

Going, Going, Gone . . . Bidding Farewell to the 1:50,000-Scale Topographic Line Map

By Colonel William Pierce

Knowledge of the battlespace is a prerequisite to any successful military operation. Maps provide that knowledge. At the National Training Center, Fort Irwin, California, the observer-controller's recipe for success in battles and engagements is very simple: see the enemy, see yourself, and see the terrain. For more than 80 years, the Army has been using the 1:50,000-scale map, technically known as the Topographic Line Map (TLM), to see the terrain. The TLM has served us well in the past, but it has limitations that diminish its utility in this information age. The leaders at the National Imagery and Mapping Agency (NIMA) have found a better way. To achieve the Joint and Army Visions for information dominance, NIMA is undergoing a revolutionary change in how it provides terrain information to the Department of Defense. This article discusses the motivation for this change in direction, describes how the Army will benefit from the change, and outlines an implementation strategy.

NIMA's New Direction

Spurred by recommendations from the Defense and Army Science Boards in 1995, NIMA published a document called the Geospatial Information Infrastructure (GII) Master Plan in October 1997. Known as the Foundation Data (FD) Concept, this plan describes the changes that NIMA and the customers of mapping products must make to achieve the information-superiority tenets of the Joint Vision. The FD Concept is a revolutionary data-production scheme that is designed to provide warfighters exactly what they want when they need it. NIMA's old production strategy was based on a suite of standard products. NIMA made the Cadillac of maps—the 1:50,000 TLM. Unfortunately, there are several problems with this old friend.

First, the map was a predefined product. There may be features on the map a warfighter doesn't care about and new features that are important in planning. However, with the TLM, it did not matter what the warfighter wanted. He got the standard complete map or no map—nothing in between.

Second, NIMA produced these very expensive maps "just in case," based on commander-in-chief- or service-defined requirements. After production, the Defense Logistics Agency (DLA) updated the map catalogs, and the map sheets remained available for the warfighters in a DLA warehouse. After several years, the information on the map became dated. Updating TLMs is expensive and time-consuming. In fact, updating TLMs is unaffordable to the nation and unresponsive to the warfighters' needs.

Finally, the TLM isn't available worldwide. The current holdings of 1:50,000 and 1:100,000 TLMs cover less than 25 percent of the earth's surface. Over the past two decades, Department of Defense forces have begun operations without complete mapping coverage on several occasions (examples are Grenada, Desert Storm, and Somalia).

FD Concept Components

The first component is the foundation data. The foundation consists of a near-worldwide medium-resolution data set of imagery, features, elevation, and safety-of-navigation information (see Figure 1). Specifically, the foundation contains the following:

Imagery. This is both 1-meter stereo and 5-meter monoscopic imagery. These imagery data sets are relatively easy to make and can serve as a map background when grid lines are added. They provide the warfighter a view of the battlespace that is unavailable with a traditional map.

Elevation Data. Based on the successful space-shuttle radar-mapping mission in February 2000, NIMA has the data it needs to cover all land between 80° south latitude and 84° north latitude with Digital Terrain Elevation Data Level 2 (DTED2)—meaning an elevation reading every 30 meters—by late 2003. DTED2 provides a contour interval approximately equal to that of a 1:50,000 TLM. Two main benefits of this elevation data are that—

- Warfighters can locate intervisibility lines in their area of operations using readily available line-of-sight algorithms.
- Warfighters can construct more accurate three-dimensional (3D) views and fly-throughs.

Foundation Feature Data (FFD). This component generates traditional map views. Collected at a resolution or density similar to a 1:250,000 Joint Operations Graphic (JOG) map, the data contains not only features—such as roads, vegetation, rivers, and lakes—but also attributes or descriptors of the feature—such as road widths, road/runway surface types, and tree types. These attributes are not restricted to the legend of the map but are an integral part of the database and can be called up by a few mouse clicks on the digital map.

Mission-Specific Data Set (MSDS)

Part of the revolutionary aspect of the GII Master Plan is the concept of an MSDS. Most warfighters would say that they could not conduct tactical operations using a 1:250,000-scale map. No one expects them to. While the components of the foundation provide enough information to conduct general planning and navigation, there is a clear recognition in the GII Master Plan that more information must be generated to satisfy the information needs of most commanders. This additional information is called mission-specific data (see Figure 2, page 12).

If a commander wants a higher-resolution data than the foundation components, he must ask for it. An MSDS is simply terrain data, *defined by the commander*, that answers the commander's terrain-information needs. As the terrain expert in the command post, the staff engineer must be able to translate the commander's needs into data requirements that NIMA can understand. Under this concept, NIMA can focus on collecting, processing, and disseminating data that is relevant to the commander's real interests (see Figure 3, page 13). Over time, as NIMA populates the database with foundation data and MSDSs, more and higher-resolution terrain information will be available to warfighters when they need it.

Another aspect of the plan is that all data sets are custom-made for warfighters. This makes the phrase “standard NIMA products” obsolete because there are no standard NIMA products. Even the FFD will vary in density depending on what is requested.

