CHAPTER 1

Topographic Engineer Functions, Organizations, Responsibilities, and Relationships

IMPORTANCE OF TOPOGRAPHIC ENGINEERING

Throughout history, the physical effects of terrain and weather have played a major role in the development of society. During wartime, the effects of terrain and weather take on a different, but no less important, role. Knowledge of the terrain on which a battle is to be fought is important during all phases and levels of military planning. Commanders can influence the outcome of battle by exploiting the limits and advantages of terrain as a combat multiplier. Commanders will win in battle through rigorous application of METT-T:

- Mission.
- Enemy.
- Terrain and weather.
- Troops,
- Time available.

The unit commander is responsible for effectively making use of the terrain during military operations. The engineer is responsible for allowing the commander to see as much of the terrain as possible. By obtaining and providing information on the configuration of the physical surface of the earth, the engineer ensures that the supported commander can better visualize the battlefield.

Doctrine in FM 100-5 details how US Army forces fight in today's battle. US forces must be prepared to fight in the full range of combat situations anywhere in the world. Threat forces may use—

- Weapons of mass destruction.
  - —Nuclear arms.
  - —Biological.
  - —Chemical.
- Complex technology.
- Conventional weapons and tactics.
- Unconventional tactics.

Regardless of conditions, US forces must generate superior combat power at decisive times and places.

While there are no simple formulas for winning, certain key factors are critical for the success of military operations. One critical factor is the topographic engineering support provided to the combined arms team.

The goal or mission of topographic operations is to ensure that timely, accurate, and sufficient knowledge of the battle space will be provided to each commander throughout all phases of combat operations.

Topographic support includes—

- Geodetic survey control for precise positioning for artillery, aviation, intelligence, and signal.
- Map substitutes.

- Tactical decision aids for commanders necessary for control, communications, intelligence, and weapons systems.
- Terrain mobility and intervisibility information for targeting and force protection.

Normally, standard topographic products used in support of combat operations will be provided by the DMA or by host nations through international agreements negotiated by the DMA. Army topographic units supplement and enhance the DMA's efforts. They provide the maneuver commander with specific tailored products reflecting the current state of the terrain. When standard topographic products are not readily available, Army topographic units provide image-based products as map substitutes and other tailored topographic products from data available.

TOPOGRAPHIC FUNCTIONS

Topographic engineers provide timely, accurate knowledge of the battlefield and terrain visualization to operational commanders and staffs at all echelons throughout the operational continuum. Knowledge of the battlefield consists of information in narrative or graphic format describing the effects of terrain and weather on military operations. The ability of the commander to "see the battlefield" in all weather conditions before the battle will help him to develop dynamic operational plans; shape the area of operations; and locate, engage, and defeat the enemy with a more agile, synchronized force. The terrain information and tactical decision aids developed by Army engineers provide the basic terrain reference for land and air forces as well as other DOD and non-DOD agencies.

Critical Tasks of the Topographic Engineer

Critical tasks of the topographic engineer include—

- Commanding and controlling topographic units and providing mapping, charting, and geodesy (MC&G) planning.
- Deploying topographic units.
- Collecting, creating, updating, validating, and managing topographic information.
- Producing special topographic products.
- Disseminating special topographic products,

Terrain Analysis. Terrain analysis is the process of interpreting natural and man-made features of a geographic area. It interprets the influence of weather and climate on these features to predict their effect on military operations. The products of terrain analysis may include, but are not limited to, those listed in *Table 1-1*, which correlates the military aspects of terrain as they relate to some common terrain analysis products.

Terrain analysis is the focus of Army topographic operations. When the DMA-produced data base is available, the terrain anlayst uses this as a starting point for analysis of a geographic area. This consists of a series of terrain factor overlays at 1:50,000 or 1:250,000 scales. The analyst modifies and updates the data bases using data collected from the field. The data collected includes information supplied through host nations and current and all-source intelligence. All this together allows the analyst to supply an up-to-date picture of the battle space.

The DMA standard factor overlays used in studying the terrain are-

- Vegetation.
- Surface configuration (slope).
- Surface drainage.
- Surface materials (soils).
- Obstacles.
- Transportation.
- Water resources (1:250,000 scale only).

Table 1-1. Terrain analysis support.

Military Aspects of Terrain (OCOKA)	Elements of Terrain Information	Examples of Terrain Analysis Products
Observation/fields of fire	• Vegetation (summer and winter) • Surface configuration • Battlefield environmental effects on the terrain • Urban areas	• Horizontal line-of-sight for direct-fire weapons, antennas, and radar • Emplacement suitability for ground surveillance
Cover and concealment	• Vegetation (summer and winter) • Surface configuration • Obstacles (microrelief) • Battlefield environmental effects on terrain • Urban areas	• Cover potential from direct and indirect fire (good/fair/poor) • Concealment potential from horizontal and vertical observation (good/fair/poor)
Obstacles	• Vegetation (summer and winter) • Surface configuration • Drainage characteristics • Natural and man-made • Microrelief • Surface materials (wet and dry) • Urban areas	• Location of existing natural and man-made obstacles • Mobility potential on the battlefield expressed in GO, SLOW-GO, and NO-GO for track and wheeled vehicles
Key terrain	• Urban areas • Lines of communication • Surface configuration • Drainage characteristics	• Location of key terrain features, both natural and man-made. Examples are bridges, choke points, high ground, and key military facilities.
Avenues of approach	• Vegetation (summer and winter) • Urban areas • Surface configuration • Surface materials (wet and and dry) • Drainage characteristics • Lines of communication	• Mobility corridors • Drop zones • Landing zones • Landing beaches • NOE navigation

In addition to DMA standard factor overlays, the following assets may be utilized by the terrain analyst:

- Ž Multi-spectral imagery (MSI) and national imagery.
- Ž Digital terrain elevation data (DTED).
- • Digital feature analysis data (DFAD).
- • Interim terrain data (ITD).
- Ž Terrain studies.
- Ž Special products such as geology, soils, and vegetation.
- Ž Library.

The analyst, uses information from these sources to produce terrain analysis products.

Using weather information and data provided by the staff weather officer (SWO), and operational parameters for tactical equipment, the commander is provided with an analysis by the G2 or S2 of the expected effects of terrain and weather on future operations.

Terrain teams prepare and present their findings in several forms: oral, graphic, image-based, or textual, depending on the commander's need. Resulting products include cross-country movement (CCM) (wet or dry), lines-of-communication, river-crossing, and cover-and-concealment information. Terrain analysis products are provided in limited quantities for staff use and maintained in local data bases.

Graphics, data tables, and textual evaluations and descriptions are characteristic of prebattle and postbattle responses. Most of the responses during battle, particularly at division level, may be verbal. Responsiveness within the time frame established by the commander is very important. Emphasis can be placed on the informational content and not on appearance. Rapid-response products are provided to meet tight time requirements. If the terrain analysis team cannot respond to a commander's need, and time allows, the requirement is forwarded to the next higher topographic unit for completion.

Where the DMA data base is not available, echelons above corps (EAC) and corps topographic units are responsible for creating terrain data base materials that can be used by division terrain teams for the production of topographic products.

Terrain analysts are responsible for analyzing the effects of the weather on the terrain. Some examples are—

- Effects of soil moisture on mobility (cross-country movement, equipment, and personnel).
- Effects of smoke on intervisibility (sensor line of sight).
- Effects of fog on nap-of-the-earth (NOE) flying.
- Effects of rainfall on fording and river crossing.

Terrain analysis products can be no more accurate than the accuracy and currency of the terrain data in the topographic data base. Terrain analysts have the responsibility of advising users of the limitations based on lack of data, currency, or accuracy of the data base.

Production. This function includes the cartographic production of image- or map-based graphics, reproduction of these graphics, and the production of topographic survey data. Cartography is the art and science of graphically portraying physical and man-made features of the earth, usually as a map, chart, or image-based photomap.

Topographic units use cartographic and reproduction techniques in the production of image- and map-based graphics to-

- Support an operation.
- Supplement or replace old or nonexistent standard products.
- Overprint terrain information not on standard products.
- Produce multiple copies required for distribution.

Production capabilities are used to make-

- Operations and intelligence overlays and overprints.
- Map substitutes (to include image-based maps).
- Expedient revisions or updates to standard maps.
- Draft manuscripts of terrain-analysis overlays and graphics.
- Special purpose products (see *Table 1-1, page 1-3, and Table 1-2).*
- Precise survey and geodetic positions.
- Digital data (transform, develop, or duplicate).

