the Commission on Government Procurement, January 1972.

⁴Summary of the Report of The Commission on Government Procurement, 1972.

statements of need and goals were lacking. The report also stated that a premature agency commitment to a system concept, technical approach, and design often results in cost growth, performance shortfalls, and schedule delays. The report stated that pressures to prematurely choose a single system approach often result in limited analyses of less costly alternatives. The report further found that money spent to evaluate alternative approaches can be inexpensive insurance against the possibility that a premature choice may later prove to be a poor and costly one.

A more recent study noted similar problems with major system acquisitions. In 1986, the President's Blue Ribbon Commission on Defense Management, also known as the Packard Commission, reported that the process of identifying the characteristics and specific requirements for a new system generally did not adequately involve participants with a detailed knowledge of the cost and schedule implications. As a result, trade-offs between cost and performance did not occur to an adequate degree and the system concept included requirements which may be desirable but whose real cost far exceeds their value.

The Packard Commission study further noted that once military needs are established, the next step is to "market" this system to get funding authorized for its development. Such marketing takes place in a highly competitive environment. This competitive environment does not encourage realistic estimates of cost and schedule because system marketers must be optimistic about how much funding and time will be needed to develop the new system.

As a result, all too often when a system finally is approved, it has overstated requirements and understated costs. To correct this situation, the Packard Commission recommended early, high-level management review of requirements to assess the trade-off between cost and performance.

Air Force Process for Establishing Requirements

In response to the Packard Commission's recommendation, the Air Force revised its procedures⁵ for acquiring major systems, including ADP systems, in April 1987. These procedures govern how system requirements are established for proposed systems. The revision was intended to

⁵Air Force Regulation 57-1, Operational Needs, Requirements, and Concepts, draft implemented on April 1, 1987, published in final form on October 7, 1988.

improve the procedures used to identify and approve military needs, initiate programs to satisfy those needs, and establish requirements for the system to be developed.

Air Force procedures implementing the Department of Defense's direction for establishing system requirements can be found in Directive 5000.1, Major and Non-Major Defense Acquisition Programs. The directive provides that the basis of need or requirement for each new acquisition program must be thoroughly reviewed and validated, and that a major defense acquisition involving development of a new system must be undertaken only after carefully assessing alternative approaches to satisfy the need or requirements.

The Air Force's system acquisition process begins by identifying a specific mission need. Generally, a using command—responsible for fielding and operating systems during training or actual combat operations (e.g., Air Force Space Command)—identifies a need and prepares a Statement of Operational Need (SON). The SON's primary purpose is to define the need, document the validity of the need, and provide preliminary requirements. The SON must be concise enough (five pages or less) to facilitate processing but be sufficiently comprehensive to define the requirements. A secondary purpose of the SON is to propose potential solutions for the need.

A draft SON is circulated among various Air Force commands and agencies to obtain their views and to avoid duplication. Under Air Force procedures, the acquiring command—a specialized command (e.g., Air Force Systems Command) that is responsible for providing research, development, and acquisition services to other Air Force commands—is to review the draft SON. The acquiring command evaluates the need and the proposed solution, identifies alternative solutions to meet the need, and provides preliminary estimates of the cost and schedule required to pursue the most attractive solution. It is the responsibility of the acquiring command to address the possible solutions to the need described in the SON.

After resolving any issues raised by the other commands, determining that the expressed need is valid, and reviewing the recommended solution, the using command approves the SON, recommending the acquisition. The estimated cost to develop the solution is included with the SON and is sent to Air Force Headquarters for use in competing for funding. Headquarters decides which acquisition programs it will recommend

and forwards them to the Department of Defense for consideration during the budget formulation process.

The system acquisition cycle begins once the SON receives funding approval in the Department of Defense Five-Year Defense Program and the Defense Appropriation. At this point, a Program Management Directive is issued by Air Force Headquarters initiating the program. This document provides direction to pertinent Air Force commands on their roles and responsibilities for carrying out the acquisition and establishes a program office to manage the acquisition. Funding levels for the system and an acquisition schedule are also established at this point in the acquisition process.

