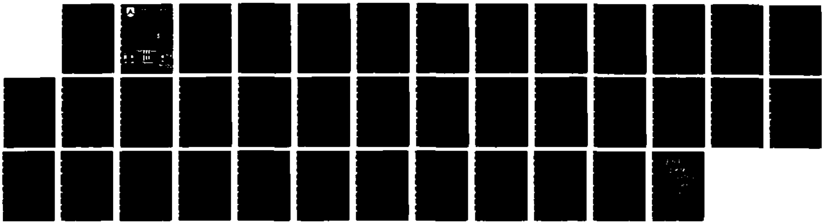
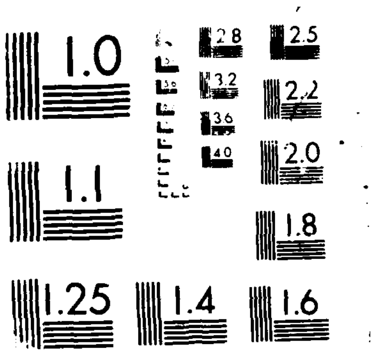
AD-A186 656 THE DEFENSE MAPPING AGENCY INTO THE 21ST CENTURY(U) AIR WAR COLL MAXWELL AFB AL J GOINES MAY 87 AU-AWC-87-076 1/1

UNCLASSIFIED F/G 8/2 NL





RESOLUTION TEST CHART

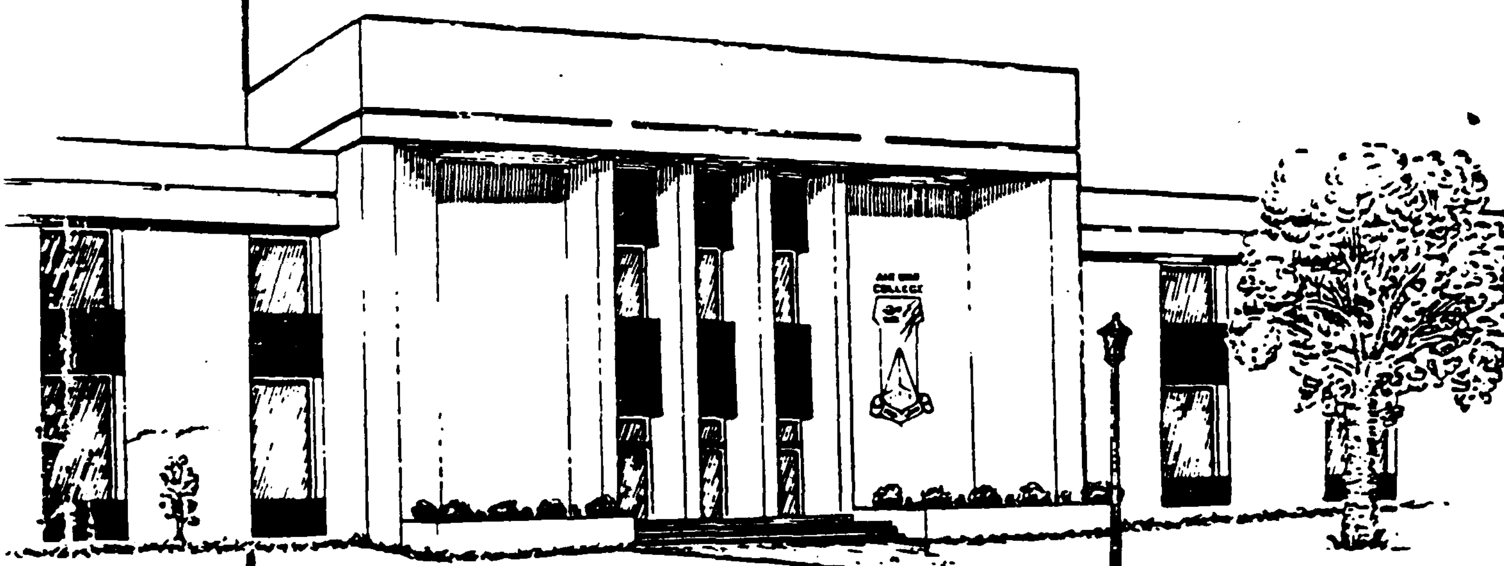
AIR WAR COLLEGE

RESEARCH REPORT

No. AU-AWC-87-076

THE DEFENSE MAPPING AGENCY INTO THE 21st CENTURY

By JOE GOINES, JR.



AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

87 11 27 130

AIR WAR COLLEGE

AIR UNIVERSITY

THE DEFENSE MAPPING AGENCY INTO THE 21st CENTURY

by

Joe Goines, Jr.

A Research Report Submitted to the Faculty

in

Fulfillment of the Research

Requirement

Thesis Advisor: Dr. Elizabeth Pickering

Technical Advisor: Col Charles Fuller

Maxwell Air Force Base, Alabama

May 1987

DISCLAIMER-ABSTAINER

THE DEFENSE MAPPING AGENCY INTO THE 21ST CENTURY

ABSTRACT

The rapid growth of technology and its impact upon weapon systems developed and deployed into the 21st century is a key issue for armed forces planners. Similiarly, Defense Mapping Agency (DMA) planners must also be concerned. The Agency currently provides comprehensive Mapping, Charting, and Geodesy (MC&G) support for all major branches of the armed forces. If DMA is to maintain its role as the unique provider of MC&G support into the 21st century, capability development decisions must be made now. Presently, in the weapon systems and MC&G commumities, much emphasis is being placed upon exotic high technology weapons and their MC&G requirements. This paper will attempt to place in perspective the glamorous offerings of technology and the developing trends in conventional warfare that will probably lead to a continued requirement for the Agency's conventional MC&G data base products well into the 21st century.

BIOGRAPHY

The author is currently a resident of St. Louis, Missouri and has lived there since 1966. A native of Louisiana, he came to St. Louis in 1966, immediately following receipt of his undergraduate degree from Southern University in Baton Rouge, La. In 1970, he earned a MS degree in Photogrammetry from the University of Illinois. Since his arrival in St Louis, Mr. Goines has been employed by the Defense Mapping Agency Aerospace Center (DMAAC). His career to date, has been expended in support of DMAAC's analytical photogrammetric control generation process and digital data programs. Prior to comming to the Air War College, he was chief of the Digital Products Department Techniques Office. This office provides the technical support required for the collection, processing, and reduction of the analytically derived planimetric and topographic digital data essiential to the mapping and charting process. The author is married to the former Eleanor Grimes of Jackson, Tennessee and they are the proud parents of three lovely children.

Table of Contents

CHAPTER I

INTRODUCTION

A. Purpose

The rapid growth of technology and its anticipated impact upon weapon systems developed and deployed into the 21st Century is a key issue for armed forces planners. Similarly, Defense Mapping Agency (DMA) planners must also be concerned. DMA currently provides comprehensive Mapping, Charting, and Geodesy (MC&G) support for all four branches of the armed forces. If DMA is to maintain its role as the premier provider of MC&G combat support into the 21st Century, capability development decisions must be made now. While the bulk of the decisions for weapon systems development and deployment may occur without DMA's input being the prime argument, DMA does have a key role to play. Technology will undoubtedly shape the battlefield of the future and create new product requirements for DMA, but while this happens, non-nuclear capability must also be maintained and enhanced. Combat support products for non-nuclear conflicts have been and will continue to be DMA's forte. This paper takes a look at trends in warfare and technology, and their expected impact on weapon systems and attempts to correlate these developments into potential broad based policy guidance for DMA.

B. Background

DMA was created in 1972 for the purpose of combining the MC&G functions of the services into a single, cost effective entity and to create the capability for better utilization of very rapidly improving computer technology. This effort combined the Aeronautical Chart and Information Center of the Air Force at St. Louis, Mo. with the Navy's Hydrographic Mapping and Charting Center and the Army's Topographic Mapping and Charting Center both located at Brookmont, Md.

Today DMA is responsible for all MC&G requirements and developments for the Joint Chiefs of Staff, the military departments, and other DoD components, as well as other government agencies and the merchant marine. All production and distribution of both hardcopy and digital MC&G products are under the direction of DMA.

C. Scope

The United States Air Force (USAF) has been since its creation some 40 years ago, the 'high technology' service. This kind of force structure requires large Research Development Test and Evaluation (RDT&E) expenditures. Today's USAF has the services' largest Research and Development (R&D) budgets (10,38). As a result, there is much in the military literature regarding the efforts of

USAF to manage the development of its combat arms capability to take maximum advantage of rapidly advancing technology. Although the other services do engage in their individual R&D as well as work some problems jointly with the USAF, the preponderance of material available deals with Air Force R&D initiatives.