Table 1-2. Topographic support to Army systems.*

Army Systems	Standard Products	Special-Purpose Products (Produced by Topographic Engineer Units)
Command and control	• Standard topographic maps: 1:50,000** 1:250,000 (Joint operations graphic (JOG)) • Gazetteers • Air target materials • City graphics • JOG • DTED • ARC Digitized Raster (Graphics)	• Terrain analysis (see note) • Image maps • Minor map update • Military operations on urbanized terrain (MOUT) analysis • Weather effects on terrain • War damage analysis • Lines of communication • Operations and intelligence overlays and overprints
Maneuver	• Standard topographic maps: 1:50,000** 1:250,000(JOG) • Standard terrain analysis products: CCM for the main battle tank (MBT) Transportation—road and bridge maps • FLIPs • Vertical obstruction data (VOD)	• CCM analysis for all types of Army vehicles (wet and dry conditions) • CCM analysis for threat vehicles (wet and dry conditions) • Route analysis • Zones of entry • Nonstandard maps • Image maps • River- or gap-crossing information • Cover and concealment • NOE (aviation support) • MOUT analysis • Flood prediction
Weapon sytems	• Standard topographic maps: 1:50,000** 1:250,000(JOG) PPDB • Trig lists • DTED • DFAD • Air target materials • Geodetic survey control points (first order)	• Line of sight • Geodetic survey control points (second order) • Nonstandard maps • Image maps • Deep battle target interdiction analysis • Cover and concealment • Route analysis
Combat suport and combat service support	• Standard topographic maps: 1:50,000** 1:250,000(JOG) • Transportation—road and bridge maps	• Route analysis • CCM analysis for all types of Army vehicles (wet and dry conditions) • Nonstandard maps • Image maps • Material resource locations • MOUT analysis

* This table depicts some of the topographic support available.
** 1:100,000 where 1:50,000 is not available.
NOTE: See *Table 1-1, page 1-3.*

Reproduction equipment of topographic units includes, but is not limited to, single-color lithographic presses, diazo-reproduction equipment, and facsimile machines. Lithographic presses are used for high-volume and multicolor printing of standard sheet-sized products (22 1/2 by 29 1/2 inches). The time required for a multicolor product can take several hours or a few days. Multiple-color products are not practical when time is critical. Single-color products are the preferred solution unless digital-based, low-volume color copies are available.

The DMA holds the charter for bulk printing and distribution of standard map products. Overprinting of these products by topographic units is not recommended.

Registering (aligning) information during printing is a problem. Field topographic units must print the sheet using color separates and overprinted information.

When only a few copies of a single-color product are required, such as rapid-response terrain-analysis products, topographic units use a diazo-reproduction machine, photographic copies, and digital plotters. Products can be reproduced on film (acetate) or on various types of paper.

Facsimile machines provide transmission of graphic materials such as maps, photographs, or printed text by electronic means.

Topographic survey provides precise geodetic positioning and elevation data required by -

- Artillery.
- Air defense.
- Aviation.
- Chemical.
- Missile fire control.
- Communications and intelligence systems.

Surveyors recover existing ground control and extend it by third-order conventional survey or satellite methods to the division rear or to the specific system when directed. They establish a minimum of two third-order or higher control points in each division area. Besides making precise point determination, they can provide azimuths for missile systems and the orientation of communications equipment. They are also able to provide precise positioning to support updating of terrain analysis data bases. Surveyors also provide low order (3d order and below) positional information of friendly positions and enemy targets. This is possible with the use of point positioning data bases (PPDB).

Topographic engineers provide quality information for all products produced, giving information about sources and dates of data, procedures and equipment used, datum and coordinate systems, and accuracy estimates.

Standard Map Storage and Distribution. Standard map storage and distribution is being eliminated as an engineer function. In the near future the Quartermaster Corps assumes this function fully. The map storage and distribution function includes the storage, maintenance, and distribution of standard MC&G products. This function is handled differently in each theater. Additionally, some map depots cannot be opened until mobilization of reserve components. Neither the DMA nor Army topographic units have organic transportation assets to move maps. Movement of maps and digital data between the continental United States (CONUS) and theater depots and movement of maps from in-theater depots to the requesting unit are based on priorities set by commanders. In-theater distribution is made on a supply point basis. Units must go to the supporting map distribution point to pickup maps.

Various organizations provide map storage and distribute bulk quantities from theater to division levels. At the theater level, the DMA supports the theater Army area commander (TAACOM).

The TAACOM provides map inventory control and handles storage and supply-point distribution of war reserve and operational stocks. At division level, the division support command (DISCOM) provides supply-point distribution for standard MC&G products. Stock levels and capabilities decrease progressively from theater to division, although war reserve stockage may be kept at levels that match expected prebattle contingencies.

The unit's basic load of standard MC&G products may be stored at any level, according to local command policy. The maintenance of maps and the replacement of obsolete products with new editions are done at the level where the stockage is held. The types and quantities of products held

and the geographical coverage are determined by the operations that are required. This is outlined in each command's contingency plans (CONPLANs), operation plans (OPLANs), and operation orders (OPORDs).

Distribution of special-purpose products produced by topographic units is, and will remain, a topographic engineer function. Topographic units will be manned to provide this service. Distribution is dependent on the theater of operations. When small quantities are produced for a specific purpose, they are distributed directly from the producing unit to the user. For example, a terrain analysis product of a specific avenue of approach would be provided directly to the user. Special products produced in large quantities are moved through the command and staff channels by the operations, engineer, or intelligence staff, depending on the product's intended use. For instance, a product depicting helicopter landing zones would be distributed through operations and aviation channels where an intelligence overlay would be distributed through intelligence channels. Digital products are distributed on magnetic media by the channels discussed above or by digital communications using standard communication channels or the intelligence communication channels.

Knowledge of the Battle Space

All aspects of military operations—close, deep, and rear—require topographic support. Missions associated with these operations can be preplanned in peacetime or they can evolve from battlefield situations. Essentially the same functions are performed regardless of the type of military operation. Each response is variable and tailored to the tactical situation and the geographic area of operations.

Major customers of topographic products and service in support of planning and operations are—

- Special operations force (SOF).
- Maneuver units.
- Field artillery.
- Aviation.
- Air defense,
- Intelligence.
- Signal corps.
- Engineers.
- Logistics.

Table 1-2, page 1-5, relates typical topographic support to Army systems.

TOPOGRAPHIC ORGANIZATIONS

Unified and Specified Commands and Staff

Unified and specified and component commanders define military task requirements to support CONPLANs/OPLANs/OPORDs, Based on a commander's concept of the operation, the topographic engineer advises the Deputy Chief of Staff, J2 (Intelligence) (J2) and other staff officers in preparing the topographic annex for each CONPLAN/OPLAN/OPORD. The commander outlines the specific support requirements needed for the command. Details for preparing a topographic annex can be found in the appendix.

DMA

The DMA provides MC&G support for all US armed forces. This agency plays an important role in army topographic operations. DMA provides the standard hardcopy and digital topographic, aeronautical, and hydrographic products to support the following:

- Position location.
- Terrain analysis.
- Strategic, operational, and tactical planning.
- Close air support (CAS).

- Offshore and over-the-shore movement.

NOTE: Based upon availability of data base.

DMA produces standard topographic products listed below to meet the requirements of the services and regional Commander in Chiefs (CINCs).

- Ž 1:25,000, 1:50,000, 1:250,000, and smaller-scale maps.
- Ž Aeronautical and nautical charts.
- Terrain analysis data bases.
- Trig list.
- Ž Gazetters.
- Flight information publications (FLIP).
- Ž Digital data.

Products will not be available in areas where requirements have not been identified. The MC&G requirements process is managed by the DMA with the MC&G officers of regional CINCs. Army topographic unit leaders must be involved with their intelligence staff counterparts to ensure appropriate topographic requirements are identified for their commands.

However, due to production priorities and prioritization of areas for production, they may not be available even if requirements have been established.

The DMA provides theater-level storage and bulk supply to the theater of operations. Digital topographic data is typically provided to select users where data analysis, point positioning, and map background display capabilities and requirements exist.

Intelligence Staffs

From the Deputy Chief of Staff for Intelligence (DCSINT) at Headquarters, Department of the Army (HQDA), down through the division G2 (Intelligence), the intelligence officer has general staff responsibility for-topography. This means the intelligence officer is responsible for-

- Ž Topographic policy.
- Solicitation and validation of requirements.
- Identification, confirmation, and coordination priorities for topographic support.

