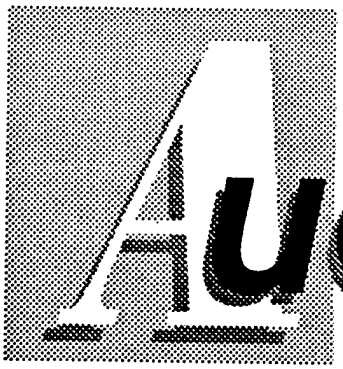

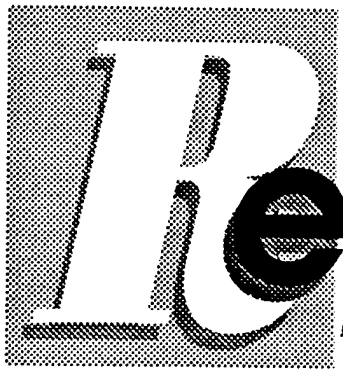

OFFICE OF THE INSPECTOR GENERAL

DIGITAL MAPPING, CHARTING, AND GEODESY DATA STANDARDIZATION

Report No. 95-060 December 19, 1994

Department of Defense

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Acronyms

DMA	Defense Mapping Agency
MC&G	Mapping, Charting, and Geodesy

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
400 ARMY NAVY DRIVE
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Report No. 95-060 December 19, 1994

MEMORANDUM FOR DIRECTOR, DEFENSE MAPPING AGENCY

SUBJECT: Audit Report on Digital Mapping, Charting, and Geodesy Data Standardization (Project No. 4RC-0051)

Introduction

We are providing this report for your information and use. The report discusses Defense Mapping Agency (DMA) actions to standardize digital mapping, charting, and geodesy (MC&G) data. Digital MC&G data have become increasingly important to DoD systems because of their operational efficiencies. The Military Departments and Defense agencies use digital MC&G data in various systems, including those that provide planning and support for command, control, communications, and intelligence; navigation for vehicles, vessels, and aircraft; positioning and guiding weapons; and simulations for training. The expanding use of digital MC&G data and the capability to electronically transfer digital data between systems require that DMA standardize digital MC&G data to facilitate system compatibility and interoperability. Compatibility and interoperability are particularly important to the conduct of combined[1] and joint[2] military operations. The use of standardized digital MC&G data eliminates the time and costs associated with either producing unique MC&G products or modifying MC&G data for use in a particular system.

Audit Results

DMA had taken positive actions in standardizing digital MC&G data. Those actions increased compatibility of system data and system interoperability among the Military Departments and Defense agencies. DMA actions include:

o converting DMA production specifications to military specifications[3] and standards[4] and developing new specifications and standards,

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[1]Combined military operations are conducted by two or more allied nations.

[2]Joint military operations are conducted by elements of more than one Service. The forces operate under a single commander.

[3]Specifications define the specific characteristics of a specific item, material, or service.

[4]Standards establish the required characteristics that one or more items, materials, or services must possess.

o establishing an advisory board of MC&G community leaders and a standards management committee of MC&G community action officers,

o establishing an office responsible for interoperability efforts,

o resolving long-standing problems in standardization, and

o developing plans to define future digital MC&G data requirements.

Officials responsible for MC&G matters at the Joint Staff, the Military Departments, and the Defense Information Systems Agency were generally satisfied with DMA's progress in standardizing digital MC&G data. To help ensure that DoD meets all operational requirements, DMA must continue its efforts on standardizing digital MC&G data.

Objectives

The primary objective of the audit was to evaluate DMA's implementation of the Defense Standardization Program. Specifically, the audit determined whether DMA, as the Lead Standardization Activity for the MC&G technology area, established adequate guidance and standards for the compatibility and interoperability of digital MC&G data. The audit also evaluated DMA's implementation of the DoD Internal Management Control Program as it pertains to DMA's implementation of the Defense Standardization Program.

Scope and Methodology

Audit Work Performed. The audit concentrated on DMA's implementation of the Defense Standardization Program since November 1989, when DoD made DMA responsible for standardization in the MC&G technology area. Enclosure 1 discusses DMA's mission and its responsibilities for the Defense Standardization Program. To assess DMA's implementation of the Defense Standardization program, we reviewed:

o digital specifications and standards issued by DMA,

o Office of the Secretary of Defense and DMA guidance on standardization of MC&G data,

o minutes of DMA's MC&G Joint Interoperability Board and Geospatial Standards Management Committee, and the Joint Staff's Military Communications Electronics Board,

o responsibilities of DMA offices assigned to standardize data and actions taken by those offices, and

o documentation on digital MC&G data requirements and standardization dated from June 1984 through September 1994.

