PA

DMA Defense '88
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That long-heralded, ultra-sophisticated computerized future of the 1990s is here now at the Defense Mapping Agency, where a massive conversion to all-digital operation is underway. When operational, DMA's thousands of map products will be provided to operational commands in digital form, suitable for on-site manipulation and addition of real-time intelligence and battlefield analysis.

This effort will not succeed without complete understanding and intensive coordination between DMA and users of DMA products. The Military Services will have access to a myriad of commercial and special hardware which will consume enormous quantities of DMA data. Matching this hardware with digital mapping, charting and geodetic (MC&G) data from DMA will require extensive education and significant effort by DMA, the Services and weapons systems developers.

DMA has inaugurated a "Rapid Demo" effort to acquaint users with DMA capabilities -- and limitations -- and the critical requirement for standardization of data and ancillary software. A series of in-house work sessions and on-site briefings at various commands is being scheduled. This effort is directed at preventing detrimental duplication, loss of interoperability, and impractical requirements. The massive, almost unfathomable amounts of data required demand an understanding of the problem and efforts underway to meet these demands.

Some five years ago, DMA entered into a decade-long conversion effort, known as its "Exploitation Modernization Program." This program is designed to phase out its highly labor-intensive method of production of maps, charts

and data in favor of an all digital production plant. The program, supported at all levels of OSD and by the Congress, will revolutionize both the generation and distribution of the numerous MC&G products required by today's armed forces.

The most revolutionary development in mapmaking since the advent of photogrammetry, this effort, which we have designated as Mark 90, will place massive amounts of digitized information from DMA data bases directly in the hands of military elements at all levels -- from command posts, to aircraft cockpits, to combat control centers of warships, to the turrets of tanks and operational elements of combat commanders at in the field.

It is, clearly, vital that these digital maps and charts "match up" in all respects, in scale and degree of detail, and accuracy -- as well as in "registration," or pin-point location of geographic coordinates of points on the surface of the Earth.

DMA's Mark 90 program will reduce our response time by about 75 percent. That is, we will be able to produce or update standard map/chart products in about one-fourth of present production time.

Rapid dissemination of this detailed, digital data is particularly critical given the Defense Mapping Agency's increasingly significant role in crisis support. Today, operational commands rely on DMA maps, charts and digital data to plan and execute rapid response to unexpected challenges --such as the Libyan raid, operations in the Persian Gulf in the face of Silkworm missile and minefield threats, and other less visible crises in the past year.

The risk of another Granada type situation is greatly reduced -- where military elements could not communicate because of incompatible radio frequencies, or where paper maps of limited utility were not available for the first

72 hours.

Consider a situation where ground forces are working from digital map information displayed on an "Army" set of hardware and/or software. Air Force supporting aircraft are using different frames of reference, while off-shore Navy directed artillery support comes from yet a different set of specifications.

Unreal? No. Such a scenario is only too possible in today's environment, where the exploding development of highly sophisticated off the shelf hardware, in dozens of forms, is already at the disposal or even already acquired by military system operators -- often with unfounded assurances from the vendor that this gear is capable of utilizing digital data generated by the Defense Mapping Agency.

Following Granada, where the Defense Mapping Agency was not put in the picture until the operation was virtually underway, new procedures formalized DMA participation in early planning for all future operations. It is now vital to ensure that DMA's expertise is included on the drawing board for tomorrow's weapons systems, all of which must use DMA's digital data to ensure effective positioning, guidance and pin-point targeting.

The Air Force is developing systems to display digital maps in cockpits, as well as digital-based training simulators. There's potential for TERCOM (terrain matching) navigation systems -- such as now used in cruise missile guidance -- in cockpits for low-level flight operations. Navy aeronautical systems as well are rapidly moving into the digital arena, while digital navigation charts are upcoming. Digitized versions of terrain analysis data as well as a wide variety of other digital map data are high on the Army's agenda.

Additionally, some intelligence systems that use reconnaissance imagery

require digital map backgrounds to underlay the digital imagery. They also require these digital backgrounds on which to apply intelligence data, mission planning information, logistics tracking data and real time target positioning, once points of interest have been identified.

These growing requirements of the services are staggering. Within the last 18 months, the Air Force has requested digital high resolution products that would require more than 1,000 manyears of DMA effort. The Army projects requirements for extensive coverage at 1:50,000 scale that could result in more than 30,000 manyears of DMA effort. The Navy's growth projections are similar to those of the Air Force.

Even though these initial requirements, obviously, need examination and refinement, the implications are clear: DMA must evolve a new suite of digital products designed to satisfy these emerging requirements and direct its development and production energy towards producing them, rapidly.