High priority is given to supporting the intelligence preparation of the battlefield (IPB) process. This includes providing commanders at all levels products which assist in battle planning. These products should reach the units at the same time as the warning orders in order to help the commander visualize the battlefield. Topographic units at corps and theater can reinforce division terrain teams to ensure that assets are available to provide this support. The corps G2 tasks the corps terrain team of the tactical operations center (TOC) direct support element and coordinates other topographic support requirements and priorities with the corps engineer. Battalion and brigade intelligence officers (S2s) compile and submit topographic requirements and priorities for their commands to their division G2. The G2 consolidates these requirements with division requirements, establishes priorities, tasks the division terrain team, and coordinates support with the division engineer.

Terrain teams at both corps and division provide the analysis of the area of operations or terrain analysis appendix to intelligence annex of the OPORD.

Engineer Staffs

From the Office of Chief of Engineers at HQDA down through the division engineer, the engineer officer has special staff responsibility for topography. This means the engineer officer is recognized as the terrain utilization expert responsible for—

- Topographic program execution.
- Training.
- Resourcing.

Ž Coordination of technical topographic requirements with the staff and subordinate commands.

Battalion task force and brigade engineers are terrain experts at their organizational levels. All engineers regularly help in terrain data collection (river, soils, route, and bridge classification) to fill data voids and verify data in analysis data bases. All engineers also exploit terrain data and analyses to focus reconnaissance efforts. Engineers help in site selection, planning, and estimating for performance of mobility, countermobility, survivability, and general engineering missions.

Engineers at all echelons are responsible for the topographic operations annex to CONPLANs/OPLANs/OPORDs. Depending on unit standing operating procedures (SOPs), topographic operations may be an appendix to engineer annex at division level.

Topographic Engineering Center (TEC)

The US Army TEC is a field operating activity under the command of the Commanding General, US Army Corps of Engineers (USACE). The mission of TEC is to-

Ž Review all concepts, mission needs statements (MNS), and operational requirements documents according to Army Regulation (AR) 70-1 and AR 71-9.

Ž Conduct research and development of the topographic sciences.

Ž Develop material that provides commands with knowledge of the battlefield and terrain visualization.

- Provide technical operational support to topographic units and organizations.

The TEC has two subordinate offices that provide support to the topographic field units, They are—

Ž The Terrain Analysis Center (TAC), which is an operational production unit that provides terrain analysis/terrain intelligence support to field units, major Army command (MACOM) staffs, Army staffs, National Intelligence Agencies, and the Federal Emergency Management Agency. It maintains a specialized terrain analysis/digital data library and a digital hydrologic database. TAC can purchase multispectral imagery for topographic support.

- The Field Support Office (FSO) which acts as the interface of topographic research and development with the operational Army. It provides technical support to fielded topographic units (battalions, company, and detachments), and other users of topographic information.

Corps of Engineer Laboratories

The three Corps of Engineers Laboratories include—

Ž US Army Engineer Waterways Experiment Station (WES).

Ž Construction Engineering Research Laboratory (CERL).

- Cold Region Research Engineering Laboratory (CRREL).

These laboratories have the mission of providing technical expertise and analytical products that relate to mobility, countermobility, survivability, and sustainment engineering.

Topographic Engineer Units

Topographic units located at EAC, corps, and division supplement the DMA's effort by compiling data from various sources into

special-purpose topographic products tailored to meet the supported commander's needs. These units belong to the topographic battalion in the theater of operations, but maintain a habitual relationship with their supported echelons (unit). Their rapid response aids the commander in—

- Visualizing the battle space.
- Understanding the effect of terrain, weather, infrastructure, geography, and environment on military operations.
- Navigating on the battlefield.
- Ensuring precise positioning of command and control, maneuver, weapons, and support systems.

Special-purpose products include—

- Terrain information (graphic and textural).
- Precise positioning through geodetic survey (EAC).
- Map overprints and image-based products (corps and EAC).

All topographic units are focused to support the forward areas and are specifically tailored to the requirements of a particular theater. Their primary interest is in direct and rapid response to support command needs. When DMA coverage is not available, these units may provide original, hasty, image-map, and terrain coverage. *Figure 1-1* shows the major participants of the topographic arena.

TOPOGRAPHIC RESPONSIBILITIES AND SUPPORT RELATIONSHIPS

Commanders at all levels are assigned areas of responsibility based on unit mission. They define the topographic requirements needed to support specific CONPLANs/OPLANs/OPORDs. At all levels, requirements are contained in a topographic annex to each CONPLAN/OPLAN/OPORD similar to that found in the appendix of this manual, The commander is responsible for maintaining and managing the unit's basic load of products and ensures the proper conservation and use of maps, In addition, the commander can establish the transportation priorities needed to ship products from supply points to users. Every division and corps commander is responsible for effectively employing their direct-support units allocated from the topographic battalion at EAC.

DMA

The DMA is the main provider of standard MC&G products. This agency provides MC&G support to the US armed forces. The DMA is responsible for—

- Producing all standard topographic, aeronautical, and nautical products.
- Providing distribution of MC&G stocks to theater depot.
- Coordinating MC&G agreements with allied forces, host nations, and allied topographic offices.

DMA production is based on requirements submitted by the services and CINCs. The priorities for production are established by the Joint Chiefs of Staff (JCS). Army components of unified and specified commands must ensure their requirements for standard products, to include terrain analysis data bases, are identified through the requirements process to DMA.

Theater Army Engineer

The theater army engineer is the principal adviser to the theater army commander for all engineer matters—to include topographic engineering (see *Figure 1-2, page 1-12).* The theater topographic engineer battalion commander (the theater topographic engineer selects the assistant theater topographic engineer (ATTE) from his staff. He is normally attached to the army component command

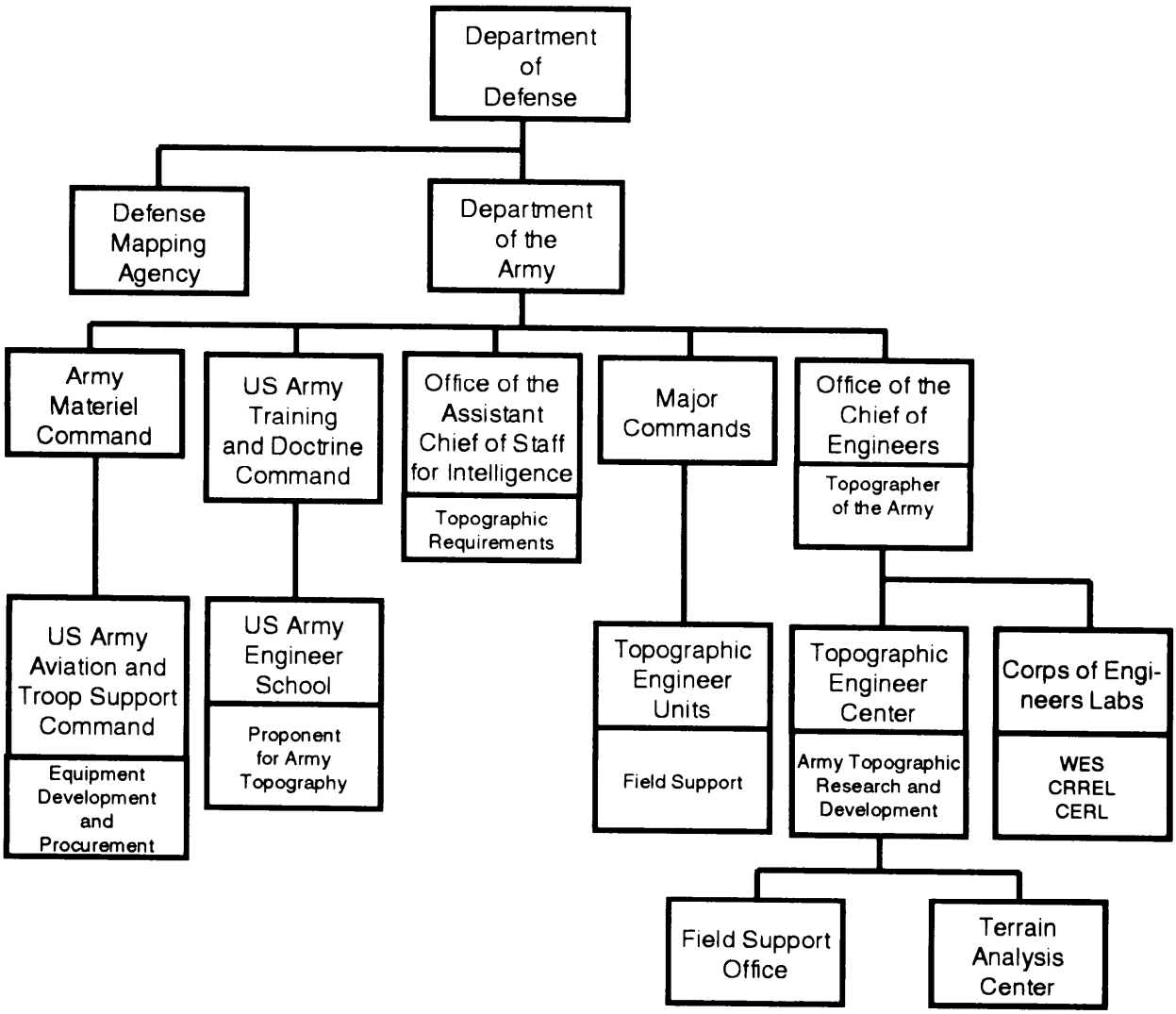


Figure 1-1. The Army mapping, charting, and geodesy community.