After the Program Management Directive has been approved, the using command develops a System Operational Requirements Document to address the detailed requirements. This document amplifies and refines the SON; its needs statements are more comprehensive and quantitative and are tailored to the possible solution. Air Force regulations direct periodic updates and reviews of the System Operational Requirements Document at subsequent acquisition phases.

Objectives, Scope, and Methodology

The Subcommittee on Legislation and National Security, House Committee on Government Operations, requested information on the Air Force's requirements-setting process for ADP systems. We initiated this review to determine if the Air Force's procedures for setting requirements and evaluating alternative solutions were causing problems in ADP acquisitions. Our specific objective was to determine whether the Air Force thoroughly defines system requirements and evaluates alternative solutions to meet user needs before approving and recommending that an ADP system be acquired. To evaluate the possible impact of the Air Force's requirements-setting procedures on the success of system acquisitions, we (1) reviewed Air Force procedures for setting requirements under Air Force Regulation 57-1, (2) reviewed how requirements were established and alternative solutions evaluated for seven ongoing or proposed ADP system acquisitions, and (3) evaluated whether analyses of requirements and alternative solutions occur prior to recommending system acquisition under the Air Force Regulation 57-1 procedures.

During our review, we focused on seven Air Force ADP or ADP-supported system acquisitions—three ongoing programs that were approved for funding and four proposed programs that were recommended for acquisition by the using command and were competing for funding in the

Defense budget process. The ongoing acquisitions we reviewed were the Command and Control Segment, the Communications System Segment Replacement, and the Space Defense Operations Center 4. The four proposed acquisition programs were the Ballistic Missile Early Warning System, the Space-Based Atmospheric Surveillance System, the Space Surveillance System, and the Mission Planning System. (Appendix II lists the estimated cost for each of these acquisitions.)

We interviewed officials at Air Force Headquarters and at the two using commands involved in the requirements-setting process, as well as officials from the acquiring command involved in developing program cost estimates and identifying and evaluating alternative solutions for specific programs. We reviewed Department of Defense and Air Force manuals, directives, regulations, and guidance; Office of Management and Budget Circulars; various Department of Defense and other government reports and studies; GAO reports; and pertinent files maintained at each location visited.

We performed our work at the Department of Defense, Joint Chiefs of Staff and Air Force Headquarters in Washington, D.C.; Air Force Space Command, Peterson Air Force Base, Colorado; Military Airlift Command, Scott Air Force Base, Illinois; Air Force Systems Command, Andrews Air Force Base, Maryland; as well as its Space Systems Division, Los Angeles, California, and its Electronic Systems Division, Hanscom Air Force Base, Massachusetts; Air Force Logistics Command's Detachment 25, Colorado Springs, Colorado; the Aerospace Corporation in El Segundo, California; and the Mitre Corporation in Bedford, Massachusetts. We conducted our work from September 1988 through November 1989, in accordance with generally accepted government auditing standards.

Air Force Prematurely Recommends Acquisition of ADP Systems

The Air Force's acquisitions of ADP systems often result in systems which do not meet users' needs, cost more, and take longer to develop than anticipated. This is due, in part, to Air Force decisions to recommend acquiring systems before defining the system's requirements or evaluating alternative solutions. This practice has resulted in requirements which could not be met or cost more to meet than originally anticipated. Officials within the Department of Defense and the Air Force recognize that the requirements-setting process needs improvement and have suggested revisions to the process.

System Requirements Not Comprehensively Defined

Air Force regulations require that preliminary requirements be defined before the statement of need is approved and the system is recommended for acquisition. In three of the ADP systems we reviewed, the Air Force did not adequately define requirements before recommending an acquisition. As a result, the Air Force developed a design based on assumptions about the requirements and estimated the cost and schedule for development based on these same assumptions. Basing acquisition decisions on assumptions rather than specific information resulted in performance, schedule, and cost estimates, which were in some cases, meaningless.

For example, in 1981 the Air Force estimated that the Command and Control Segment (previously referred to as the Data System Modernization program) for satellite command and control would cost \$195 million and would be operational by 1985. However, the system is laboring through development problems, schedule delays, cost increases, and is not yet fully operational. The Air Force currently estimates that the system will be operational in 1993. As of December 1988, Air Force documents show that about \$458 million had been spent developing the system. The Air Force expects that total system costs will be at least \$557 million when the system achieves full operational capability.

