United States General Accounting Office

GAO

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

February 1991

NAVY COMMAND AND CONTROL

Better Systems Integration and Organizational Structure Are Needed

GAO/NSIAD-91-115

GAO

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

National Security and
International Affairs Division

B-242456

February 27, 1991

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

Dear Mr. Chairman:

As you requested, we assessed the acquisition management of selected data fusion[1] efforts within the U.S. Navy Command and Control System to identify any data fusion deficiencies and evaluate plans to overcome the deficiencies.

We divided our work into two phases. Our first report[2] disclosed that the Navy considered its data fusion capabilities at sea (afloat) to be incomplete, manpower intensive, and time-consuming. We concluded that until the Navy acquired a full afloat correlation system capability, data fusion for battle group commanders afloat would be limited, resulting in a continuing unsatisfactory tactical picture. This report addresses Navy data fusion capabilities ashore and the command and control system from a broader perspective.

Background

According to the Navy, the threat capabilities of possible adversaries have led to a significant reduction in battle group commanders' reaction time to hostile situations at sea. This resulted in Navy plans to acquire and deploy long-range sensors and weapons. However, the Navy has encountered problems in adequately handling the increased volume of data from wide-area surveillance sensors located both inside and outside the battle groups. This has led to an unsatisfactory tactical picture for operational commanders.

The Navy uses its command and control system to manage a variety of information and control naval forces. The system is expected to (1) obtain data on enemy locations and capabilities, (2) integrate and deliver these data in a timely manner and a useful format to operational

[1]Data fusion is defined as the merging of information from a variety of sources.

[2]Navy Command and Control: Data Fusion Needs and Capabilities for Battle Group Commanders (GAO/NSIAD-90-69BR, Mar. 7, 1990).

commanders, and (3) provide a capability through automation and decision aids to reduce the burden associated with commanders' decision-making.

The system consists of several elements, including facilities, equipment, communications, procedures, and personnel, and is organized into two parts: ashore and afloat.

- The system's ashore elements include sensors and other electronic equipment that provide national and theaterwide data. Data from these elements are processed and evaluated at installations ashore before being provided to the battle groups at sea and are called nonorganic because the elements are not controlled by battle group commanders.
- The system's afloat elements include sensors and other electronic equipment that provide data about potential threats and targets that extend out to about 1,000 miles from the battle groups. Data from these elements are called organic because the elements are under the control of battle group commanders.

Appendix I lists several major command and control system elements, two of which are critical for data fusion. For example, the Ocean Surveillance Information System is used ashore to receive, process, and distribute data on targets of interest above, on, and below the ocean surface. The Afloat Correlation System, which was the focus of our first report, is under development for use by battle group commanders at sea and is expected to fuse data from systems ashore with data from systems afloat.

Results in Brief

In 1982, the Navy awarded a contract to improve its data fusion capabilities ashore by acquiring an upgrade to the Ocean Surveillance Information System. However, it initiated production of the upgrade without performing an operational evaluation. Subsequently, when the first evaluation was performed, the system experienced numerous deficiencies. Although many have been corrected, others remain and will have to be corrected before the system is operationally effective. Currently, the Navy considers its data fusion capabilities ashore as marginally satisfactory and has restructured the program to correct the deficiencies and add capabilities by 1993—a 4-year delay from the earlier program upgrade completion date.

In the interim, the Navy acquired several prototype systems to overcome the data fusion deficiencies. However, these systems neither individually nor collectively meet the Navy's stated mission needs or satisfy Navy program requirements for documentation, logistics support, testing, training, and configuration control. This failure to meet mission needs or satisfy various program requirements is partially attributable to the lack of (1) effective systems engineering and integration and (2) an effective organizational management structure.

The lack of adequate data fusion capabilities results in inefficient or untimely use of ashore and afloat sensors and battle group weapons. Until adequate data fusion capabilities ashore and afloat are available, Navy battle group commanders will have less than a satisfactory tactical picture for decision-making, and some Navy missions could be at risk.

Navy Considers Current Data Fusion Capabilities Ashore as Marginally Satisfactory

The Navy considers its data fusion capabilities ashore as marginally satisfactory because the Ocean Surveillance Information System does not meet all operational requirements, even though several changes have been made to the system since its inception.

In 1970, the Navy established an ocean surveillance requirement to detect, locate, and classify selected air, surface, and subsurface targets and distribute these data to users in as near real-time manner as possible. In 1979, in response to this requirement, the Navy installed the Ocean Surveillance Information System at five locations: London, England; Norfolk, Virginia; Pearl Harbor, Hawaii; Rota, Spain; and Kamiseya, Japan. The system consists of various computers, work stations, display units, and mass data storage devices. It provides information to ashore and afloat commanders at both the sensitive compartmented and general services levels of security classification.