Benefits for the Army

The FD Concept will support the Army terrain-information needs in several ways:

- All foundation data and MSDSs will be tied to the same earth reference or datum. There are currently in excess of 100 datums in use worldwide. The datum used for each map sheet is listed in the legend of the map. One example of a common datum is North American Datum 1927 (NAD 27). The Department of Defense has defined the World Geodetic System 1984 (WGS 84) as the standard for military mapping. Thus, under the FD Concept, all data—whether digital or hard-copy—is tied to the same earth reference, providing a common view of the battlespace.
- Information learned about terrain for one operation is preserved for future use as it is incorporated into the NIMA database.
- The new data supports automated-decision support. The embedded attributes in the database will support automated analysis and generation of tactical-decision aids. Examples include cross-country-mobility analysis, automated route selection, slope analysis, 3-D fly-throughs, and line-of-sight analysis. This attributed data will provide the link between command, control, communications, computers, and intelligence (C4I) systems and modeling and simulation (M&S) systems to support realistic mission planning and rehearsal.
- Commanders can specify the content of the high-resolution terrain information they need to make decisions.
- Under current production processes, changing a map is a laborious task. Under the FD Concept, it will be possible to integrate field-derived information in local and national databases. The result is that every soldier is now a potential collector of terrain information. Attributes that can be determined on the ground—such as stream velocity, bank height, and bridge classification—can be captured and saved.
- For most warfighters, maps have been the primary source of terrain information. Under the FD Concept, image-based maps that can be produced relatively quickly will be available to the commander.

Implementing the FD Concept

To implement the FD Concept, the Army had to define Army-specific MSDSs. With superb support from NIMA, the Army developed packages of terrain information that resembled the 1:100K and 1:50,000 TLMs. These packages contained the features the Army has traditionally required on the TLMs. In addition, they also included attributes that support the automated analysis described in this article. In 1999, NIMA made a comprehensive set of hard-copy and digital prototypes of these MSDS-defined packages. The prototypes were sent to the field for evaluation and, based on feedback, the Army was able to specify its terrain- data requirements.

All services had questions about NIMA's implementation strategy. Since the FD Concept is more than just a database, there were concerns about requirements management, data dissemination, and exploitation systems. In other words, who can ask for MSDS, how will the data be delivered, and how will warfighters view

the data? In this concept, commanders are able to ask for specific features or attributes in an area of operations using some type of Web-based architecture. As NIMA continues to generate MSDS during an operation to satisfy a commander's information needs, there is a recurring requirement to send this new, updated information to the field. Once the data is received, soldiers must be able to view the data on their Army Battle Command System (ABCS).

In August 2000, NIMA initiated a joint forum to address the implementation concerns of the services. This forum developed a Geospatial Concept of Operations, an updated version of the GII Master Plan, and cost estimates to fully implement the FD Concept. While all of the accomplishments of the forum are outside the scope of this article, some conclusions are worth noting.

- Due to resource constraints, NIMA cannot continue to provide legacy products to the services and agencies while simultaneously populating the database with foundation data and MSDSs. At some point, NIMA must make a break from the legacy production processes.
- Neither NIMA nor the services are ready to move to an environment where the content of the map changes with every request. While this is the vision of the GII Master Plan, the challenges associated with this information environment will not be solved in the next few years.
- As a near-term transition step, the services-defined MSDS packages can serve as a bridge between the legacy products and the full implementation of the GII Master Plan.

Although this concept of treating MSDS packages like products seems to be a reasonable approach, it will be difficult for the services to move into the future for several reasons:

- NIMA is meeting most of its terrain-information needs with legacy products.
- Several aspects of the FD Concept require new training strategies. Modifying current topographic training is not sufficient. This new training will range from changes in technical topographic training and the military decision-making process, where ordering an MSDS is an explicit step, to basic map reading.
- NIMA's current holdings of this new data are relatively sparse.

The motivation to make this transition may come from NIMA. The NIMA leadership is currently looking at a strategy to end production of the legacy TLMs in the next few years. It could happen as early as FY03. This does not mean that NIMA will no longer provide the geospatial information that tactical commanders need to accomplish their missions. The geospatial production elements in NIMA are developing a strategy to either maintain the TLMs that have already been produced or replace them with MSDS packages. The existing stock of TLMs will still be available to the services for several years. However, any new TLM mapping requirements will be fulfilled by an Army-defined MSDS package that looks like a TLM to users.

NIMA produced several 1:100,000 TLM maps of the National Training Center for the 4th Infantry Division Capstone Exercise in April 2001. These maps were generated from FFD but are indistinguishable from the legacy TLMs. The only difference is that these products were made using NIMA's new production processes.

The Bottom Line

NIMA's implementation of the FD Concept will result in a much more comprehensive and relevant view of the battlespace for warfighters and will provide the level of detail required for information dominance. While some of the implementation details remain unanswered, it is clear that NIMA cannot continue to populate the new database while supporting warfighter requirements for legacy mapping products like the TLM. The soldiers NIMA serves will have the geospatial information they need to accomplish their missions in a format that is familiar to them under the FD Concept. It is now time for engineers to learn this important part of their mission and help their maneuver commanders through this revolutionary transition.

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