G2 or G3 (Operations and Plans). He performs staff planning and coordination for topographic support within the theater. He arranges topographic support between the Army component command, the DMA other services and allied organizations. The theater army engineer is responsible for—

- Operational control of the theater topographic battalion and, indirectly, all Army topographic assets in the theater.
- Ž Overall planning, management, and coordination of topographic support to the theater army.
- Ž Providing topographic support for the theater army and coordinating these requirements with higher joint headquarters, the DMA, host-nation, and allied topographic offices.
- Ž Acting as the interim theater-level map inventory control point.
- Ž Preparing the topographic annex in concert with the theater army staff.
- Coordinating topographic requirements with the theater army staff.
- Ž Providing topographic technical expertise to the commander and staff.

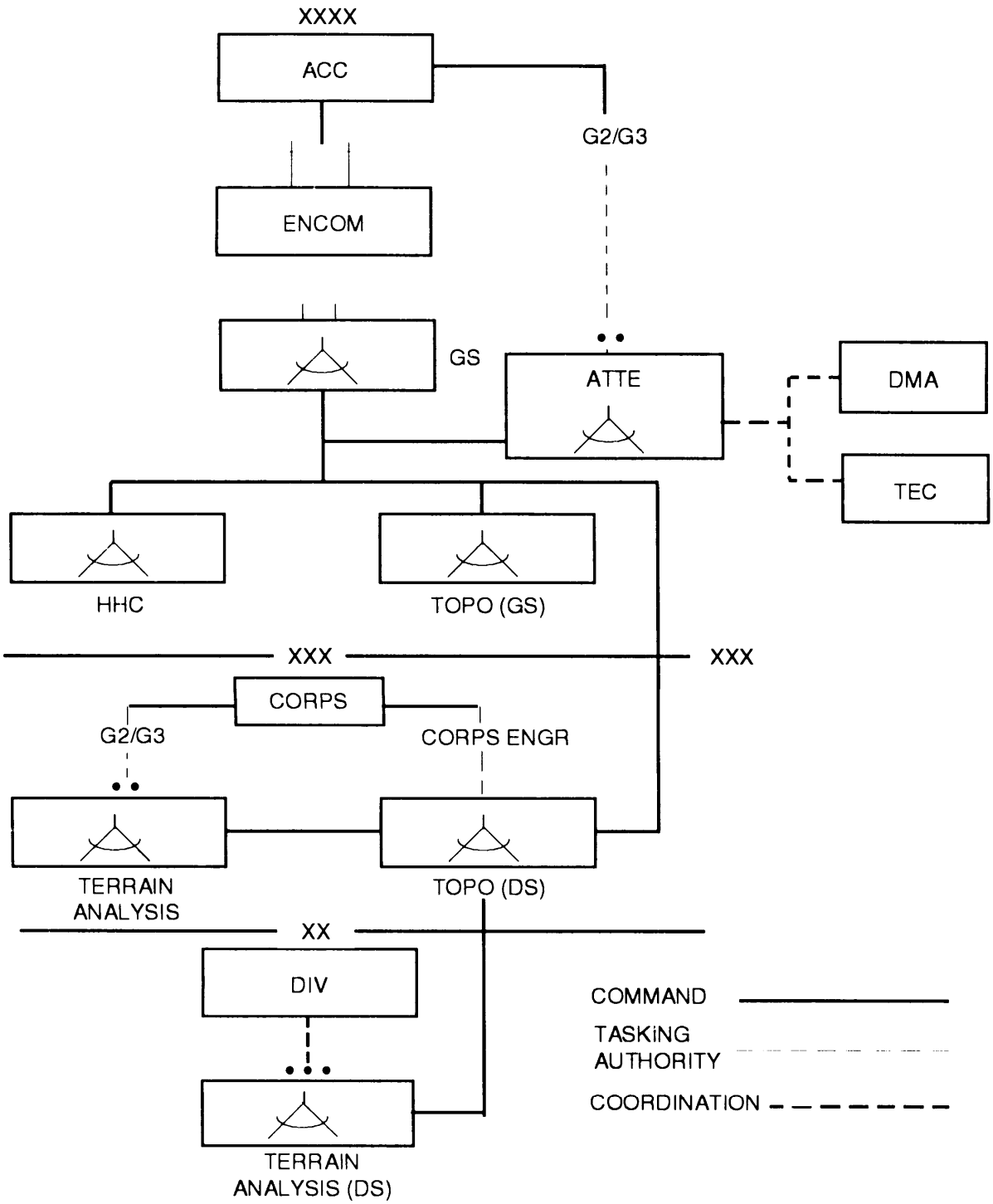


Figure 1-2. Normal topographic organizational alignment

Topographic Engineer Battalion Commander

The commander of the topographic engineer battalion at EAC commands all topographic units in the theater. This commander has a responsibility to—

- Provide the ATTE element to the appropriate theater army component staff. This element helps the theater engineer to accomplish his topographic mission and coordinates production requirements and priorities.
- Provide general support to unified and specified commands.
- Provide general support to subordinate topographic units for requirements beyond their capability.
- Furnish topographic support to all Army units at EAC.
- Manage the in-theater, topographic production program, to include topographic data bases.
- Provide supply-point storage and distribution of special topographic products at EAC and corps levels.
- Assist assigned units with topographic technical supplies.
- Provide direct and general support maintenance of topographic equipment located at all assigned units.

ATTE

The ATTE performs staff planning and coordination for topographic support within the theater. The ATTE works with the CINC MC&G officer to arrange topographic support between the Army component command, the DMA, and other services and allied organizations. The ATTE is normally attached to the Army component command, (DCSINT) G-2, or the Deputy Chief of Staff for Operations (DCSOPS). The ATTE coordinates requirements for special topographic products with both the customer and the topographic engineer battalion.

Corps Engineer

The corps engineer is the corps engineer brigade commander. This special staff officer is responsible to the corps commander for all engineer-related matters, including topographic engineering. The corps engineer is aided by the corps topographic engineer located in the Assistant Corps of Engineers (ACE) office. The corps engineer has a responsibility to—

- Coordinate corps topographic support requirements for terrain analysis and production with the theater engineer.
- Task and prioritize the work effort of the corps topographic company that is in direct support of the corps from the theater battalion.
- Facilitate direct support of corps topographic company to corps G3/G2.
- Coordinate with the corps G3/G2 for collection of battlefield-terrain information.
- Assist in the distribution of terrain analysis and other special topographic products.
- Prepare the topographic operations annex for corps CONPLANs/OPLANs/-OPORDs.
- Assist G2 in defining stockage requirements for maps to be held to support the corps.

Division Engineer

The commander of the division engineer brigade or battalion is the division engineer. This special staff officer is responsible to the division commander for all engineer-related matters including topographic engineering. The division engineer is the chief adviser to the division commander on how to use the battlefield terrain effectively. The division engineer has a responsibility to—

- Provide advice to the division commander on effective use of the terrain.
- Facilitate terrain team-support requirements of division G3/G2 plans and operations.
- Assist the G3/G2 in evaluating topographic-support requirements and setting priorities.
- Assist the distribution of terrain analysis and other special topographic products.
- Coordinate with the corps engineer for additional requirements in terrain analysis beyond the capacity of the division terrain team.
- Coordinate with corps engineer for requirements in topographic production.
- Coordinate with the G3/G2 for collection of battlefield terrain information.
- Prepare the topographic operations annex or topographic appendix to engineer annex for division CONPLANs/-OPLANs/OPORDs in coordination with the G2, G3, G4 (Logistics), and chief of the division terrain team.