This paper will concentrate on the United States Army (USA) and USAF plans for their transition into the 21st century and how these plans will impact upon DMA. Air Land Battle requirements will be discussed from both the USA and USAF perspectives because of the significance of the potential volume of their demands on DMA.

Security classifications will also limit the scope of this investigation. To avoid any potential for problems in this arena, this paper will only generically address those high technology developments found in the literature and their potential correlation to requirements for DMA.

CHAPTER II

WARFARE

A. The Soviet Threat Today

Over the past four decades, we have expended a significant portion of our national budget to support a national strategy designed to counter the Soviet threat. However, there is growing concern about the lack of emphasis being placed on the development, maintenance, and deployment of an appropriate force structure for isolated, small scale non-nuclear conflicts. Force planners and policy makers are only slowly coming to grips with the realities of a changed political and military environment. While our research and development continues to be focused on the high-intensity warfare contingency, some experts consider this the least probable of scenarios (19,41-43). Such arguments are generally based on our inability to effectively counter recent Soviet initiatives in Africa, Latin America, Afganistan, and other Third World areas. And while the Soviet threat to NATO countries may not have diminished, existing evidence clearly indicates the development of a Soviet strategy designed to utilize proxy and surrogate forces to exploit situations in the Third World.

The strategic force planners of today are in unenviable positions and their jobs are likely to become even more complex. Continual problems of budget, public will, treaties, foreign policy, politics, and the like make Strategic planning for the Soviet Threat difficult. However, these same issues when coupled with the volatile, and unpredictable nature of lower level conflicts, create a veritable pandora's box for the force planner. The travel and communications advances that make this such a small world also create many new opportunities for the creation and escalation of conflict. In the very near future, travel times will be expressed in minutes rather than the months, weeks, or days of years gone by, or even the hours of today. Daily, the media gives overwhelming evidence that there will be little change in the attitudes and behaviors of the peoples that inhabit the globe. Religious prejudice, ethnic differences, cultural traditions, and economic conditions are, and will continue as significant factors, for relationships between nations and peoples. The sensitive and inflammatory nature of these factors when coupled with increased proximity and communication, will bring increased potential for exacerbating existing tenuous conditions and escalating them into serious conflicts for which we have no contigency plans.

Low intensity conflict (LIC), insurgency, and state sponsored terrorism are just a few of the terms used by the media and military experts to describe the kinds of warfare that have been on the increase over the last 20 years. Such hostilities have become even more widespread in the 80's and a trend appears. LIC and state sponsored terrorism constantly surface in today's news. The Honorable Newt Gingrich (Rep, Georgia) predicts that this trend will continue . His rationale is "The simple fact is the Soviet Empire and its colonies have studied the West and have come to the conclusion that our greatest vulnerability is in low intensity conflict. In this type of conflict, the Soviet Union suffers little if its client is defeated but gains greatly if its client wins." (4,ix).

B. The Threat into the 21st Century

Without question, East - West tensions and Third World problems will continue as we evolve into the 21st century. The Soviet threat as perceived by the West will probably still be countered by some form of deterrence based on an arsenal of high technology weaponry. The defense community and civilian military experts widely expect that technological developments will dominate the battlefield of the future (3,47).

In our endeavors to counter the Soviet threat at the superpower to superpower level, the strong probability of increased LIC must not be overlooked. It is highly probable that the next century's battles will be played out in this arena. The feared East - West confrontations could take place in peripheral arenas, often with the use of proxy forces employing 80's type weapon systems (11,178). As force planners pursue the development of the more exotic weapon systems made possible and appealing by technology, our capability to support non-nuclear warfare must also be maintained. A conscious effort must be put forth to ensure that technology is also used to enhance conventional weapon systems and combat support. For example, DMA currently provides a field deployable data base that supports targeting in the field. The application of expected advances in technology could result in field deployable digital data bases offering more capability and greater efficiency.