In 1988, because of these problems, a task force was established to review the system to determine if it was fatally flawed. The first action of the task force was to document the program's baseline requirements. However, according to the task force, requirements were continually being added while limited dialogue occurred between the satellite operators and the acquirer to define real user needs. According to the task force chairman, this situation resulted in a lack of a stable requirements baseline, which contributed to the program's cost, schedule, and technical problems.

The Space Surveillance System, which is to augment existing ground-based capabilities to track satellites, is another example where requirements were not comprehensively defined before recommending system acquisition. Although program officials said that preliminary requirements were established and evaluations of alternatives were done before they approved the SON, data processing requirements were based on several assumptions rather than comprehensively defined requirements.

For example, the program officials said that the data processing requirements of the Space Surveillance System (which is one of the systems competing for funding in the Defense budget process) were based on the assumption that minimal on-board processing will occur on satellites. However, when the Air Force recommended acquisition approval, it had not decided whether data processing will be done on the satellites or at ground-based stations. If the Air Force decides to process the data on the satellites, it will result in increased requirements for the satellite that could add to its weight, technological risk, and cost. In addition, ground sensors may be sized incorrectly because on-board satellite data processing will affect the amount of data processed by the ground stations. This is the type of requirement that should be established before the Air Force recommends an acquisition approach.

Another example where requirements were not defined before the Air Force recommended an acquisition is the Military Airlift Command's Mission Planning System. This program is also competing for funding in the Defense budget process. The program is to develop an automated system that air crews can use to accurately and rapidly select the best air route. According to the acquiring command, which is responsible for providing or verifying information on alternative solutions and cost, it had difficulty providing information on alternative solutions and cost for the system because the SON did not define potential system requirements and its description of the need was not specific enough. As a result, the acquiring command cautioned that the cost and schedule estimate it prepared for the SON was rough and could increase significantly when systems requirements are later defined.

Alternative Solutions Are Not Thoroughly Evaluated

Air Force regulations require that commands consider various possible solutions to satisfy the need before approving the statement of need and recommending system acquisition. In four systems we reviewed, thorough evaluations of alternative system solutions were not conducted before recommending an acquisition. Had the Air Force adequately evaluated alternative solutions, it would have been in a better position to

determine whether the proposed approach was the best approach to meet the need.

For example, in its Space Defense Operations Center 4 acquisition effort—a system intended to monitor up to 10,000 objects in space—the Air Force included a requirement that the system be capable of operating at a level of security, namely controlled mode security, that had not been achieved in any comparable system. A system operating in controlled mode is intended to ensure that users cleared to receive information at the secret, confidential, or unclassified level can gain access to only the information to which they are entitled. However, the Air Force did not evaluate alternative solutions to determine whether there were other approaches to achieve controlled mode security—even after it was put on notice by two concept definition contractors (Martin Marietta Corporation and Ford Aerospace Corporation) as to the risk of this undertaking.

Martin Marietta made it clear in its initial trade-off analysis that there had been little success in achieving controlled mode security and that the Space Defense Operations Center 4 acquisition need not be put at risk when other viable alternatives were available. In a subsequent design proposal, Martin Marietta proposed that security limitations be identified and a security analysis be undertaken. Further, Ford's initial design proposal identified hardware and software limitations and exceptions to the security requirements. The initial concerns raised by both concept definition contractors and the limitations subsequently identified in Martin Marietta's later design should have put the Air Force on notice that an independent assessment of the achievability of the security requirement was needed. However, none was performed.

It is not surprising then that the contractor experienced problems in building a system to this requirement. The primary problems were the software complexity and the difficulty in attaining satisfactory system performance, given the extra processing needed to run software with extensive security features built into it. In addition, the extra processing load slowed system performance. As a result, the contractor could not achieve controlled mode security or most of the system's critical performance requirements. This system was scheduled to be fully operational in 1988 at a cost of \$290 million; however, the Air Force now estimates that the system will not be completed until 1995 and will cost \$576 million.