The division engineer and the Assistant Division Engineer (ADE) must be familiar with the capabilities and limitations of engineer topographic units. They must give priority to the management of all engineer resources, to include topographic engineering, They need a completed special background investigation so they can manage data base acquisition and personnel operating in the all-source intelligence arena.

Chapter 2

TOPOGRAPHIC ENGINEER OPERATIONS

EMPLOYMENT OF UNITS

Army topographic engineer battalions provide tailored topographic products and services in support of planning and operations. Army topographic engineer battalions also have the responsibility to provide joint service support if tasked by the unified or specified command within whose area they operate.

Topographic Units Within a Theater of Operations

These are components of the theater engineer topographic battalion. The theater topographic engineer battalion is responsible for topographic planning and control of all topographic assets in support of the operation. Detachments and companies from this battalion are located at EAC, corps, and division levels. They provide rapid-response, nonstandard, and special-purpose topographic products to aid the tactical commander. The theater EAC topographic company will assume the corps topographic mission during the deployment of the corps topographic assets and vice versa. Management and validation of topographic data bases is the responsibility of all topographic units.

The primary focus of topographic support is to the tactical commander. Priority is placed on providing the forward-deployed tactical units with timely, accurate, and tailored support. Support requirements that cannot be met by forward-deployed units because of priority workload or project complexity are done by the topographic unit at the next higher level of command.

Tactically deployed topographic units should use freed facilities such as warehouses, hangars, and barns for concealment whenever possible. Deployment considerations include—

- Air superiority.
- Ž Enemy nuclear, biological, and chemical (NBC) capabilities.
- Rear-area operations.

Selected facilities should provide the best protection from the effects of enemy air superiority and NBC, yet support the utilities requirements of topographic units. Dispersing the unit in wooded areas under camouflage nets degrades the unit's efforts to provide rapid, efficient support. Dispersion adversely affects production efficiency and creates a large electronic signal. Equipment configuration is constrained when power requirements are supplied by generators. The use of fixed facilities greatly reduces the battlefield signature and enhances survivability of scarce topographic resources.

The visual and electronic signatures of the topographic engineer unit must be considered when siting engineers near maneuver command headquarters. To lessen the effect of their signature, topographic commanders and staff personnel at theater, corps, and division levels should recommend appropriate employment locations of topographic units. *Figure 1-2, page 1-12,* depicts a typical employment concept for topographic units in a theater of operations.

Topographic Units Outside the Theater of Operations

These also have an important role. As they are not deployed, they have minimal force protection and sustainment requirements, As a result they can employ soldiers to maximize topographic production. While topographic units outside the theater cannot rapidly respond to immediate requirements, they may be employed in a supporting role to produce additional terrain analysis data base materials, which can be shipped to the theater. Electronic transmission of data should be used to the greatest extent possible.

COMMAND AND SUPPORT RELATIONSHIPS

General Relationships

Two kinds of relationships control topographic engineer units. They are—

- Command relationships.
- Support relationships.

All units within a theater of operations are assigned to the theater topographic battalion. This battalion provides topographic supply and maintenance of topographic equipment to all units within the theater. Usually a company from the battalion is placed in direct support of each of the supported corps. Terrain analysis detachments from the theater topographic battalion are placed in direct support or attached to each division in the corps. Topographic commanders, battalion S2 and S3, terrain analysts, and cartographers in the topographic company all require access to all-source intelligence information that is vital to the production of image maps and terrain data bases.

EAC

The ATTE element is assigned to the theater topographic battalion and is located with the theater army component command. The ATTE element is attached to the G3 and G2 in the event of deployment. It provides—

- Planning for MC&G support.
- Coordination of topographic support to the theater.

The ATTE is the topographic officer at Army component command staff. He provides advice to the theater army commander and staff for the theater topographic battalion commander on topographic matters (see *Figure 1-2, page 1-12).* He is responsible for determining support requirements for the theater. The element coordinates with higher-level joint headquarters, the DMA, and host or allied nations for acquisition of products, source materials, and data bases.

The topographic battalion at EAC ensures the full spectrum of functional support to all theater assets. This includes—

- Terrain analysis.
- Ž Precise positioning (geodetic) surveys.
- Production of MC&G products.
- Ž Data-base management—both hard copy and digital.
- Special product storage and distribution.
- Supply of topographic material.
- Intermediate maintenance support of topographic equipment.

Terrain assets of the theater topographic support company will support the special operations forces.

Corps

A topographic company from the battalion at EAC is placed in direct support of each of the supported corps. Capabilities of this

company include the full spectrum of topographic support as in the battalion, with personnel and equipment to provide products for corps area of operations.

Depending on the distance from the battalion and the tactical situation, the topographic company may be attached to the corps for administration and nontopographic logistics support. The topographic battalion at EAC provides topographic supply and intermediate maintenance for topographic equipment.

A terrain analysis element of the company is placed in direct support of the corps G3/G2 and another terrain element remains in general support of other customers, such as the G4, engineer, and signal. They furnish rapid-response and special-purpose topographic support to the corps staff for operations planning and IPB. The production assets remain available to all in a central location. The surveyors are normally operating throughout the corps area extending geodetic control.

Other elements of the company may be task-organized and placed in support of a supported division or task force for a limited time for a particular tactical operation. Requirements that cannot be met by the company because of priority workload or complexity are passed to the topographic battalion for completion.

The corps topographic engineer company is centrally located in the corps rear area. Selected personnel from this company provide forward support at the corps G3/G2. Terrain analysts working in the G3/G2 require routine access to all-source intelligence when preparing and updating products. Personnel require a top secret (TS) clearance and special background investigation (SBI).

Division

Division terrain teams should be in direct support or attached to their respective divisions. Tasking authority should normally be with the G2, with the advice and assistance of the Division Engineer.

Priority is placed on providing terrain analysis support to the division staff for operations planning and IPB. The terrain detachment at the division is collocated with the G3/G2 planning and operations staff. They have immediate access to all-source intelligence information that is vital when preparing updated products. Personnel require a TS/SBI clearance.

The terrain analysis detachment is typically attached to the division for administration and nontopographic logistics support. Topographic supply and intermediate maintenance of topographic equipment are provided by the topographic battalion at EAC through the company at corps level.

Other elements of the topographic company at corps level may be task-organized and placed in direct support of the division for a limited time. They provide expanded capabilities to support tactical operations as needed.

Operations

Preparation for combat begins in peacetime. To ensure success in combat, peacetime military unit operations and training have always stressed developing and maintaining a high state of readiness. The major purpose of topographic operations in peacetime is to prepare the tactical commander to execute wartime missions.

Topographic operations during peacetime are of utmost importance because of the need to gain knowledge about potential battlefield terrain. Wartime topographic operations are addressed in CONPLANs/OPLANs/OPORDs. Joint operations plans have a separate MC&G operations annex—Annex M (see Appendix). With contingency operations more likely in the future, rapid production of image-based products, terrain data bases, and tailored topographic products becomes more critical.

Terrain analysis is the key to obtaining information about potential battlefields in any part of the world. The information collected and stored in data bases is used to prepare special-purpose topographic products and decision aids for the commander to visualize and understand the battlefield terrain. These activities assist both military planning and tactical operations.

An important facet of operations carried out by topographic engineer units is production and reproduction of topographic products (hard-copy and digital). Data bases, imagery, and other information sources are used to make topographic products such as those listed in *Table 1-1, page 1-3.*

Support efforts play a direct role in military operations. For instance, the following topographic information must be known during prebattle activities:

- Mobility corridors.
- Obstacles (natural and man-made).
- Landing zones.
- Key terrain features.
- Gap crossings.
- Lines of communication.

During battle, support shifts to providing tactical commanders with updated products to support the tactical operation. During postbattle, the emphasis switches to—

- Updating terrain data bases.
- Preparing for the next battle.
- Supporting postwar cleanup.
- Humanitarian and civic actions.

Maintaining enough stock of technical supplies to produce special topographic products in the field is a vital topographic engineer support function. This function is explained later in this chapter.

PREPARATION FOR TOPOGRAPHIC OPERATION

Data Bases

In Army topography, databases are assembled to form the basic reference material needed to produce special topographic products. Responsibility for assembly of these functional data bases lies with the topographic unit commander, other army agencies, and the DMA. Information in each topographic functional area data base may be combined or exchanged with the others. Data bases can be digital, image-based, or hard-copy information from a variety of sources.