System Upgrade

In 1982, the Navy awarded a contract to upgrade the Ocean Surveillance Information System because the system operated too slowly, lacked sufficient capacity to handle increasing amounts of sensor data, had an inadequate number of display terminals, and contained insufficient security safeguards. This contractual effort was called the Ocean Surveillance Information System Baseline Upgrade program and was to be completed in 1989. The upgrade involved providing greater automation associated with incoming messages, target contacts and track correlation, data storage, security safeguards, and analytical tools.

During the development period, the Navy made several changes to the system upgrade. For example, early specifications required the system to handle 10,000 contacts per hour, but these specifications were later reduced by over 80 percent to 1,800 contacts per hour. According to a Navy program official, this reduction was necessary due to a lack of resources and slow development of sensors. Also, the Navy (1) added requirements to improve the system's inherent computer security after discovering certain security weaknesses, (2) substituted a lesser capability for the planned automatic air tracker, and (3) deferred several support functions. The redesign effort associated with the computer security change alone resulted in a program schedule delay of about 1 year.

Operational Testing

The system upgrade acquisition plan, which became effective in 1983, included initiating production before performing an operational evaluation. Subsequently, the Navy published instructions requiring that at least one complete phase of operational testing be performed before using procurement funds and that an operational evaluation be completed before approving full-rate production. The Navy's operational test organization raised concerns about the program's development not being in compliance with the latest instructions. However, in September 1985, the Chief of Naval Operations concluded that sufficient testing was planned for the system upgrade, and he supported the expenditure of production funds before completing any operational testing.

In May and June 1989, over 2 years after deployment began, the Navy's operational test organization performed the first operational evaluation of the upgraded system and identified numerous deficiencies in 10 of 16 major areas. The system was rated not operationally effective in part because it did not meet some of the timeliness requirements—data processing was too slow, making the end product late for useful near-real-time decisions, and work station response times were rated as inadequate. Also, the system upgrade site was not adequately hardened against shock, blast, or electromagnetic pulses. The system was rated potentially operationally suitable even though reliability, availability, and maintainability were characterized as not acceptable. Also, documentation support and personnel training were rated as unsatisfactory.

After the 1989 operational evaluation, the Navy installed new software and work station hardware to improve system responsiveness, data processing, and the man-machine interface. In April 1990, the Navy's

operational test organization performed a second operational evaluation. The results showed that although most of the major deficiencies identified in the earlier operational evaluation were corrected, 29 major deficiencies remained and were not tested again because of plans to correct them in the future. The test organization assessed the upgraded system as potentially operationally effective and suitable, pending correction of the remaining deficiencies. A third operational evaluation to assess system performance is scheduled for June and July 1991.

Program Restructuring

Meanwhile, in January 1990, the Navy restructured the program into the Ocean Surveillance Information System Evolutionary Development program to correct deficiencies in the upgraded system and add capabilities as needed. For example, additional analytical tools and decision aids are to be developed; the man-machine interface is to be improved; various prototype systems are to be evaluated and interfaced; and interoperability is to be improved between ashore and afloat systems and between joint and allied systems.

Navy representatives stated that a January 1990 decision coordinating paper calls for the original Ocean Surveillance Information System requirements to be satisfied in fiscal year 1993. This reflects a 4-year delay in the full system capability from the earlier 1989 system upgrade completion date. Navy officials stated that the current development, procurement, and life-cycle maintenance costs for the system upgrade and evolutionary development effort is estimated to be $339.7 million through fiscal year 1999.

Navy Lacks Effective Systems Integration and Organizational Management Structure

The many individual elements of the Navy Command and Control System must be engineered and integrated as a whole system if information collection, processing, and distribution requirements are to be efficiently and effectively met. The Navy's command and control plan states that standardized computer resources, decision aids and displays, and software are needed for effective information management. However, the necessary systems integration is not being done effectively, and the Navy's organizational management structure is not adequate to promote efficient systems engineering.[3]

[3]Systems engineering is a technical and management process occurring throughout a system's life cycle with the purpose of establishing optimum system cost, schedule, and performance objectives by integrating numerous factors into a total effort.

In 1985, the Navy established the Space and Naval Warfare Systems Command (SPAWAR) to have the primary responsibility for development and procurement of space and command, control, and communication systems. These responsibilities included (1) systems engineering and integration to convert operational requirements into contract specifications and (2) control of program resources to implement system acquisitions.