For it is apparent that today's Armed Services are moving from a future limited by hardware technology to a "data limited" future. With today's high speed storage and processing capabilities, it may very well be that availability of comprehensive data bases produced by the Defense Mapping Agency will be the pacing factor in weapons system design, navigation system development and implementation of scores of systems now in process.

It is to meet this very real and immediate challenge that we have broken down implementation of DMA's "modernization" effort into two phases -- Mark 85 and Mark 90. Digital products developed for DMA "customers" from these conversion efforts will be distributed in two designations -- Mark 85.1 and Mark 90.1. The Mark 85 conversion phase, currently moving on schedule, incorporates near-term upgrades to our production system. It has brought installation of some 150 stereo feature extraction workstations and another

60 multifunctional workstations are already delivered and on line.

However, Mark 85 production is still generated largely from traditional photographic source information -- on paper or on film -- which is then digitized to match the newer production processes now coming on line. Mark 90, in turn, will be entirely digital, from source acquisition, through manipulation, storage and dissemination of this data to the field.

Of immediate concern to users of DMA products and data is what we term the Mark 85.1 program. MC&G information in the time frame between now and the end of this decade will be distributed on varied media, such as magnetic tape, floppy disk, video and optical disks. At the same time, DMA's annual production of some 50 million paper maps, charts and other information, will continue -- but with upgraded, computerized distibution and accounting systems.

However, under the Mark 85.1 initiative, a new family of both digitized and digital products will be distributed. Existing DMA paper products will be digitized or "video-ized" and various storage media, to meet the requirements of the user community, will consist primarily of videodisk, high density tape and, most significantly, optical disks such as the CD ROM.

The latter affords the most effective practicable capability. Today's normal distibution media, the 1600 bpi magnetic tape, contains approximately ten 60 by 60 nautical mile cells of digital data, while the CD ROM can store more than 225 cells.

While DMA's two primary data bases -- Digital Terrain Elevation Data (DTED) and Digital Feature Analysis Data (DFAD) -- are digital products, most additional near-term production will be digitized versions of existing paper products. These will be of the same scale and accuracy as the original maps or charts.

An exception is for the Terrain Analysis mylar overlays, where direct digital production is being developed for Army use. Similarly, we are studying direct digital production for Air Force and Navy high resolution data requirements.

A prototype Tactical Terrain Data (TTD) product is now being demonstrated to the Services. Point Positioning Data Bases (PPDB), comprised of digital imagery, are in development. These imagery based products are vital to targeting and other operations requiring extremely accurate coordinates.

The TTD prototype, which covers an area around Ft. Hood, Texas, goes beyond the Digital Land Mass System (DLMS) data base now produced by DMA to provide a "baseline" map rendition upon which battlefield commanders may rapidly overlay the additional local, tactical information vital to support the mobility and quick reaction inherent in today's Army doctrine.

Another DMA initiative has put some 30 videodisks on its product list. These include one world map disk with small scale coverage and 36 regional disks with large, medium and small scale coverage. The disks may be used in the field on several different hardware systems.

It is this distribution of maps and charts in digital and electronic (video) form that is the heart of the Mark 85.1 effort. DMA proposes to distibute raster versions of these products with eight bits each of red, green and blue information on CD ROM. This process captures a map as a digital raster image in its original projection and coordinate system. DMA transforms the raster images at predetermined geographic coordinates, yielding a seamless gridded product, where edges match. Continuous moving map displays on CRTs are supported by these products: overlaps between paper maps have been eliminated, tick marks have been aligned, and the world-wide system is gridded to the World Geodetic System 84. An initial user of this so called "ARC-based Digital Raster Graphic" data is the moving map display

display display for the AV-8B, F-18 and V-22 aircraft.

DMA's Mark 85.1 initiative acknowledges that DMA "customers" are increasingly aware of the current revolution in hardware availability, that customers have growing needs to work with higher resolution products in some areas and that these users of DMA data are already becoming ever more involved in auxiliary MC&G tasks in the field, such as critical point positioning, prediction and simulation support.

DMA has underway a wide variety of efforts to ensure an appropriate transition into the Mark 90 mode. With initial Mark 90 producted anticipated in 1992, the Mark 85 and Mark 85.1 initiatives satisfy immediate requirements for digital information. More importantly, they will lay the groundwork for an orderly transition into the Mark 90 era of all-digital source, product generation and disemmination of digital products into the field.

The emerging Mark 90 data base to be developed by the Defense Mapping Agency will be huge, in the order of one hundred million gigabits, or 10 to the 17th power -- or, more graphically, will contain more information than is stored in 400 million college textbooks. Information from this base then may be extracted selectively by DMA to meet unique requirements of individual weapons systems or DoD operational elements.