In another instance, we found that the Air Force did not perform thorough analyses of alternative solutions to meet system requirements to upgrade the third and last Ballistic Missile Early Warning System (BMEWS) site before approving the statement of need and recommending system acquisition. BMEWS is a ground-based computerized radar system operated by Air Force Space Command at three sites to provide ballistic missile attack warning information. Air Force Space Command, the using command, wrote the statement of operational need for the third site based on the information developed during the upgrade to the first site. However, the acquiring command stated that the requirements definitions were inadequate for the third site because unique hardware and power requirements for that site had not been defined. As a result, the acquiring command could not evaluate alternative solutions and made assumptions about the user's proposed solution when it provided information on the estimated cost to upgrade the last BMEWS site. The acquiring command qualified its cost estimate stating that the estimate was based on an "oversimplified version" of data used for the first two sites and not based on the unique needs of the third site. This potential acquisition is now competing for funding based on a questionable \$320 million cost estimate and technological approach.

Air Force Officials State Resources Are Not Available to Adequately Evaluate Requirements and Solutions

Air Force officials said that commands responsible for acquiring systems are not given enough time or resources to evaluate requirements and alternative solutions when commenting on statements of operational need. As a result, they said emphasis is placed on developing a cost estimate for the solution proposed by the user and not on examining the need and justification for the proposed system versus other alternatives.

Air Force officials stated that it could take years to identify and evaluate requirements, alternative solutions, and costs for many statements of operational need. However, Air Force procedures allow only 30 days for the acquiring command to do these analyses. The officials added that most of the 30 days is consumed by administrative handling, leaving only about 1 week to work on the statement of operational need. For example, acquiring command officials stated that they were allowed about 1 to 2 weeks to prepare information on solutions and cost to be included in the statements of operational need for three of the programs we reviewed. As a result, comprehensive information about potential system requirements, alternative solutions, and estimated costs is not available when decisions are made to recommend acquisitions.

In addition, acquiring command officials stated that they are not given sufficient funding to provide the resources needed to analyze requirements, solutions, and costs during development of statements of operational needs. One acquisition official acknowledged that the amount of funding would depend on the level of technological complexity and risk of the systems involved; he estimated that between \$500,000 and \$5 million might be needed to develop this information for most programs. Another official estimated that an average of about \$1.6 million is needed to develop this information. However, funding to evaluate all statements of operational need at Air Force Space Systems Division has declined from \$1.8 million for fiscal year 1988 to \$780,000 in fiscal year 1989. One program official told us that this funding has been reduced to zero for fiscal year 1990.

Defense Officials Recognize the Need to Conduct Early Evaluations

As discussed in this report, prior GAO and Defense studies have highlighted inadequate requirements definition and evaluations of alternative solutions as acquisition problems. These problems continue today. Officials at all levels within the Department of Defense and the Air Force have indicated an awareness that the requirements-setting process needs improvement. For example, the Secretary of Defense's July 1989 Defense Management Report to the President suggested further revisions to the process for establishing requirements to achieve the degree of improvement recommended by the Packard Commission in 1986. Further, a senior Joint Chiefs of Staff official has stated that the requirements process needs to be closely examined and that acquisition should not be initiated until all alternatives have been evaluated and a system concept has been defined. Finally, Air Force Systems Command proposed in March 1989 that the requirements process be changed to ensure that requirements are defined and alternative solutions are evaluated before initiating an acquisition.

1989 Management Review Report to the President

In July 1989, the Secretary of Defense issued a Defense Management report¹ to the President outlining a plan to improve the defense acquisition process. The report acknowledges that the Department of Defense has not fully implemented the Packard Commission's recommendation to conduct early high-level management reviews of requirements to assess the trade-off between cost and performance. The report identified further changes needed to realize improvements in the acquisition process to the degree contemplated by the Commission. In particular, the

¹Defense Management Report to the President, Department of Defense, July 1989.

report states that system acquisitions should not be initiated until sufficient information is gathered on alternative solutions. The report contains a plan to revise the requirements-setting process to ensure that systems are acquired at less cost, in less time, and with greater assurance of promised performance.