In addition, we interviewed:

o personnel responsible for DMA's implementation of the Defense Standardization Program and for providing oversight of DMA's standardization program and

o Military Department points of contact responsible for MC&G matters.

Auditing Period and Standards. This program audit was made from June through September 1994 in accordance with auditing standards issued by the Comptroller General of the United States as implemented by the Inspector General, DoD. Accordingly, we included such tests of internal controls as we considered necessary. We did not rely on computer-processed data to assess DMA's implementation of the Defense Standardization Program. The organizations visited or contacted during the audit are listed in Enclosure 3.

Internal Controls

Internal Controls Reviewed. We reviewed DMA's implementation of the DoD Internal Management Control Program and assessed internal controls related to the MC&G technology standardization area. Specifically, we reviewed DMA's:

o guidance on the DoD Internal Management Control Program,

o 5-year Internal Management Control Plan,

o annual statements of assurance for FYs 1991 through 1993, and

o follow-up system for tracking internal control weaknesses and recommendations.

In addition, we determined whether DMA provided training to managers responsible for internal controls. We also determined whether the DMA included responsibilities for internal management controls in performance plans for managers responsible for digital data standardization.

Results of Review of Internal Controls. DMA had established an internal management control program as defined by DoD Directive 5010.38, "Internal Management Control Program," April 14, 1987. The audit deemed internal controls to be effective in that the audit disclosed no material weaknesses. The audit identified one area of internal controls in which improvements could be made (see Other Matters of Interest).

Prior Audits and Other Reviews

No audits in the last 5 years specifically related to the standardization of digital MC&G data. However, Inspector General, DoD, Audit Report No. 90-070,

"Report on Mapping, Charting, and Geodesy Support Requirements to the Acquisition Process," May 22, 1990, concluded that DoD acquisition program offices identified MC&G requirements to DMA in a timely manner.

By identifying MC&G requirements early in the acquisition process, program offices can design or require that contractors design systems to use available standardized data. If the program offices identify new MC&G products, DMA can develop standardized products in time to support the new system. Report No. 90-070 concluded that DoD policies regarding the identification of MC&G requirements were effective and that the Military Departments had implemented related policies. In addition, the report concluded that DMA's assignment of liaison officers to the Military Departments and the Military Departments' establishment of points of contact for MC&G matters increased the awareness of MC&G issues in the DoD. The report contained no recommendations. During the current audit, the Military Departments and the Joint Staff were still identifying MC&G requirements early in the acquisition process.

Other Matters of Interest

Records DMA used to assign numbers to MC&G standardization projects and to track the development progress of those projects were not complete. DoD Manual 4120.3-M, "Defense Standardization Program (DSP) Policies and Procedures," July 1993, requires offices responsible for standardization in a Military Department or DoD agency to maintain records of standardization projects.

Since DMA's appointment as the Lead Standardization Activity for the MC&G technology area on November 1, 1989, DMA's Departmental Standardization Office had recorded 149 projects through July 11, 1994, for the standardization of digital and hardcopy data, products, formats, and handbooks. DMA officials could provide documentation on only 52 of those 149 projects. After coordinating with other DMA offices, DMA officials provided information on an additional 94 projects. As of August 15, 1994, DMA officials had not identified information on the remaining three projects. After the auditors discussed the status of the records with officials in DMA's Departmental Standardization Office, DMA officials assured the auditors that needed information would be recorded in the future. Accordingly, the report makes no recommendations for corrective action.

Discussion

Development of Digital MC&G Specifications and Standards. DMA has made significant progress in developing digital MC&G specifications and standards since being designated the Lead Standardization Activity for the MC&G technology area in 1989. Initially, DMA concentrated on converting DMA production specifications for high-demand products to military specifications and standards. Subsequently, DMA, in coordination with the MC&G community, has been working to develop specifications and standards for new products and formats. To help lead standardization efforts, DMA

developed a format for products containing vector MC&G data[5] before the Military Departments began demanding products with vector data. The Military Departments are now using vector MC&G data instead of raster MC&G data[6] in more of their systems. A standard format for vector data reduces the potential for DoD acquisition program offices or contractors to design systems that require unique data. As of September 20, 1994, DMA had completed and published 10 digital MC&G specifications and standards and was developing an additional 19. Enclosure 2 lists the completed and draft digital MC&G specifications and standards.