CHAPTER III

TECHNOLOGY AND WEAPONS SYSTEMS

A. United States Air Force and Technology

The high technology developments necessary for Electronic Warfare (EW) in the next century are being pursued with vigor and high finance today. The bulk of this development is being pursued with emphasis on countering the Soviet threat. Formidable modern weapon systems are being developed to the extent that today's sci-fi will become reality in the 21st century. Brown (3,49) suggests that perhaps the most significant development that will affect weapon systems of the next century is the Very High Speed Integrated Chip (VHSIC). Low Level Laser Guided Bombs (LLLGB), TOW, Patriot, and Hellfire missiles are just a few of the types of weapon systems expected to benefit from VHSIC developments.

USAF maintains RDT&E facilities world wide and has always vigorously pursued the application of technology to its weapon systems. Air Force Systems Command (AFSC) is responsible for identifying research objectives, and the work is carried out by the Air Force Office of Scientific Research (AFOSR). The recent AFOSR report 'FORECAST II', gives a detailed account of the significant technological developments that will be pursued to provide for our common defense into the 21st century. In addition, the military literature is filled with promises of other technological advances that will also create the need to upgrade existing weapon systems or create altogether new weapon systems for the 90's as well.

Sensor image technology and micro computer technology will continue to develop into the 21st century. Large phased array satellites will significantly improve navigation and communication capabilities. Major advances in sensor technologies are predicted across the entire electromagnetic spectrum, particularly in the area of infrared and millimeter waves, and in laser radar (17,64-65). Likewise in the world of computers, major improvements are expected in integrated circuitry (VHSIC and VLSI) and storage media (optical disks, bubble memory, etc). Advances in these areas are expected to yield big returns in the technologies of information, computation and display. All of these developments are key factors in improving data base capability for battlefield management and communications.

FORECAST II envisions the preceding technology coming together in a 'super cockpit' of the future to present flight information to the pilot in a new and unusual way

(17,65). The pilot will see computer generated three-dimensional color graphics in panoramic detail right on the inside of his helmet screen. Real time information will be provided about everything he needs to know: terrain, friendly aircraft and enemy aircraft, enemy anti-aircraft missile silos, targets and the safest flight paths for entry and exit. This clearly translates into a new requirement for more deployable digital cartographic data base support from DMA.

The future will also certainly create a demand for realistic integrated sensor simulation scenes for training, research, and planning. General Electric has already developed a prototype SAR (Synthetic Aperture Radar) and Electronic Tactical Map for such purposes. As other spectral sensors evolve (infra red, electronic warfare, signal processing, electronic intelligence sensors, thermal, force, torque, tactile range, proximity sensors, etc) they too can be expected to be integral parts of DMA data base requirements.

The battlefield management area is also expected to benefit from the VHSIC technology based advances in information, computation and display technologies (17,66). These advances should result in very realistic, modern battlefield management systems for strategic, tactical and space systems operations. These systems will also have as their basic data set deployable interactive three dimensional cartographic data bases from DMA.

Synthetic Aperture Radar (SAR) is a prime example of the rapidly maturing image sensor technologies that have import to weapon system developers and DMA. In addition to its applications for intelligence, and target identification and location, SAR has tremendous potential as a mapping source. Since LIC sometimes occurs in areas that are poorly mapped, SAR provides an excellent source for the quick approximate topographic mapping of such areas (4,165).

Optical and electro-optical sensor systems operate in the visible spectrum and are encumbered by foul weather, foilage and or snow cover. Such systems are not only dependent upon near perfect sunshine, but the sun angle itself is critical for successfully acquiring imagery that can be used for mapping and charting. Adverse conditions exist to the extent that some key areas of the world cannot be mapped using these techniques. SAR provides an almost 'all condition' capability that could fill this void.

Recent technical developments have greatly improved the potential of radar as a source for mapping and charting (12,50). Key among these have been the advent of digital signal processing and the maturity of side looking radar systems. Digital returns of these advanced radar systems can usually be processed using general purpose image processing systems and require no unique electro-optical-mechanical viewing systems. Side looking radar systems, employing fixed antennas that are moved through the air or space via their platforms, have become very popular. Of this type radar, SAR appears to offer the most potential for mapping and charting. In addition to its capability in adverse conditions, SAR offers a significant ground resolution which can be better than 0.5 meters (12,51). This tremendous ground resolution, a critical parameter for mapping and charting, makes SAR a valuable source for DMA. SAR systems are unlike electro-optical sensor systems where focal length and flying heights are always issues because of their impact on the image-to-object relationship which translates into ground resolution. The ground resolution of SAR images are independent of the distance between the radar's source and the object of interest .

