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ARMY BATTLEFIELD AUTOMATION

Oversight Needed to Assure Integrated System

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The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

The Army's ability to marshal combat power in battle is increasingly tied to its reliance on automated information and control systems. The Army believes that battlefield systems such as maneuver control, air defense, and intelligence must be effectively integrated into an interoperable network if they are to process and make available—in a timely manner—the large amount of data needed for critical battlefield decisions. This report responds to your May 30 and December 14, 1989, requests for the status of the technical and integration challenges that will confront the Army as it begins to integrate five command and control systems into an overall system referred to as the Army Tactical Command and Control System (ATCCS). A detailed explanation of our objective, scope, and methodology is contained in appendix I.

Results in Brief

The Army estimates that the acquisition cost for ATCCS' five battlefield command and control systems (component systems) and the three communications systems that will link them together is over $20 billion. Although these systems were conceived as independent and stand-alone, and have value as individual systems, the Army now views their integration into an overall system as essential to meeting the battlefield commander's needs for timely information. Given this situation, it is important that the Army reduce the risk that the systems may not be able to be integrated without costly redesigns or retrofitting.

The Army is working to resolve the many technical problems it faces integrating these various systems. Three problems—completing system specifications; ensuring adequate communications among the component systems; and designing and implementing an automated communications network management system—are critical. However, no independent oversight of ATCCS exists; the Army therefore cannot be assured that

well. Third, the three major communications systems that ATCCS will use to link the battlefield areas are also in various stages of development or deployment.

The Army has taken steps to manage ATCCS as a system of systems. These include: implementing ATCCS in phases by incorporating the component systems into ATCCS as they complete development and are deployed; consolidating the management of the five command and control systems under one manager;[2] using off-the-shelf common hardware and software to develop the component systems; coordinating development of software that is common to two or more component systems; developing standard command post shelters[3] for all five systems; establishing an ATCCS test and evaluation master plan; and hiring a systems engineering and integration contractor to help implement this approach.

All of these actions, many of which required considerable effort and work to change the existing ways of doing things, are positive steps and are expected to have benefits. For example, the emphasis on common hardware, software, and command posts is intended to simplify the Army's logistics, maintenance, support, and training burden and lower the cost of acquiring and fielding an integrated set of automated command and control systems. In June 1990, the Army estimated that using these common items would save approximately $980 million.

Nonetheless, the challenge of integrating five command and control systems and three communications systems, all in various phases of development or deployment, into a system of systems poses significant risk, which the Army must minimize.

[2]The Army established the position of program executive officer in 1987 to provide clear accountability for program acquisition. A program executive officer is responsible for managing the five command and control systems and integrating them into ATCCS; the program executive officer for communications is responsible for developing the three communications systems ATCCS will be using.

[3]These shelters provide all of the components necessary to operate a command post, e.g., shelter, power, and racks for mounting computer and communications systems.

Communications Systems' Ability to Handle ATCCS' Traffic Volume Is Unknown

The Army has not analyzed the communications work load to be generated by the five component systems and, therefore, does not know whether the communications systems it plans to use for ATCCS are adequately sized. This increases the risk that the battlefield commander will not get information when it is needed.

A communications work load study would determine what capabilities the communications systems must have to transmit information among and between component systems. Typically, such a study would have been done as part of defining the communications systems' specifications for ATCCS. Instead, the Army decided in 1986 to use communications systems which were being developed at that time. However, these systems were sized without considering the work load ATCCS would generate.

In January 1989, in response to congressional concerns about the Army's ability to handle its overall battlefield communications needs, an Army study concluded that its post-1994 needs for data transmission will exceed planned capabilities and that the needs are expected to keep growing. In other words, without upgrades, the Army will not have the communications capability to meet the needs of ATCCS, which is expected to become operational after 1994. In addition, this study addressed only some of the Army's communications needs—it did not address all of ATCCS' needs. For example, the communications needs for the combat service support system, one of the ATCCS component systems, were not addressed. In addition, the communications requirements for the maneuver control system (another ATCCS component system) were not validated, thus the needs that were used may not have represented actual user requirements.

The Army recognizes the importance of performing an ATCCS communications work load analysis. It has tasked its systems engineering and integration contractor with determining ATCCS' communications work load and assessing whether the communications systems ATCCS plans to use can handle it. The Army expects the study to be completed in April 1991.

This analysis must be completed to ensure that sufficient communications capability will be available when needed by ATCCS. If the study is delayed or if needed changes cannot be expeditiously implemented, it increases the risk that the ATCCS component systems will be ready to be deployed before sufficient communications capability is available.

Achieving the goals and benefits expected from ATCCS depends upon successfully integrating the five component systems and their supporting communications systems. Delays or functional shortfalls in any system can compromise ATCCS' goals and its schedule. For example, the fire support system cannot operate without the Army Data Distribution System. Consequently, the resolution of individual systems' problems and the impact of their solutions must be addressed not only from the perspective of the individual system, but also from the perspective of ATCCS itself.