Forum for Coordinating MC&G Issues. During 1993, the Director, DMA, established the MC&G Joint Interoperability Board and the Geospatial Standards Management Committee to manage and facilitate the standardization of digital MC&G data. The MC&G Joint Interoperability Board and the Geospatial Standards Management Committee consist of leaders and action officers from the MC&G community. The MC&G Joint Interoperability Board and the Geospatial Standards Management Committee provide the MC&G community effective forums for debating and resolving standardization issues. The diversity and level of membership on the MC&G Joint Interoperability Board and the Geospatial Standards Management Committee help ensure that the MC&G community fully debates significant MC&G issues and supports the decisions made on critical MC&G issues.

Establishment of an Office for Interoperability Issues. During 1994, DMA further emphasized interoperability by separating responsibilities for interoperability issues from the overall management of the DMA Standardization Program. DMA established the Interoperability Office, Technology and Information Directorate, to maintain DMA's strategy and master plan for interoperability and to act as the secretariat for the MC&G Joint Interoperability Board and Geospatial Standards Management Committee. DMA established the Standards and Specifications Division, Technology and Information Directorate, to manage the overall DMA standardization program. The establishment of the Interoperability Office properly emphasizes the importance of interoperability of digital MC&G data.

Resolution of Long-Standing MC&G Standardization Issues. DMA, in concert with the MC&G Joint Interoperability Board and Geospatial Standards Management Committee, had resolved several long-standing problems in standardization. For example, DMA reduced multiple raster formats and planned the development of interoperable map exploitation software.

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[5]Vector MC&G data rely on a structure of points, lines, and areas. Vector MC&G data may be obtained by digitizing existing cartographic material or imagery and labeling features using a complex data extraction process. The resulting vector MC&G data can be easily changed or analyzed.

[6]Raster MC&G data are based on a cellular or gridded structure and generally are obtained by scanning existing material. Because of the structure, raster data require more storage space than vector data. Raster MC&G data can be rapidly and easily displayed, but have limited capacity for change or analysis.

Reduction of Multiple Raster Formats. DMA improved interoperability by reducing the Military Departments' need to modify ARC[7] Digitized Raster Graphics products. An ARC Digitized Raster Graphics product electronically displays maps in either command and control systems, weapon systems, or simulators. The Military Departments must modify the format of an ARC Digitized Raster Graphics product for it to function properly in certain systems, such as the Army's Maneuver Control System and All-Source Analysis System, the Navy's AV-8B and FA-18C/D aircraft, and the Air Force's Mission Support System and Rapid Application of Air Power System. Modifications are needed for those systems because the systems were designed before DMA developed the specification for ARC Digitized Raster Graphics products. During 1994, DMA obtained agreement from the MC&G community for a new product, Compressed ARC Digitized Raster Graphics, which reduces the need to modify formats for ARC Digitized Raster Graphics products. With the Air Force's technical expertise, DMA developed the Compressed ARC Digitized Raster Graphics product to eventually replace the ARC Digitized Raster Graphics product. With some exceptions, the Military Departments will use Compressed ARC Digitized Raster Graphics products in those systems that require modified versions of ARC Digitized Raster Graphics products. Until they are obsolete, certain systems, such as the AV-8B aircraft, that cannot use Compressed ARC Digitized Raster Graphics products will continue using modified versions of ARC Digitized Raster Graphics products.

Interoperable Map Software. In response to the memorandum, "Map Display Systems," February 7, 1994, from the Assistant Secretary of Defense (Command, Control, Communications and Intelligence), DMA developed a plan for acquiring, certifying, and using standard map exploitation software and algorithms. Map exploitation software is software designed for the manipulation and display of MC&G information. Map exploitation algorithms are mathematical rules or procedures for solving a specific problem or for providing a specific software function or routine. DMA previously had not been active in establishing user-oriented standards for exploiting MC&G data. According to DMA's draft concept of operations, "Interoperable Map Software," May 26, 1994, DMA plans to use the expertise of the MC&G community in developing the exploitation software and algorithms. DMA estimated that standard exploitation software and algorithms would be developed by FY 1996. The standard exploitation software and algorithms will reduce the proliferation of redundant software and algorithms, reduce training costs, and increase interoperability.