NASA has taken a lead role in the development and utilization of SAR systems and imagery. NASA researchers and other scientists have used images from NASA's 1984 Space Shuttle Imaging experiment (SIR B) to demonstrate successfully the potential of SAR as a mapping and charting source. DMA has also done some testing in this area, and with its newly acquired digital image processing capability, will be able to do much more. Techniques and equipment have been available for some time that demonstrate SAR's potential for exploitation as a mapping source, but additional work must be done soon if DMA is to generate precise mapping products from this source in the next decade.

B. United States Army and Technology

The Army began plans early in this decade for an Air Land Battle Environment (ALBE) that will translate into significant requirements for DMA in the 90's. This concept calls for a combination of Army and certain Air Force assets into a mobile integrated force that will allow the Army to change from its linear, attrition-style conflict to a more fluid battle fought in depth (1,58).

Research to support ALBE is being done by the US Army Engineer Topographic Laboratories (USAETL). USAETL's projects in automated analysis, computer assisted photo-interpretation, and environmental effects support the overall ALBE effort (6,470). USAETL's plans for this project, called the Digital Topographic Support System (DTSS), calls for deployment in the 1991 timeframe. DTSS is designed to give engineer terrain teams an automated capability for storing, updating, and processing digital topographic data.

USAETL further anticipates that the DTSS will provide support for other users such as the 'Firefinder' counter-artillery counter-mortar radar system. DTSS will give the users the ability to extract geographic data from various sensors and source materials and use this information to update terrain data bases provided by DMA. Another related USAETL project scheduled for deployment in the 90'S time frame is the Terrain Analyst Work Station (TAWS) (7,397). This system will use digital techniques to extract, interpret and display digital terrain data. TAWS will use recent advances in micro-computer technology, analytical photogrammetry, computer assisted photo-interpretation and geo-based information processes. USAETL anticipates that these technologies will also allow combat users to produce and update digital terrain data base information (again with reference digital data provided by DMA).

Ultimately, the effective implementation of ALBE will depend heavily upon USAF's capability to perform the close air support role and the ability of both services to exploit information available for battlefield management. One requisite for success in this endeavor is that the Army and Air Force view the same terrain from a common data base with flexible display capability. Currently, many of the products being produced by DMA come from requirement specific data bases that have limited commonality and flexibility.

Battlefield managers will also need an interactive data base that will accept input from a variety of different sensors. The impact to DMA for additional unique USAF and USA requirement specific data bases could prove overwhelming if these new requirements are permitted to materialize without constraint. Even with the expected improvements in DMA's production capability, DMA would be hard pressed to fill voluminous uncoordinated requests for various kinds of data base coverages over the same terrain. A universal input and storage format (an issue that is being pursued in DMA's technology upgrade programs), for example, makes for a more user friendly product and it eliminates the need for the creation and maintenance of several correlated data bases by DMA.

CHAPTER III

Defense Mapping Agency (DMA)

A. DMA Today

DMA's modernization efforts to upgrade its technology, and hence its capability to provide accurate and timely MC&G combat support information began in earnest during this decade. Technological advances and changes in the methodology of image sensing systems made available a digital image output that could not be optimally exploited by DMA. A two phased modernization approach was initiated. First, an augmentation of existing equipment was performed to yield improved capability for the exploitation of digital images by 1985 (Mark 85). The second upgrade (Mark 90), scheduled for the early 90's will involve the installation of an all new digital image production capability that should see DMA well into the 21st century.

Mark 85 gave DMA a limited capability to exploit available digital imagery in the creation of products for existing or new product requirements. Mark 85 was primarily a technological upgrade of an aged production capability by taking advantage of new, but proven off the shelf technology. Basically, computer hardware and software systems were upgraded and networked to facilitate performance of some of the more labor intensive tasks associated with the production of digital data. For example, the cartographer's daily production of the subsets of digital data required for a complete job can now be stored, sorted, edited, and merged at user friendly computer work stations. Previously, much of this work was performed using computer tapes as the storage medium in a cumbersome and time consuming process that required the cartographer to physically transport his data during the sort, merge, and edit process. In addition, Mark 85 ushered in 'configuration control' to ensure compatibility of production processes between its major production centers located in Brookmont, Md. and St. louis, Mo. and its several field offices around the country.