Geodetic Positional Data Bases. This consists of a listing of geodetic control points set up within a given geographic area and keyed to standard topographic maps (trig list). In addition, the PPDB and digital point positioning data base (DPPDB) produced by the DMA is included in the survey data base.

The Survey Information Center. This center does the following:

- Receives data and information from surveyors.
- Reproduces and disseminates positioning information.
- Provides technical interpretation of survey data to users.

The topographic engineer unit commander must consider all aspects of required survey data and acquire the data necessary to satisfy operational requirements. Data acquired may be used to satisfy eventual combat needs such as siting—

- Air defense systems.
- Field artillery weapons.
- Communication systems.
- Aviation inertial navigation positions.

Terrain Analysis Data Base. Terrain analysis teams acquire as much terrain data as possible for their respective areas of interest. The DMA is responsible for producing the planning terrain analysis data base (PTADB) at a scale of 1:250,000, and the tactical terrain analysis data base (TTADB) at 1:50,000 scale. Terrain teams use the data bases to support the maneuver commander's needs. The DMA produces standard DTED and ITD used by terrain teams. In any area of the world where coverage is not available and the commander's OPLAN considers the area(s) operationally significant, the terrain analysis team must prepare these digital and hard-copy data bases. Much of the peacetime operations is dedicated to this effort.

The terrain analysis data base also contains information from any source deemed appropriate by the terrain analysis supervisor at EAC, corps, or division levels. The DMA and the Army TAC of the Topographic Engineering Center provide information appropriate for this data base. Both produce transparent terrain-factor overlays for many areas throughout the world at map scales of 1:50,000 and 1:250,000. For each map sheet, the overlays depict—

- Vegetation.
- Surface configuration (slope).
- Surface materials (soils).
- Transportation.
- Obstacles.
- Surface drainage.
- Bridge information tables.
- Water resources (1:250,000 scale for selected arid regions only).

Standard digital data includes-

- DTED Level I - Contour information is equivalent to 1:250,000 scale mapping. It is the basic data base for portraying landforms, slope, line of sight, and elevation in digital format.
- DTED Level II - Contour information that approximates a 1:50,000 scale map.
- ITD - These are six factor overlays at a scale of 1:50,000 that is the digital equivalent of TTADB, or at a scale of 1:250,000 that is the digital equivalent of a PTADB. This is designed to provide digital terrain-analysis data for systems being fielded before the production of standard tactical terrain data (TTD). The Digital Topographic-Support System (DTSS) uses this information to perform automated analysis for-
  - —Terrain visualization.
  - —Route or site selection.
  - —Mobility or countermobility planning.
  - —Intervisibility.
  - —Cover and concealment.
  - —Communication planning.
  - —Landing and drop zones.
  - —Navigation.
  - —Fire-support planning and execution.

Each unified and specified command and select federal agencies identify to the DMA (through command channels) those areas of the world that need standard terrain factor overlays and digital data. After the DMA produces these terrain analysis overlays, they are provided by automatic distribution to Army topographic units and included in their terrain-analysis data base.

Besides supporting the standard DMA program, the TAC produces various other types of standard and nonstandard, worldwide terrain products for many different users. Regional area studies and operational guides for desert, arctic, and tropical areas are examples.

Various agencies produce geographic studies and analyses. The Defense Intelligence

Agency (DIA), the US Geological Survey (USGS), allied nations, and commercial agencies maintain their own type of terrain data bases. Imagery from digital and analog sources is included in the terrain analysis data base. Sometimes imagery is more complete or more current than map overlays and can be used to augment or update overlay information. Imagery is available through Army intelligence, TEC, and the DMA channels. Additional information may be obtained through the intelligence-collection process from the tactical units. Other units involved in providing this information are from the following elements:

- Reconnaissance units.
- Engineers.
- Combat and combat service support elements.

Topographic units must be prepared to rapidly create data bases to support contingency operations. By their nature, contingencies cannot be accurately forecast and standard data bases from DMA and other sources may not be available. The primary responsibility for collecting and processing data base materials in a contingency is with the topographic company and battalion.

Topographic units can prepare for likely contingencies by acquiring imagery of potential contingency areas in advance. MSI should be requested through command channels. Close coordination with intelligence staffs is required to assure access to national imagery and other intelligence data early in a crisis. Topographic units must routinely practice the production of image-based products and hasty terrain analysis from imagery and other nonstandard data sources so products can be provided to early deploying contingency units.

The TEC and the Intelligence and Threat Analysis Center (ITAC) have capabilities to quickly produce topographic data and terrain intelligence data during national emergencies. This data may be in hard-copy or digital form. Topographic battalions should maintain liaison with TEC and ITAC to ensure access to any production capabilities available.

As a contingency operation continues, topographic units will continue to produce products and continue to build, expand, and densify the data base. Topographic unit commanders must aggressively manage this dynamic, growing data base to ensure all potential data is incorporated; data is checked for validity before incorporation into the data base; old, inaccurate data is removed when superseded; copies of the current data base are pushed to subordinate topographic support units; and collection of critical terrain information is tasked to appropriate units.

Production. Topographic production includes graphic portrayal of information (usually in cartographic and photographic format) and reproduction of these graphics.

The cartographic and reproduction data base used by topographic engineer units includes at least a single copy of every available 1:250,000 and 1:50,000 scale military map or local national map in each unit's area of interest. A map may be used to produce a negative and a positive film copy. This copy is placed in the cartographic or reproduction data base. The copy is used to produce a black-and-white (monochrome) reproduction of the standard, four-color topographic map. This monochrome reproduction base can be used as the background for—

- Operations or situation map overprints.
- Terrain analysis map overprints.
- Crash grids.
- Other kind of map overlays or overprints.
- Route reconnaissance overprints.

The cartographic and reproduction data base may also include separate color flats used by the DMA to make a standard, multicolor topographic map. These flats, or reproducibles, represent separately each color found on the map. They can be used when a multicolor map base is required for updated or operational overprints. By using the color flats and updated graphics to print both the map base and the overlay or other information in the same press, the overprinting problems with using DMA printed products are eliminated.

Analysis of the Area of Operations

Analysis of the characteristics of the area of operations and an estimate of its effect on friendly and enemy capabilities occurs during the planning sequence as well as during the conduct of operations. It is generally presented as a document with accompanying graphics.

Mission Analysis

Topographic, particularly terrain analysis, support provides friendly staff elements with essential information used in the mission area analysis and course of action development as well as in the preparation of many of the annexes developed for an operations order (see FM 101-5). This support integrates the same aspects and graphics described below for the IPB (threat) analysis as they apply to friendly operations and equipment.

IPB. The IPB is a systematic and continuous approach to analyzing the enemy, weather, and terrain in a specific geographic area. Much IPB activity takes place before the battle, allowing commanders to make advance decisions that affect possible CONPLANs/OPLANs/OPORDs development. This approach integrates the following.

- Enemy doctrine.
- Weather and environmental effects.
- Terrain.

Ž Enemy capabilities and vulnerabilities.

Ž Courses of action.

NOTE: See FM 34-130.

Graphics are basic to IPB analysis. Staff members involved in the IPB process use—

Ž Annotated military maps.

- Multiple overlays.
- Annotated image maps with overprinted grids.
- Map substitutes.
- Textual studies.

Graphics are often digitally created and stored so current information can be integrated quickly. These graphics are the basis for many aspects of intelligence and operations planning. They serve, too, as an extension to the analysis of the area of operations and the intelligence estimate.

Ideally trained and equipped to aid in this process, topographic units are vital to the success of IPB. Engineer terrain analysts analyze the battlefield terrain and the effects of weather and environment on it. They predict the impact of terrain on military operations. Intelligence order-of-battle analysts correlate aspects of terrain with enemy combat system capabilities. Both types of analysts combine their talents to analyze the military aspects of terrain (OCOKA). Together they provide the tactical commander with more valuable information than either could provide separately.

Factors Affecting Operations

Topographic engineer operations, like all military operations, are affected by the factors of METT-T. Different types of military operations affect the type,

frequency, and amount of topographic support required. Examples of different operations include—

- Offense.
- Defense.
- Rear-area combat.
- Military operations on urbanized terrain (MOUT).
- Special operations.

Communication networks and unique technical supplies essential for topographic support affect the degree to which and the efficiency with which this support can be provided.

Topographic engineers have little organic protection from attack and require outside assistance to maintain security. As a result, these units must carefully select battlefield locations that offer maximum unit survivability.