DMA's Future Way of Doing Business. The increasing reliance by the Military Departments and the Joint Staff on digital data and the diminishing reliance on paper products requires that DMA change the way it does business. In reducing its reliance on paper products, DMA intends to develop and maintain a data base of worldwide digital information. DMA's focus on global, digital information will enable DMA to provide the MC&G support needed by the Joint Staff's Command, Control, Communications, Computers, and

[7]Equal Arc Second Raster Chart/Map

Intelligence for the Warrior concept.[8] To ensure that digital MC&G data are interoperable, DMA should continue to develop standards for digital MC&G data, and the Military Departments and the Joint Staff should continue to implement the standards. To manage the change in business orientation, DMA has drafted an internal operations concept for the future, a description of the architecture needed to support future operations, and milestones for developing the changed business orientation.

Perspective of the MC&G Community on DMA's Standardization Efforts. Officials responsible for MC&G matters in the Joint Staff, the Military Departments, and the Defense Information Systems Agency were generally satisfied with DMA's progress in standardizing digital MC&G data. Those officials were especially pleased with DMA's standardization efforts and the results of the MC&G Joint Interoperability Board and Geospatial Standards Management Committee since 1993. Officials considered the MC&G Joint Interoperability Board and Geospatial Standards Management Committee good forums for discussion and resolution of MC&G issues. In addition, strong leadership by DMA officials and members of the MC&G Joint Interoperability Board and Geospatial Standards Management Committee had facilitated developing solutions for key MC&G issues.

Management Comments

We provided a draft of this report to the Defense Mapping Agency on November 17, 1994. Because the report contains no findings or recommendations, no comments were required and none were received. Therefore we are publishing this memorandum report in final form.

The courtesies extended to the audit staff are appreciated. If you have any questions on the audit, please contact Mr. Charles Santoni, Audit Program Director, at (703) 604-9556 (DSN 664-9556) or Mr. John Mundell, Audit Project Manager, at (703) 604-9508 (DSN 664-9508). The distribution of this report is listed in Enclosure 4. The audit team members are listed inside the back cover.

Robert J. Lieberman
Assistant Inspector General
for Auditing

Enclosures

[8]The objective of the Joint Staff's Command, Control, Communications, Computers, and Intelligence for the Warrior concept is to have a joint task force that is functionally integrated and interoperable. The use of standard data of all types, including digital MC&G data, is a key factor in ensuring forces are integrated and interoperable.

Defense Mapping Agency's Responsibilities for the Defense Standardization Program

Defense Mapping Agency Mission. DMA provides support to the Office of the Secretary of Defense, Military Departments, Joint Staff, unified commands, Defense agencies, and other Federal Departments and Agencies on MC&G matters. As part of its mission, DMA produces digital MC&G data and products. The Assistant Secretary of Defense (Command, Control, Communications and Intelligence) provides direction, authority, and control over DMA.

Purpose of the Defense Standardization Program. DoD Manual 4120.3-M prescribes the policies and procedures for implementing the Defense Standardization Program. Public Law 82-436 requires DoD to establish, publish, review, and revise specifications and standards. The objectives of the Defense Standardization Program include:

o improved operational readiness of the Military Departments and the Defense agencies,

o improved quality, reliability, maintainability, and safety of systems and items of supply, and

o enhanced interchangeability and interoperability of equipment and supplies between the Military Departments and the Defense agencies.

Establishing MC&G Technology as a Standardization Area. During the 1980's, DoD recognized that additional emphasis was needed on the standardization of MC&G digital data. In 1987, the Joint Staff's Joint Requirements Oversight Council determined that DoD did not have military standards for digital MC&G data. The Joint Requirements Oversight Council recommended to the Office of the Secretary of Defense that DMA lead the DoD standardization effort for digital MC&G data. On November 1, 1989, the Defense Quality and Standardization Office, Office of the Assistant Secretary of Defense (Production and Logistics), now the Assistant Secretary of Defense (Economic Security), established MC&G technology as a standardization area and designated DMA as the Lead Standardization Activity for MC&G technology.