Under this plan, the Secretary of Defense and Chairman of the Joint Chiefs of Staff will use the Joint Requirements Oversight Council to review deficiencies in current capabilities and the validity of identified mission needs, and develop a prioritized list of systems for review by the Defense Acquisition Board. The Board is the primary advisor to the Secretary of Defense on need, affordability, cost, and schedules for major system acquisitions. The systems are not to be funded until information on alternative solutions has been generated and a decision has been made on an acquisition approach. The Air Force is revising its regulations to adopt the Secretary's plan, which is to be implemented in 1990.

Views of the Vice Chairman, Joint Chiefs of Staff

The Vice Chairman of the Joint Chiefs of Staff has made public his views on defense acquisition process deficiencies.² The Vice Chairman said the services should not be driven to make early decisions; systems get in trouble if minds are made up too early and commands are held to prematurely established (before system concept definition) dollar thresholds. He added that information on potential technologies and the cost to develop them cannot reasonably be developed until system requirements, alternative concepts, and alternative solutions have been explored.

The Vice Chairman said that more attention must be given to exploring alternative concepts before an acquisition enters full-scale development. He added that acquisition initiation decisions should be based on the results of alternative concept evaluations and the demonstration that the proposed solution is valid.

²"Herres Eyes Acquisition Fixes, To Delay 'New Starts' Beyond Milestone Zero," Inside the Pentagon, October 14, 1988, pp. 4-7.

Air Force Systems Command Recognizes That the Requirements-setting Process Needs Improvement

On March 13, 1989, Air Force Systems Command issued a draft paper which discusses deficiencies in the Air Force's current requirements process and sets forth a proposal for improving the process. The proposal endorses the findings of the earlier commissions³ and basically reiterates the existing regulations. The proposal suggests that concept exploration, development activities, and trade-off analyses involving requirements and cost should occur before initiating acquisitions. Air Force Systems Command believes, and current regulations require, that acquisitions should begin only after a thorough analysis of the need by the commands that will acquire and use the system. The acquirer should be given sufficient time to analyze available technologies and alternative solutions during development of the SON—well before initiating acquisition. According to Air Force System Command's proposal, the most significant change which needs to be made to the requirements process is to avoid the assumption that there is only one solution to an established need. Once a need is identified, the proposal states that analyses must be performed involving system performance, cost, and schedule to determine the optimum operational capabilities.

Under the proposal, concept exploration and development would take place before acquisitions are initiated to develop a better understanding of alternative solutions; to incorporate technological considerations in analyses of mission, requirements, solutions, and cost; and to identify the best solution to the stated problem. Alternatives should be defined in sufficient conceptual detail so that they can be considered in terms of technology, support, operations, maintenance, and life-cycle costs.

Conclusions

In this and prior reviews, we identified Air Force ADP system problems that began early in the acquisition cycle because requirements were not well defined and alternative solutions were not thoroughly evaluated. These problems occur even though Air Force regulations clearly state that system requirements should be defined and alternative solutions evaluated before the Air Force recommends acquisition of a system and competes it for funding in the Department of Defense budget process. Furthermore, since the early 1970s major independent commissions have made the same point and put Defense on notice that when system requirements are not comprehensively defined and alternative solutions are not fully evaluated, modifications are often necessary, resulting in cost increases, schedule delays, and performance problems.

³The Commission on Government Procurement and the Packard Commission.

In the cases we reviewed, the Air Force recommended ADP acquisitions before system requirements were adequately defined or alternative solutions to meet the need had been evaluated. Had the Air Force adequately evaluated alternative solutions, it would have been in a better position to identify the best solution in terms of achievability, cost, and schedule. However, the Air Force committed to acquisitions without a clear understanding of how to solve the problem, or any assurance that the system it is acquiring will meet the stated need. We believe this commitment is premature. Furthermore, the failure of the Air Force to resolve problems after repeated notification indicates a lack of commitment to the process, and a lack of appreciation for its criticality.

Requirements need to be thoroughly defined and alternatives evaluated before recommending an acquisition. Until this is done, future ADP system acquisitions can be expected to encounter problems similar to those discussed in this report—such as the Space Defense Operations Center 4's \$286 million overrun and 7-year delay. Especially in this time of budget constraints, the Air Force needs to take quick action to implement its regulations. The Air Force cannot afford to initiate ADP acquisitions without solidifying system requirements and evaluating alternative solutions that firmly establish a system's technical approach, design, and cost.