SPAWAR was to develop and manage command and control architectures, and it specifically established the Warfare Systems Architecture and Engineering Directorate for this purpose. By establishing SPAWAR, the Navy intended, in part, to stop what it viewed as a fragmented approach to managing command and control programs. The Navy stated that fragmented management had resulted in multiple program delays, additional costs, interoperability problems, and less than optimum battle force integration.

After 5 years of operations, however, SPAWAR is not adequately performing systems engineering for the Navy Command and Control System, and the Navy's organizational management structure is still fragmented. For example, many prototype systems have been acquired by various users—the Commander-in-Chief, Atlantic Fleet; Commander-in-Chief, Pacific Fleet; Commander, Naval Intelligence Command; and Naval Research Laboratory—to fill gaps caused by Ocean Surveillance Information System Baseline Upgrade and Afloat Correlation System schedule delays and reduced capabilities. (See app. II.) Some of the prototype systems, which are now being extensively used in the fleet, contain duplicate hardware and software functions and neither individually nor collectively meet the Navy's stated mission needs or satisfy Navy program requirements for documentation, logistics support, testing, training, and configuration control. We requested a SPAWAR official to provide acquisition cost information for these prototypes, but the information was not readily available.

The Navy Director for Space and Electronic Warfare, who is the sponsor for many SPAWAR programs within the Office of the Chief of Naval Operations, stated that his office has too many different programs under separate titles to accomplish the same function. SPAWAR representatives stated that the Warfare Systems Architecture and Engineering Directorate (1) lacked funding control, (2) did not have the in-house expertise to handle a large project like the Navy Command and Control System, and (3) was understaffed. In addition, some of the elements within the command and control system were funded by other Navy commands,

each with its own priorities and objectives, making it more difficult for SPAWAR to manage the overall system. For example:

- The Naval Sea Systems Command manages the Navy Tactical Data System and its follow-on system, the Advanced Combat Direction System. These are primary automated command and control systems that (1) provide the necessary integration between a variety of sensors and weapons on today's major warships and (2) monitor the overall tactical air, surface, and subsurface environment. The Command also manages the Aegis weapon systems that includes a computer that monitors the overall air, surface, and subsurface tactical picture for the battle group by correlating and maintaining organic and nonorganic tracks of potential targets.
- The Naval Air Systems Command manages the Tomahawk Weapons Control System, which performs functions similar to the Afloat Correlation System and Aegis, by correlating and tracking potential air, surface, and subsurface targets.

According to Navy representatives, they were currently undergoing a transition period to merge both ashore and afloat command, control, communications, and intelligence requirements. The Ocean Surveillance Information System is to be included in late 1991, along with some of the prototype systems listed in appendix II. This merging effort is scheduled to be completed in 1995.

Recommendation

To minimize system duplication, we recommend that the Secretary of the Navy review the organizational management structure to ensure that effective systems engineering and integration is achieved for programs within the Navy Command and Control System.

Scope and Methodology

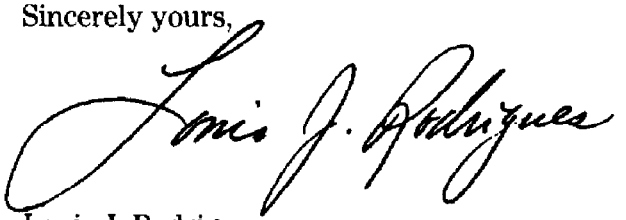
We interviewed officials responsible for Navy data fusion efforts in the Office of the Secretary of Defense, Office of the Chief of Naval Operations, Office of the Navy Comptroller, and SPAWAR. We also interviewed selected contractor representatives associated with Navy data fusion systems ashore. We reviewed and analyzed planning and contractual documents, cost and schedule information, system requirements and design data, and correspondence concerning the management and direction of the Navy's data fusion ashore efforts. We completed our work in December 1990 in accordance with generally accepted government auditing standards.

As requested, we did not obtain written agency comments. However, we discussed the contents of this report with Office of the Secretary of Defense and Navy officials and have included their comments where appropriate.

Unless you publicly announce its contents 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 Secretaries of Defense and the Navy, and the Director, Office of Management and Budget. We will also make copies available to other interested parties.

Please contact me on (202) 275-4841 if you or your staff have any questions concerning this report. Other major contributors are listed in appendix III.