The ever-changing battle space of military operations may be a factor affecting the availability of topographic support. Forward-based combat units can be positioned several hundred kilometers away from rear-based support activities. Thus, it is important that these forward units have adequate topographic engineer support readily available to reduce their reliance on rear-based support.

SUPPORT TO MILITARY OPERATIONS

The topographic engineers provide support to all types of military operations. The topographic engineers perform the majority of their warfighter support in the predeployment and decisive operations phases of force projection. Topographic support is also provided in nation assistance and disaster and humanitarian relief missions.

Force Projection

Predeployment Activities. The majority of the topographic work effort occurs during the predeployment activities. During this phase, a threat to our national interest is recognized, its nature determined, and a series of options developed to resolve the threat. The primary mission of topographic engineers is to gain maximum knowledge of the potential area of operation and impart that knowledge in a quick, simple, useful format to commanders and their staffs. Topographic engineer functions are organized, support operations are initiated, terrain and survey data is collected, and initial products are produced and distributed before deployment of forces. Topographic assets are task-organized and tailored to the mission. This stage of military operations requires the largest amount of topographic preparation. Commanders use current CONPLANs/OPLANs/OPORDs to anticipate and identify, through command channels, their topographic support requirements.

The DMA compiles, produces, stores, and supplies—

- Bulk standard maps, charts, and related products.
- Standard terrain analysis data bases (both digital and analog).
- Digital topographic data.

Using all-source intelligence and the DMA products, topographic units develop functional data bases for specific geographic regions. Contingency operations may occur on short notice in an area where few standard DMA products or data bases exist Topographic units must be prepared to quickly access all-source intelligence and other sources to quickly build a data base. This can be used to produce hasty products to support planning and execution of the contingency missions.

The data bases provide the basic reference for the production of special-purpose topographic products to support the planning requirements of the tactical commanders. Collection and maintenance of the topographic data base is a primary function of the topographic unit.

DMA produces, maintains, and stores the bulk of standard MC&G products required during the first 60 days of combat. The products are stored in map depots throughout the world. The DMA continues to provide the bulk of standard topographic products needed for the decisive operation. Topographic units supplement and enhance the DMAs efforts by providing quick, combat-oriented topographic information products to Army commanders and staffs at theater, corps, and division levels.

Information is provided orally, by quickly prepared image-based products, quick-response graphics, or by video display terminal.

The first level of topographic support will likely be collected from fixed (such as DMA, DIA, and TEC) CONUS and forward-deployed organizations, Imagery will be obtained with remote sensors. In some cases, the information may reflect data gathered during previous exercises, deployments, or nation assistance efforts. National systems need to be accessed to provide unique data to topographers. Data sources and products include, but are not limited to, multispectral imagery and image maps, local maps, climatology, geography, demographics, and digital data. Other sources of data include DMA-produced standard digital data, DTED, DFAD, ARC digitized raster graphics (ADRG), ITD, TTD, station descriptions, and trig lists.

Deployment and Entry. Deployment and entry of topographic engineer forces (terrain teams and surveyors) may be early. Early collection of local data is of primary interest. Terrain teams will continue the collection of data to enhance analog and digital data bases. All available information from allied and local sources will be incorporated. Data may include maps, country studies, lines of communication (LOC), water resources, hydrologic information, books, pamphlets, reproducible material, and imagery. Limited reconnaissance may be required to validate the terrain information. Surveyors will establish geodetic control in the theater as soon as possible to support artillery, aviation, intelligence, and signal operations. They must be able to convert local datums to the DMA standard datum for use in our weapon systems.

Topographic support should be well established in the area by this phase. Rapid collection and production of topographic products is used to support the continuing IPB process and operational planning in a timely manner. Rapid response is paramount. Geodetic control is extended throughout the region.

Data collection and data base management continues upon the entry phase. As the operation matures, data base maintenance and topographic support will peak. Topographic units will update digital data and provide map backgrounds and tactical decision aid (TDA) support for the Army command and control system (ACCS) suite of systems as well as a multitude of other automated systems. In this situation, it is the Army topographic engineer's responsibility to supplement DMA's standard support to these systems. information may include—

- Analysis through deep-battle target interdiction.
- Information on mobility and countermobility.
- War damage.
- Weather analysis impact.

Information is provided orally, by quickly prepared image-based products, or by quick-response graphics.

When resupply is interrupted or products no longer portray up-to-date conditions, topographic units also provide expedient substitutes. These products are prepared in limited quantities to meet critical needs. Topographic units are responsible for updating data bases with current information as it becomes available. Changes to these data bases are managed intently and redistributed as required by designated topographic units. Verification of these for incorporation into master data sets will be accomplished as soon as possible and normally requires the assistance of DMA.

Topographic survey units provide quick and accurate positional information needed by command, maneuver, weapon, and support systems. This is done through the establishment of a survey information center located within the topographic battalion or company.

Decisive Operations. The focus in this phase is the culmination of all previously collected topographic information with tactical and operational planning. The tactical commander is provided with expedient, tailored and updated topographic products to assist in planning and control of the battle space. Fast responses, especially at the corps and division level, allow the commander to—

- Visualize the terrain.
- Make rapid decisions.
- Anticipate the impact of terrain and weather on the current and future operations.

The IPB process plays a primary role m prebattle support. Engineer, weather, and intelligence personnel work together. It is important that the topographic engineer company at corps maintain direct contact with the corps all-source analysis section and SWO. This contact ensures that intelligence materials required by terrain analysts are available, such as—

- Imagery.
- Enemy obstacle information.
- Target locations.
- Enemy order of battle.
- Enemy equipment characteristics.
- Weather data.

Conventional and digitally produced material are important during this stage of operation. These products must be readily available before combat. Prior to combat actions in the decisive operations phase, tactical commanders and topographic engineers must jointly establish priorities for products and coordinate their production. Common terrain products are to be “pushed” to the customers by the topographic units. This ensures that commanders are provided with accurate and timely support.

The IPB process is continuous. Maneuver commanders will require mobility information in order to move their units on the battlefield. The data bases used, which include the latest information of the operational area, are supplemented by the topographic engineers. Quality assurance by the terrain analyst ensures that all maneuver elements are provided defined avenues of approach and that trafficability information is correct, ensuring synchronization of the force.

Maneuver forces are not the only elements that require topographic support. Combat service needs terrain information for convoy routing, cover and concealment, and storage sites.

Topographic engineers use real-time intelligence to produce tactical decision aids identifying changes on the battlefield in time to influence the battle. As the battlefield changes, topographic units must be able to respond quickly to new requests for information. Due to the dispersed nature of the force, critical topographic data must be delivered electronically across the battlefield.

Restoration and Redeployment. Combat capabilities lost during the decisive stage

must be regenerated. Restoration of the force ranges from sustainment (rearm, repair, recover, or replace) through reorganization and regeneration to redeployment.

Topographic engineers provide a variety of products to the force during restoration. Updating the topographic data bases is their most important task. This prepares the reconstituted force for the next operation.

In addition to providing support to the regenerating forces, topographic engineers must also be able to react to the reconstitution process. Sufficient special materials must be on hand to replenish exhausted stocks. Equipment must be repaired or replaced as necessary. The topographic support teams must remain flexible and be able to respond to mission or task organization changes.

The events of a military operation are cyclical. The majority of the reconstituted topographic support forces will be task organized to provide support for the next operation.

Nation Assistance. Topographic operations assist in documenting changes to the areas or provide initial information. Long-term programs can generate skills and jobs. Nation assistance can occur in areas where few standard products are available. Extensive topographic effort may be required to prepare topographic data bases which will be used to produce products in support of the forces providing nation assistance. Nation assistance missions offer opportunities to build and manage a dynamic and growing data base.

Humanitarian and Disaster Relief. Operations of this nature are likely to occur in areas where standard product coverage is not available. Topographic units must aggressively coordinate with the military headquarters providing support and local, city, state, and national civil authorities to gain access to available data. This ensures the widest possible dissemination of any products produced by Army topographic engineer units. Topographic products should be pushed to military forces and other relief agencies until they have an opportunity to state their specific requirements.

During contingency operations, peacetime engagement, disaster relief, or nation assistance, topographic support must be task organized to provide the required support. Allocation of topographic engineer units must be made based on an estimate of the magnitude of the topographic mission. The estimate must consider—

- The size of the operations area.
- The availability of the standard topographic products and data bases.
- The time available.
- Ž The level of backup support available from DMA, TEC and ITAC.
- Ž The size of the unit supported.