Weapon system support requirements to date have been relatively stable. As previously stated, the Mark 85 upgrade addressed an aging production capability and configuration control of that production process. At that point, technology had not impacted on weapon systems to the extent where DMA could not meet current product requirements. The digital image processing capability delivered by the Mark 85 upgrade does however, give DMA the capability to evaluate some of the current and planned digital output sensor systems for production support. DMA will now be able to investigate for example, improved SAR and other spectral image sensing systems for MC&G utility through the complete production process.

Presently, DMA produces a wide variety of digital and paper products for combat system support (20,18-20). Cruise missiles, whether launched from air, land or sea, ultimately require DMA generated digital terrain elevation data for precise guidance. Radar return scenes are developed for the Pershing II. Airborne Warning and Control Systems, the Navy's P-3's on submarine patrol, B52's and the ground hugging A-10's are all examples of weapon systems that require digital map products developed by DMA. Electronic navigation systems, targets, battlefield management systems, the space shuttle mission, and simulators for sophisticated trainers all function with DMA products. DMA also provides the gravity models required to support all forms of sea or land launched ICBM's and other long range inertial guidance systems.

B. DMA into the 21st Century

DMA's plans for the 90's (the aforementioned Mark 90 plans) are designed to take advantage of some of the same rapidly maturing technologies that will support weapon system requirements in the 90's. Knowledge based technology, advanced radar systems, improved computer circuits, new storage media and positioning systems will be vigorously pursued. As the technologies mature, new military applications will occur resulting in increased demands for digital data for planning and navigation (5,1-1 - 1-2):

- Ground based systems for use in weapons delivery, mobility planning, robotics and warfare planning.
- Airborne systems for use in manned and unmanned (missiles, drones) vehicles. This application is developing as a result of technology improvements (smaller size, capacity, speed).
- And for improving:
  - mission planning
  - navigation
  - terrain following/terrain avoidance
  - weapon delivery
  - sensor blending
  - post mission briefings
  - training/simulators

These kinds of developments will potentially impact weapon systems in such a way that new requirements will be generated for DMA; requirements that DMA will be able to satisfy with its modernized digital production base.

The service R&D laboratories exist to bridge the gap between technology and weapon systems. In the normal course of events, DMA also acquires from the laboratories the appropriate technology and the capability to support new weapon systems. However, because of the rapidity with which such developments are expected to mature in the next decade, DMA must be concerned and began its planning now. Although DMA's forte has been and probably will continue to be the digital cartographic data base, a plethora of requests for unique support will pose serious production rate problems. These potential problems have such serious implications that a new DoD directive has been issued to address this very subject (14,1). This new directive (DoD 5000.3) will require all DoD elements and new weapon system developers to include standard DMA data in the initial design of all systems - or "foot the bill" for conversion of DMA data to each special requirement.

The recently mandated emphasis on 'jointness' between the military services, and DoD Directive 5000.3 "Test and Evaluation" should have a significant impact upon DMA. These two new initiatives, coupled with a prior Secretary of Defense Program Decision Memorandum to the Military and

Defense Agencies requiring each service to fund its costs for unique MC&G support from DMA, will give DMA additional leverage in its endeavors to create a more uniform product specification.

This directive in and of itself does not eliminate all of the data base problems for DMA. Certainly as sensor and navigation systems improve, a newer more accurate kind of digital cartographic data will be required. The question is 'What should be the format of this new data base product?'. D.G.G. McNaughton, manager of technical support for Synercom's Canadian operation has given this subject considerable thought (13,266). Mr. McNaughton describes the desirable attributes of a Military Information Mapping System (MIMS) as follows:

- Be hardware upgradable
- not render existing data inaccessible by a redefinition of data base files
- feature data retrieval times that are independent of data base size
- feature a totally integrated graphic and non-graphic data base
- be economic in its use of permanent storage media
- feature definable graphic representations at display or output time

McNaughton's arguments although somewhat idealistic on the whole, have an irrefutable desirability. Expected advances in computer technology and storage media will enhance the attractiveness and viability of McNaughton's position. The successful development and implementation of such a concept would yield immeasurable benefits in cost and capability to DMA and DoD.