DMA's Responsibilities as Lead Standardization Activity. As Lead Standardization Activity, DMA is responsible for managing and coordinating all standardization actions for the MC&G technology area. The MC&G technology area includes procedures, methods, techniques, and documents for gathering, analyzing, and documenting MC&G information. The MC&G technology area also includes product-oriented standards for displaying MC&G data, user-oriented standards for exploiting MC&G data, and sustainment standards for maintaining current MC&G data.

Digital Mapping, Charting, and Geodesy Specifications and Standards

As of September 20, 1994, DMA had published the digital MC&G specifications and standards listed in Table 2-1. In addition, DMA was developing the draft specifications and standards listed in Table 2-2.

Table 2-1. Completed Digital MC&G Specifications and Standards

Specification or Standard Number	Title	Effective Date
MIL-A-89007	ARC Digital Raster Graphics	February 22, 1990
MIL-D-89009	Digital Chart of the World	April 13, 1992
MIL-D-89010	Digital Bathymetric Data Base	March 4, 1994
MIL-D-89011	Digital Cities Data Base	July 2, 1990
MIL-W-89012	World Vector Shoreline	July 27, 1990
MIL-R-89013	Relocatable Target Assessment Data	April 13, 1990
MIL-I-89014	Interim Terrain Data/Planning Interim Terrain Data	November 30, 1990
MIL-F-89018	Firefinder Elevation Data	October 1, 1992
MIL-D-89020	Digital Terrain Elevation Data Levels I and II	May 28, 1993
MIL-STD-600006	Vector Product Format Standard	April 13, 1992

Table 2-2. Draft Digital MC&G Specifications and Standards

Specification or Standard Number	Title	Estimated Date of Publication
MIL-T-89002	Terrain Contour Mapping	December 1994
MIL-D-89005	Digital Feature Analysis Data Base Level I	February 1995
MIL-D-89006	Digital Feature Analysis Data Base Level II	February 1995
MIL-D-89017	Digital Feature Analysis Data Base Levels IC and IIIC	February 1995

Table 2-2. Draft Digital MC&G Specifications and Standards (cont'd)

Specification or Standard Number	Title	Estimated Date of Publication
MIL-D-89023	Digital Nautical Chart	TBD*
MIL-D-89030	Digital Gazetteer	TBD
MIL-V-89032	Vector Smart Map Level II	TBD
MIL-V-89033	Vector Smart Map Level I	December 1994
MIL-D-89034	Digital Point Positioning Data Base	TBD
MIL-D-89035	Digital Sailing Directions	TBD
MIL-U-89036	Urban Vector Map	TBD
MIL-C-89038	Compressed ARC Digital Raster Graphics	December 1994
MIL-C-89040	Vector Product Interim Terrain Data	TBD
MIL-C-89041	Controlled Image Base	TBD
MIL-STD-2400	Text Products Format	TBD
MIL-STD-2407	Vector Product Format (Second Edition)	May 1995
MIL-STD-2411	Raster Product Format	December 1994
MIL-STD-2411-1	Registered Data Values for Raster Product Format	December 1994
MIL-STD-2411-2	Integration of Raster Product Format Files into National Imagery Transmission Format	December 1994

*To Be Determined

Organizations Visited or Contacted

Office of the Secretary of Defense

Assistant Secretary of Defense (Command, Control, Communications and Intelligence), Washington, DC
Assistant Secretary of Defense (Economic Security), Washington, DC

Department of the Army

Assistant Chief of Staff for Intelligence, Washington, DC
Topographic Engineering Center, U.S. Army Corps of Engineers, Fort Belvoir, VA

Department of the Navy

Oceanographer of the Navy, Washington, DC
U.S. Marine Corps Intelligence Activity, Quantico Marine Corps Base, VA

Department of the Air Force

Deputy Chief of Staff for Intelligence, Washington, DC
497th Intelligence Group, Washington, DC

Joint Staff

Office of the Director for Operations (J-3), Washington, DC
Office of the Director for Command, Control, Communications, and Computer Systems (J-6), Washington, DC

Defense Agencies

Central Imagery Office, Vienna, VA
Joint Interoperability Engineering Office, Defense Information Systems Agency, Reston, VA
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