In the mid-'90s, DMA's Mark 90.1 initiatives will transmit high volume digital data with rapid retrieval software on CD ROM or other high density media for field utilization and manipulation. This data can be updated by local tactical intelligence supplemented by additional updates as applicable from DMA via high-speed landline or satellite transmission.

A significant element of the Mark 90.1 concept is the concept of "value adding," which can enhance tremendously the utility of digital MC&G products by user commands. Operators in the field have a growing capability to enhance

basic DMA geographic data with additional detail -- such as more accurate feature detail and positioning, and, of course, local intelligence information. Return of the updated MC&G information to DMA will be vital. Upon verification and rectification, the upgraded information may be rapidly transmitted to other users around the world.

Here again, the standardization is critical -- the ground commander, his air support and his intelligence resources must be playing from the same sheet of music at all times. This can only be assured through adoption of and conformance with rigorous data specifications.

At the same time, DMA will design a deployable integrated scheme for regionally organizing MC&G information and imagery for user applications in the field with ease of access for the operator.

As a subset of the available Mark 90.1 data dissemination effort, a major new Deployable Digital Data Base (D^3B) will incorporate layering and regionalizing resource material, including both stereoscopic and monoscopic imagery in digital or digitized form on high density media, again most likely the CD ROM. The "layers" in the D^3B product may include digitized DTED and DFAD, Digital PPDB, place names data and Symbolized Graphics Data (SGD) data, which includes symbolization, graphic text, and other information necessary for rapid human visual interpretation of map and chart representations. Any or all elements may be called up on demand in the field.

Additional software will permit interactive geographic information display, generation of perspective scenes and additional elevation extraction software -- such as Vertical Obstruction Data (VOD) and others.

To print out paper versions of this data, a deployable version of a Quick Response Multicolor Printer (QRMP) is being designed by the Army's Engineering Topo Lab to take digital data and rapidly produce full-sized

"xerographic" color copies of maps or other large products, for local distribution. Other printing capabilities are being explored.

Most importantly, DMA will provide guidance for emerging products and prototypes and standards, with specifications for the digital hardware and softrware of the 90s.

DMA has conducted an initial symposium for military department users of our MC&G data and further dialogue in this area was a major element of the 1987 DoD MC&G Conference last fall.

Additionally, I have written all major commanders with a two-part request: First, I offered to send DMA briefers into the field to discuss Mark 90.1, issues involved in standardization and high resolution data, and DMA's overall R&D efforts. Second, I have proposed that DMA, the Services and the CINCs establish a Senior Officer Steering Committee to review Mark 90.1 development at DMA, coordinate related developments in the Services, and ensure that both encompass the needs of the ultimate users.

While Mark 90 will at least double DMA's output of our most critical products, a mismatch between requirements of the Services and the capabilities of the Defense Mapping Agency will continue into the late '90s. The degree of this mismatch depends upon the appetite of new weapons for DMA data. All indications are that their appetite will be considerable.

We are undertaking several efforts to alleviate the requirements mismatch. These include a general requirements scrub. We have asked the user community to give their needs a thorough scrub, even to the extent of starting from a zero baseline. Results are encouraging: while 1986 requirements grew some $170 million, this year requirements dropped $25 million from the prior year's level.

Further, we have emphasized the need for all military users of DMA

products to prioritize carefully their real needs. DMA will produce to those priorities.

Third, and perhaps most significantly, we have urged all military users of DMA's products and data to employ digital MC&G exchange standards. Any new data base, even with moderate levels of detail, can cost several hundred million dollars. Data beyond DMA standard sets will be required for emerging smart and brilliant weapons systems. We must collectively define the minimum number of new data bases capable of supporting many systems within the DoD community. We must look at our requirements in a global sense, from which DMA distills the minimum data needed. We just cannot afford to create and maintain system-unique data.

This past August, the Joint Requirements Oversight Council of the JCS gave its go-ahead to Military Standards as a tool to control proliferation of digital MC&G solutions, and the first of these MIL-STDS should appear shortly.

A revision to DoD acquisition directives issued last September, caused programmatic steps to be inserted to assure closure between MC&G data bases and parameters of systems under development. System managers will have to use standard data, formats and media, or demonstrate the need for -- and fund -- unique solutions.

Certainly, difficult and even disagreeable decisions are facing both the Agency and military users of DMA products. As director of the Defense Mapping Agency I am charged with making many of these decisions -- and will do so.

But we are all in this together. Effective communications between DMA and supporting and supported organizations are key to decisions that mesh our mutual interests.

Within constrained resources and ever increasing requirements, we at DMA are incorporating increasing knowledge of the user community, better use of the total MC&G support system and every technological trick at our disposal to provide timely, tailored information to our combat commanders, who must have this data to effectively employ their forces and associated navigation, weapons, and command and control systems.

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