In addition, independent oversight will help assure that ATCCS is viewed as a system of systems. While ATCCS is composed of five command and control systems linked by three communications systems, to be effective, it must perform as a system. As one top Army official recently told the Congress, it is important that ATCCS be viewed as a system of systems, fully integrated, rather than as a loose collection of programs. Further, independent oversight will help protect the significant investment being made in the systems that comprise ATCCS.

Conclusions and Recommendations

The Army faces a significant challenge in integrating the five command and control systems and the three communications systems into a system of systems. The Army has taken many appropriate actions to integrate these systems and is working to resolve the technical problems it faces. Until resolved, however, these problems increase the risk that (1) component systems may have to be changed significantly and that ATCCS will not be able to provide all of the information the battlefield commander needs, and (2) that the component systems will be deployed and ready to operate together before the communications systems and their automated network control capabilities are available. Independent oversight from an ATCCS perspective would help bring about the timely resolution of these technical problems.

In addition, independent oversight, focusing on delays and functional shortfalls in any system, would reduce the risk that the eight systems may not be able to be integrated as a total system without costly redesigns and retrofitting. Further, the complexity of the challenge and the size of the investment in the systems that will comprise ATCCS demands independent oversight. Since ATCCS needs to perform as a system, it needs to be overseen as a system.

Therefore, both ATCCS-level and individual system-level problems and solutions must be addressed from an ATCCS perspective to assure the

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Objective, Scope, and Methodology

As requested by the Chairman of the Senate Appropriations Subcommittee on Defense on May 30, 1989, and the Chairman of the House Appropriations Subcommittee on Defense on December 14, 1989, the objective of our review was to provide information about the technical and integration challenges which will confront the Army as it begins to integrate the five command and control systems into ATCCS.

To accomplish this objective we reviewed system development, planning, technical, and contractor documents, and Department of Defense and Army standards and regulations, and interviewed Army officials at the Office of the Program Executive Officer, Command and Control Systems, Fort Monmouth, New Jersey; individual ATCCS program managers at Fort Monmouth and at McLean, Virginia; the Office of the Program Executive Officer, Communications, Fort Monmouth; the Combined Arms Combat Development Activity, Fort Leavenworth, Kansas; the Communications-Electronics Command, Fort Monmouth; the Army Operational Test and Evaluation Agency, Alexandria, Virginia; the Army Materiel System Analysis Activity, Aberdeen, Maryland; the Signal Corps, Fort Gordon, Georgia; TRW Defense Systems Group, Redondo Beach, California; and at the General Electric Corporation, Fort Washington, Pennsylvania.

Our review was conducted from July 1989 through June 1990. We discussed our findings with officials from the Offices of the Program Executive Officer, Command and Control Systems and Communications, and the Office of the Secretary of Defense. We included their comments where appropriate. However, in accordance with the requesters' wishes, we did not obtain official agency comments on a draft of this report. We performed our work in accordance with generally accepted government auditing standards.

timely resolution of these interdependent problems before any individual system proceeds too far in development. To reduce the risks associated with the complex, technically challenging, and expensive task of integrating the five command and control systems and the three communications systems, we recommend that the Secretary of Defense require the Defense Acquisition Board to oversee the overall ATCCS program.

Furthermore, it is critical that the Army complete the ATCCS specifications and the communications work load study. The Army expects to complete these two efforts in 1991; thus, 1991 will be a pivotal year in determining the future success of ATCCS. Accordingly, we recommend that the Secretary of Defense require that the Defense Acquisition Board, as part of its oversight of ATCCS, assess the impact of (1) the ATCCS specifications on the design of the component systems and (2) the estimated communications work load on the existing communications systems, and submit the results to the Secretary to use in determining the funding requests for the component and communications systems.

As requested by your offices, we did not obtain official agency comments on a draft of this report. We did discuss the factual contents with Department of Defense and Army officials and incorporated their comments where appropriate. Our work was performed in accordance with generally accepted government auditing standards.

As arranged with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Chairmen, Senate and House Committees on Armed Services; the Secretaries of Defense and the Army; the Director, Office of Management and Budget; and other interested parties. This work was performed under the direction of Samuel W. Bowlin, Director, Defense and Security Information Systems, who can be reached at (202) 275-4649. Other major contributors are listed in appendix II.

Ralph V. Carlone
Assistant Comptroller General

Automated Capability to Manage Communications Systems Is Lacking

ATCCS component systems will rely on three Army communications systems, for voice, data, and message service. Like the ATCCS component systems, each communications system (Mobile Subscriber Equipment for voice, facsimile, and data transfer in a direct user-to-user mode; Single Channel Ground and Air Radio System for voice and data transmission; and Army Data Distribution System for data transmission) was conceived as an independent, stand-alone system. Only later did the Army recognize that substantial operational benefits could be derived by managing the separate communications systems as one composite system. For example, greater communications robustness may be achieved in battle if the status of the systems and the work load on the systems can be quickly and accurately determined. By doing this, bottlenecks can be identified and traffic rerouted to maximize communications capabilities.