Recommendations to the Secretary of the Air Force

To help reduce the number of costly and lengthy ADP acquisition programs, we recommend that the Secretary of the Air Force quickly take action to implement its regulations established to assure that system requirements are adequately defined and alternative solutions are evaluated before approving and recommending acquisitions. These evaluations should consider technological advances and limitations; requirements achievability, reasonableness, and cost-effectiveness; and acquisition schedule and affordability so that the Air Force can assess whether the proposed acquisition will meet its needs. As part of this effort, the Secretary should pull back those programs competing for funding within the Department of Defense where requirements and alternative solutions have not been adequately defined and considered. The four proposed ADP acquisitions discussed in this report should be specifically pulled back and included in this reassessment.

Agency Comments

We requested official agency comments on a draft of this report from the Department of Defense. While official written comments have not

been provided, we met with agency officials to verify data presented in the report and have made revisions where appropriate.

Department of Defense Major Systems Acquisition Phases

Mission area analysis and program initiation generally precede the five Department of Defense acquisition phases. Defense components continually analyze their assigned mission areas to identify deficiencies (needs) and to determine if new systems or major upgrades to existing systems are necessary. These analyses often result in recommendations to initiate new acquisition programs through the validation of a need to correct the deficiency. Once a need has been identified and validated and Defense initiates an acquisition program, the program enters the concept formulation phase.

Concept Formulation Phase

In this phase, potential requirements and alternative approaches to satisfy the need are identified and evaluated. Various types of analyses considering trade-offs among performance, life-cycle cost, and schedule are conducted to select among possible concepts to satisfy the need. Once a concept has been identified, it is presented to Defense for approval.

Demonstration and Validation Phase

In this phase, feasibility and desirability of the selected requirements and the system concept is further analyzed, generally using techniques like computer simulation, hardware prototyping, developmental test and evaluation, operational test and evaluation, or a combination of test methods. When the feasibility of the concept has been convincingly demonstrated and validated, the program enters the full-scale engineering and development phase.

**Full-scale Engineering
and Development
Phase**

In this phase, the system, including all of the items necessary for its logistic and operational support, is designed, fabricated, and tested. At the conclusion of this phase, the system is ready to be produced.

**Full-rate Production
and Initial Deployment
Phase**

During this phase the proposed system is built and released to the user. At this point, the system becomes operational.

**Operations Support
Phase**

This phase covers that period of time immediately following deployment of the system and extends until the system is removed from Defense inventory. Two major Defense reviews are conducted in this phase. The first takes place 1 to 2 years after deployment to determine if operational readiness and support objectives are being achieved and maintained. The second review occurs 5 to 10 years after deployment. It evaluates system capabilities and assesses whether major upgrades are needed or if the system should be replaced.

Cost Estimates for Developing the Seven ADP Systems

Dollars in millions			
	Recent cost estimate	Original cost estimate	Cost increase
Ongoing Systems			
Command and Control Segment (previously called Data System Modernization)	557	195	362
Communications System Segment Replacement	422 ^a	202	220
Space Defense Operations Center 4	576 ^a	290	286
Subtotal			868
Proposed Systems			
Ballistic Missile Early Warning System	320		
Space-Based Atmospheric Surveillance System	1,131 ^b		
Space Surveillance System	1,446		
Mission Planning System	53		
Total	4,505		

^aEstimates include costs for Research, Development, Test, and Evaluation, Other Procurement, and Operation and Maintenance.

^bEstimates include costs through the demonstration and validation phase. They do not include costs for full-scale engineering and development.

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Related GAO Products

Military Space Operations: Operational Problems Continue with the Satellite Control Computer System (GAO/IMTEC-89-56, Aug. 8, 1989).

Attack Warning: Better Management Required to Resolve NORAD Integration Deficiencies (GAO/IMTEC-89-26, July 7, 1989).

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Attack Warning: NORAD's Communications System Segment Replacement Program Should Be Reassessed (GAO/IMTEC-89-1, Nov. 30, 1988).

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