Sincerely yours,



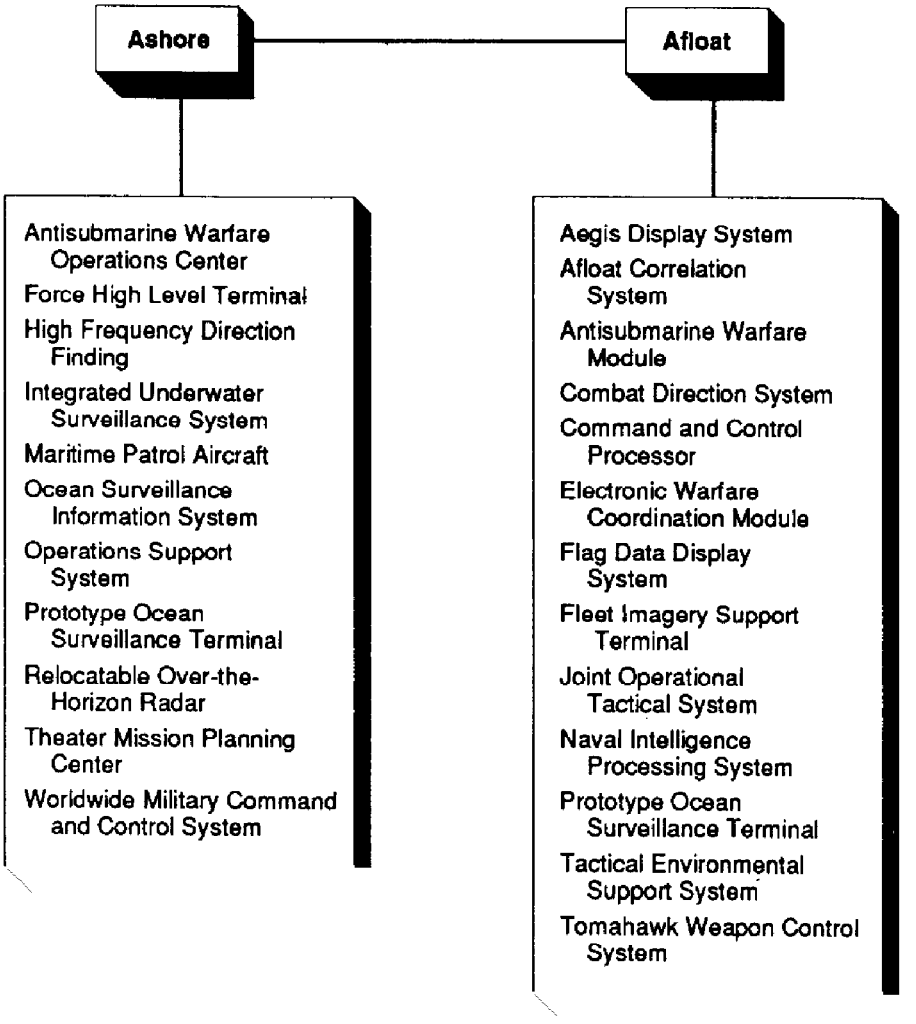
Louis J. Rodrigues
Director, Command, Control, Communications,
and Intelligence Issues

Contents

Abbreviations

GAO	General Accounting Office
SPAWAR	Space and Naval Warfare Systems Command

Major Navy Command and Control System Elements



Prototype Systems Acquired to Fill Navy Command and Control System Gaps

Prototype system	Purpose
Air Tracker Prototype	An electronic intelligence system for correlating air targets
Combat Area Support Terminal	A wide-area surveillance system that correlates data, providing an integrated intelligence picture
Developmental Aircraft Reports Tracker	A system to manage air tracks and forward information to fleet users
Electronic Collateral Support System	A processor that includes automatic message handling
Fleet Command Center/ Battle Management Plan	An artificial intelligence system that provides tools for displaying and interpreting data for operational support decisions
Fleet Imagery Support Terminal	A system that provides digital imagery for processing by afloat units
Force Requirement Expert System	A software application that analyzes and calculates logistic requirements for force mobilization decisions
Intelligence support to strike/amphibious forces	A local area network used to process incoming data for intelligence products and reports
Joint Operational Tactical System	A battle management system that provides a display of tactical situations
Prototype Analyst Display Station	An electronic intelligence display station
Prototype Analyst Workstation	A work station that primarily supports and facilitates the analysis of electronics intelligence data
Prototype Ocean Surveillance Terminal	A wide-area surveillance system with some data fusion capability
Submarine Acoustic Warfare System	A submarine analysis work station
Tactical Information Management Subsystem	A shipboard program that provides tracking information and battle planning aids

Major Contributors to This Report

National Security and International Affairs Division, Washington, D.C.

Homer H. Thomson, Assistant Director
Kent L. Fixman, Evaluator-in-Charge
Richard O. Kyhn, Evaluator
Robert G. Carpenter, Evaluator

Ordering Information

The first five copies of each GAO report are free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

U.S. General Accounting Office
P. O. Box 6015
Gaithersburg, MD 20877

Orders may also be placed by calling (202) 275-6241.