The Army is now pursuing an automated communications planning and management system called the Integrated System Control Facility (ISYSCON) to effectively integrate many individual Army communications systems, including those supporting ATCCS. Although ISYSCON was not funded in the past, the Army currently plans to establish the program in October 1991. ISYSCON is expected to have an initial operating capability by December 1994. Its capabilities must be available in 1996, when the Army plans to have all five command and control systems in the field. If it is not available when ATCCS is fielded, ATCCS' overall usefulness and benefits could be considerably lessened.

No Army- Or Defense-Level Oversight of ATCCS as a System of Systems

Defense policies and procedures for automated system development call for thorough and effective oversight commensurate with the anticipated investment. "Major"[4] systems are normally developed through five distinct phases, with the results of each phase reviewed and approved before permitting the system to progress to the next phase. Major systems that are reviewed by the Defense Acquisition Board must be approved for continued development by the Secretary of Defense.

Since the ATCCS component systems were initiated as individual systems, they are overseen separately. Three of the component systems have received independent oversight from the Defense Acquisition Board. The other two are overseen by the Army System Acquisition Review Council. However, there is no independent oversight of ATCCS as a whole.

[4]Defense Directive 5000.1 defines major systems as those with estimated acquisition costs of more than $1 billion, those with eventual total expenditures for research, development, test, and evaluation of more than $200 million, or those designated as special interest because of urgency of need, development risk, joint funding, or congressional interest.

Technical Issues Place Successful Integration at Risk

The Army is working to resolve over 40 technical problems that it believes are important to developing and integrating ATCCS. While correcting all of these problems is necessary for a successful system, we believe that three in particular—completing system specifications, ensuring adequate communications among the five command and control systems, and designing and implementing an automated communications network management system—are critical to integrating the component systems into ATCCS.

System Specifications Have Not Been Fully Defined

The Army has not yet fully defined how the component systems will operate as a system of systems. For example, the Army has not yet finished identifying what specific ATCCS data must be provided by and exchanged among each of the five component systems. Nor has it determined how the information will be stored or what formats will be used to transmit and receive the data at each battlefield area. Until these specifications are completed, the Army does not know what information the five component systems must provide, how often, how current it must be, and in what format. Once these specifications are completed, an assessment of individual systems must be made to determine what modifications, if any, must be made to integrate these systems into the overall ATCCS system configuration. Any needed revisions may prove to be costly.

The Army in 1989 tasked its systems engineering and integration contractor with defining ATCCS-level specifications; this task is expected to be completed in early 1991. This effort will include

- determining how the component systems will work together;
- determining what functions each system must perform to meet ATCCS requirements; and
- assessing the component systems to determine how they need to be changed to meet ATCCS requirements.

Before the specifications definition for ATCCS is completed, however, writing of software will be underway for four component systems. Writing software for component systems without knowing ATCCS specifications may result in the Army later spending additional time and money to make the component systems' software comply with ATCCS specifications. More important, the Army plans to make major production decisions in August 1992 on two component systems, which gives the Army very little time to design, test, and implement any changes which may be needed to meet ATCCS specifications.

ATCCS integration problems are being resolved and that future ATCCS concerns are considered in decisions being made on the component and communications systems.

Background

ATCCS is designed to rapidly collect, process, analyze, display, coordinate, and exchange timely battlefield information to enhance the decision-making process. When completed, ATCCS will have automated systems at the five battlefield functional areas used to command and control a battle: (1) planning, directing, and controlling artillery (fire support); (2) status monitoring of troop movements and general battlefield conditions (maneuver control); (3) controlling short-range air defense weapons (air defense); (4) managing supply, maintenance, transportation, medical, and personnel activities (combat service support); and (5) receiving, analyzing, and distributing intelligence information (intelligence and electronic warfare). The voice and data communications capabilities that will link the battlefield areas and their component systems will be provided by three communications systems.

The integration of the five component and three communications systems into a system of systems is expected to provide commanders from corps to battalion with what the Army describes as a "force multiplier"; i.e., producing greater fighting effectiveness through better use of the same or fewer battlefield resources. Working together, these component systems are intended to permit battlefield areas, using computers linked by radio and wire, to communicate efficiently and to produce common data bases of command information and pictures of the unfolding battle. The estimated acquisition cost of the ATCCS component systems and the communications systems that they will use, according to Army figures, is more than $20 billion.[1]

The Challenge: Integrating Systems in Different Phases of Development

While the Army has been automating its command and control systems for years, it was not until December 1986 that the Army decided to integrate them into a system of systems. Integrating the five component systems is complicated by several factors. First, the five component battlefield systems are in different phases of development, ranging from concept definition to full-scale development. Second, each component system itself is very large and complex, and is supposed to satisfy both its own functional requirements (e.g., fire support) and those of ATCCS as

[1] This estimate does not include some intelligence and electronic warfare system costs, which are classified.