The National Geodetic Survey (NGS) has recently completed the development of a Multi Purpose Cadastral (MPC) with a spatially based Geographic Information System (GIS). Presently the system is designed for use by local governments for planning and analysis and does not meet military accuracy requirements (15,132). Conceptually however, the system warrants serious consideration. The idea of a multi purpose digital terrain data base on which additional cartographic information from a variety of sensors could be layered is certainly worth investigation by DMA.

The deployable digital cartographic data base will certainly survive into the 21st century. Peter F. McCloskey, president, Electronic Industries Association, predicts that in the years beyond 2005: 'Access to data bases envision the battlefield of the future where the commander knows the precise location of individual soldiers and the soldier will have his own device that will not only provide him with telecommunications, but also a video display of what he is looking at, buildings over the horizons, etc...'(8,18)

The military literature addressing the issue of combat into the 21st century abounds with references to the requirements for three-dimensional digital terrain data bases. This is done to the extent that there can be no doubt about the need for DMA generated products well into the 21st century. The challenge to DMA (as mentioned earlier in the MIMS discussion) will be the design and development of a universal data base that will have the longevity and flexibility to satisfy its many different customers.

CHAPTER V

SUMMARY

'Prediction is very difficult, especially about the future', Neils Bohr, philosopher.

The expected advances in sensors, micro computer technology, data storage and retrieval media will heavily influence the kinds of weapon systems deployed into the 21st century. With proper guidance, technology can have the same beneficial influence on the existing force structures available for LIC or limited conventional war. Such force structures must be mobile and capable of operating independently within a hostile theatre. Field deployable combat support will also be required for the planning, targeting, battlefield management and navigation functions necessary to support such force structures. This combat support will certainly include requirements for DMA's digital cartographic data bases. In addition to being deployable, these data bases will also need to be interactive and augmentable. The user will want to be able to update his data base with any and all available real time information that affect his environment and hence his chances for survival and mission success.

Linkages of high technology and weapon systems will certainly increase in the decades to come. In fact, progress in the areas of navigation and positioning systems will probably cause some to ponder the very need for a DMA into the 21st Century. The 'Global Positioning System (GPS) for instance promises to provide navigational information to missiles, vehicles, and troops that will provide location information to within a few feet (8,24). Given that such a capability can and will be developed to perform this feat, DMA's existence will not be threatened. There will still be the requirement to integrate such information into accurate digital data bases (8,18). Deployable products will be required for military planners and operators to determine their positions in relationship to the enemy in hostile environments where GPS may not be sufficent or even available amid the anticipated Clausewitzian 'fog of war'.

Significant improvements in budgetary allocations cannot be expected as we move into the 21st century. Therefore, force planners, weapon systems developers, and DMA planners must act with fiscal prudence. The obvious benefits (efficiency, flexibility, ease of training, etc) of a universal data base notwithstanding, economics will probably prove to be the major determinant in moving toward this concept. And although the mapping and charting production process will surely become less labor intensive, these savings will be quickly offset by the increased demand for DMA products. DMA must vigorously pursue the development of a universal data base capability to stay abreast of this increased demand.

Military lessons learned from some of our most recent conflicts should also be of interest to DMA. The 1973 Arab-Israeli War and the 1982 Falklands Conflict, for example, make the strong point "that in spite of the emphasis on technology, the soldier on the ground is far from obsolete. He is just as essential on the modern battlefield as he was on the ancient ones" (16,7). These and other conflicts have clearly demonstrated that in spite of high technology weaponry, the highly trained soldier with spirit and dedicated leadership is still the essential ingredient in war. And this being the case, a soldier will always need to know his position and location with respect to his adversary and how he can use the surrounding topography to best advantage. The deployable interactive digital data base provides an invaluable planning, targeting and navigation tool when command, control, communications and intelligence break down in the "fog of war". In essence, a map or chart of some kind will always be critical. Weapon systems developers, force planners and DMA must never forget this point.

Final guidance for DMA comes from Lt Col Clayton R. Newell's article, 'Operating in the 21st century' (16,10). Paraphrasing Col Newell's thoughts, the most important challenge for DMA as it prepares for the 21st century will be to remember the soldier in its design and development of a new generation of high technology based digital maps and data bases designed for the ultimate high tech confrontation between East and West. The data bases for both the superpower and LIC arenas obviously need to be designed with simplified, user friendly interfaces. They need to be easily deployable and ready to support real time augmentation from a variety of sensor inputs. And above all, the airman and the soldier, albeit from different perspectives, must be able to view data selectively, from the same cartographic scene. The data base must be comprehensive yet flexible enough to allow each of these different user groups to tailor the scene to fit their real world view. In this way, DMA can continue to provide optimum support (from the same data base) for the high tech battlefield management systems and navigation, and for the airman and soldier embroiled in LIC and other non-nuclear conflict well into the 21st century.

CHAPTER VI

RECOMMENDATIONS

-Initiate the planning and design development for a 'layered' digital cartographic data base with sufficient flexibility and density to support a ballooning family of users.

-Capitalize on the current issue of 'jointness' to lobby for a new JCS initiative calling for a study group comprised of users, DMA, weapon systems planners and developers to evaluate the requirements and impacts of a universal or layered data base.

-Develop a deployable and interactive digital data base capability for the combat environment.

-Develop data base flexibility that will support data entry from different sensors. As SAR and other spectral sensors evolve, requirements will call for a more synergistic product.

BIBLIOGRAPHY

1. Barger, Millard. "What USAF has to do to put the 'Air' in Airland Battle." Armed Forces Journal International, vol 123 no 12, (June 86), pp 58-64.

2. Bramson, Dr. Arnold. "Computer Image Generation - What the Future Holds." National Defense, vol LXXI no 422, (Nov 86), pp 84-87.

3. Brown, Reginald. "Electronic Warfare in the 21st Century." Defense Science and Electronics, vol 3 no 4, (July 84), pp 47-55.

4. Dean, Lt. Col. David J. (ed). Low Intensity Conflict and Modern Technology. Maxwell Air Force Base, Ala., Air University Press: Center for Aerospace Doctrine, Research, and Education; Washington D. C., 1986.

5. Display Systems Laboratory Radar Systems Group. "ITARS Design Review Package." Technical Report, Hughes Aircraft Company, El Segundo, CA., May 85.

6. Elser, A. C., and Capelle, Francis G. "Digital Topographic Support System." The Military Engineer, vol 77 no 502, (Aug 85), pp 470-471.

7. "ETL Has A New System." The Military Engineer, vol 76 no 495, (Sept 84), p 397.

8. Green, Gerald. "Approaching 2000 - Technology and Defense." National Defense, vol LXX no 413, (Dec 85), pp 17-24.

9. Guthrie, John. "Cockpits of the Future." International Combat Arms, vol 4 no 5, (Sept 86) pp 72-77.

10. -----. "Military R&D." International Combat Arms, vol 4 no 6 (Nov 86), pp 36-40.

11. Kuppperman, Robert H., and Taylor, William J. (eds). Strategic Requirements for the Army to the Year 2000. Lexington, MA., Lexington Books, 1984. 539p.

12. Lerber, Franz and Mercer, Bryan. "Chasing the Clouds Away." Computer Graphics World, vol X no 4, (Apr 87), pp 50-52.

13. McNaughton, D.D.G. "Some Considerations for Selecting a MIMS." The Military Engineer, vol 77 no 501, (Jul 85), pp 265-268.

14. "New Directive Requires DMA Data in Design of New Weapons Systems." Defense Mapping Agency Orientor, vol XXVIII, no 14, (Jul 86), p 1.

15. "New NGS Program Aids Local Governments." The Military Engineer, vol 78 no 506, (Mar-Apr 86), pp 132-133.

16. Newell, Lt. Col. Clayton R. "Operating in the 21st Century." Military Review, vol LXVI no 9, (Sept 86), pp 4-10.

17. Skantze, Gen. Lawrence A. "21st Century Air Force." International Combat Arms, vol 4 no 5 (Sept 86), pp 60-68.

18. Steven, Roger and Valan, Spiker. "Computer Generated Topographic Display Applications for High Performance Aircraft." Technical Report, ANACAPA Sciences, Inc., Santa Barbara, CA., May 85.

19. Taylor, William J. Jr., et al. (eds). Strategic Responses to Conflict in the 1980's. Lexington, MA., Lexington Books, 1984, 527p.

20. Wilkinson, Rear Adm. E. A. "Mapping the Earth in Bits and Bytes." Defense 85, (May 85), pp 18-24.

END
DATE
FILMED
JAN
1988