An entire company or battalion may be required to provide rapid response to forces conducting a short-notice contingency in an area that is not well mapped. Early in the deployment it may be best for major elements of the supporting topographic company or battalion to remain at the home station, where they are assured access to source materials and no loss of productivity due to preparation for movement. Products can be produced, printed, and shipped forward until it is appropriate to deploy the topographic engineer assets.

Communications

Topographic engineer units have limited radio and wire capabilities. In order to carry out effective missions they rely upon communication networks of supported units. The unit commander must establish communications to lower headquarters and to supported units. This, along with internal communications, will effectively use all the unit's available communication assets. Topographic units will usually require additional support from supported units.

Technical Supplies

Topographic engineer units require large quantities of low-density supply items, such as—

- Map paper.
- Printing inks.
- Drafting supplies.
- Map-size photographic film.
- Lithographic printing plates.
- Chemicals for photographic developing and printing.

In some topographic functional areas, it is impossible to provide support without these supplies. Because topographic technical supplies are low-density, the unit commander must start proper and adequate logistic coordination in order to get supplies from the unit providing support. This is especially important during peacetime.

Contingency stocks of wartime supplies, such as map paper, must be planned for by topographic and logistical commanders. For the contingency stocks to remain usable, perishable materials (shelf-life items) must be rotated.

Because topographic engineer units at corps level and below are not collocated with their battalions, getting supplies can become an administrative and logistical problem. The higher unit headquarters must attempt to help lower headquarters in dealing with problems associated with providing topographic technical supplies.

Technical Maintenance

Properly scheduled and performed maintenance is the cornerstone to success in combat. Failure to execute a successful maintenance program for the topographic equipment can lead to failure to meet mission requirements. The low-density topographic technical equipment usually cannot be readily repaired. Commanders must ensure that the unit has properly trained maintenance technicians and uses them in the most effective manner possible. The Defense Mapping School offers courses for additional skills in reproduction equipment repair and survey instrument repair. These courses provide units with capable repair technicians for the topographic equipment. Commanders must ensure that the repair technicians are used to the fullest extent. Additional duties and details assigned to these individuals may adversely effect the unit's topographic equipment maintenance program. Commanders are responsible to ensure that the nonmission capable (NMC) topographic equipment is properly documented and reported. A tendency to overlook a nonreportable piece of NMC topographic equipment may lead to the inability to accomplish a mission. Proper documentation and historical files on topographic equipment assist in obtaining equipment upgrades and or new items.

APPENDIX

TOPOGRAPHIC OPERATIONS ANNEX TO CONPLANs/OPLANs/OPORDs

All corps-level and higher commands prepare a topographic annex to all CONPLANs/OPLANs/OPORDs. This annex provides the direction needed by subordinate elements of the command to obtain support from topographic units and guidance for the employment of those units. At division-level and below, this information may be in an appendix to the engineer annex or in accordance with local SOPs. The format for the topographic annex is shown on Appendix-3. This format is the same as that used by the unified and specified (U&S) commands, which is Annex M (MC&G) of the Joint Services Operations Plans (JSOPs). Note that all the references in this appendix refer to a general OPORD. Proper preparation of the annex demands detailed identification and definition of all requirements for topographic products and services, whether provided by the DMA or field units. The preparation of the topographic annex is not limited to topographic products, but applies to any products and services in the MC&G field which are required to support the command's CONPLANs/OPLANs/and OPORDs.

As with the preparation of any CONPLAN/OPLAN/OPORD, the quantity and complexity of information contained within the format of the annex or appendix will vary with the level of the unit developing the plan. For instance, preparing the annex for a brigade without a supporting topographic unit will be quite simple compared with that for a corps. As a minimum, maps and charts required for operational support must be identified.

The types of products and services needed to carry out unit missions and the quantity and frequency of the support desired, are addressed in the Format for Topographic Annex shown on Appendix-3.

To calculate the quantity of maps required for a particular OPLAN, plot the geographical areas covered by the unit's areas of operations and interest on copies of appropriate indexes from the DMA or on a MACOM map catalog. A small-scale map of the general area may be used to plot and correlate the area to the index. Factors to be considered in setting up areas of operations and interest are given in FM 100-5. Areas of operations are designated by the next higher level of command. An alternative method is listing the stock numbers for all the sheets required. Usually a combination of both methods is done, since each has specific advantages.

The next step is to determine the size and type of units to be employed, since this defines the quantity of products required to support the OPLAN. The MACOMs usually publish supplements to AR 115-11, which contain a list of generic units and the quantities of MC&G products each is authorized to order. If a supplement has not been published, the tables found in Section IV,

Topography, of FM 101-10-1/2 provide the necessary guidance. The quantity per sheet is then the sum of authorization for all subordinate units. The quantity per sheet multiplied by the number of sheets required for the geographical area is the *basic load*. The term *days-of-supply* is meaningless for maps, since the speed with which a unit moves through any given area is determined by the mission as influenced by weather, terrain, and the enemy situation.

Planning stocks are those maps required by commanders and staffs to plan an anticipated operation. Allowances, most of the time, are no more than 20 percent of the basic load. Command guidance should define whether or not this quantity is authorized in addition to or *part* of the basic load.

Operational stocks are those consumed, through loss or destruction, during execution of CONPLAN/OPLAN/OPORD, that must be replaced. Operational stock allowances are usually limited to no more than 20 percent of the basic load.

Overlap must be considered. A simple addition of authorizations for all units under a command is not the total number of maps required for any particular map sheet. To figure this total correctly, look at the geographic area coverage required for each unit at any level, based upon the unit's mission and employment capabilities. Questions such as "Do all brigades in a division require coverage for the entire division area?" need to be addressed. For an infantry squad or a tank platoon, the answer should be "No." On the other hand, entire coverage may be required for an attack helicopter unit in the covering force or a brigade in reserve, even though all the maps may not be in use at the same time.

(Appendix-3 through Appendix-9 is an excerpt from JCS Publication 5-03.2, Volume II).

Format for Topographic Operations Annex M

CLASSIFICATION

HEADQUARTERS, ORIGINATING UNIT
ADDRESS
DATE

ANNEX TO M HQ OPLAN (NUMBER) (U)

TOPOGRAPHIC OPERATIONS (U)

(U) REFERENCES:

a. List those standard maps that are required for an understanding of this annex.

b. List those documents which provide the guidance required for the necessary planning functions that are relevant to this annex.

1. ( ) SITUATION

a. ( ) MC&G Requirements. List the MC&G products that are required to support this plan. Show desired area coverage and quantitative requirements using an appendix if necessary or by portraying them graphically using standard index bases.

b. ( ) Available Products. Provide a general statement regarding the availability and adequacy of the MC&G data and related material required to support the plan.

c. ( ) Capabilities. List those topographic engineer forces that are assigned or attached. Show latest arrival date (LAD) for each topographic engineer unit that is contained in the time-phased force deployment data (TPFDD). If this is of sufficient length, use an appendix for recording detailed transportation requirements and procedures. Reference the appendix. Take notice that the format for the appendix should follow local procedures.

CLASSIFIED BY_____
DECLASSIFY ON_____

CLASSIFICATION

CLASSIFICATION

d. ( ) Supporting Capabilities. List those topographic engineer forces that are not assigned or attached but which will be required to provide topographic support needed to implement this plan, including units not deployed. Specify the type of command relationship desired for each unit plus the type and duration of support required.

e. ( ) Assumptions. List those assumptions upon which this annex is based. The assumptions should state expected conditions over which the commander has no control.

2. ( ) MISSION. Restate OPLAN mission statement.

3. ( ) EXECUTION

a. ( ) Concept of Topographic Operations.

(1) ( ) General. Give a broad statement on how the command will provide the topographic support necessary to meet the commander's overall mission requirement. Include—

- Time phasing of operations.
- Nature and purpose of topographic operations to be conducted.
- Support that is interrelated or cross-service.
- Support from the DMA.
- Support provided by agreements, coordination, and cooperation necessary for the successful implementation of this plan. Describe the scope and extent of host nation support (HNS) that is available to enhance topographic operations in support of the plan.

(2) ( ) Deployment. Summarize the requirements for deploying topographic engineer forces and depot activities from their normal peacetime locations. Include the area of operations, emphasizing careful time planning of this deployment.

(3) ( ) Employment. Describe in general terms how deployed topographic engineer forces are to be employed to conduct topographic operations.

b. ( ) Tasks. Proper planning demands that provisions be made for the effective operation of all topographic engineer units supporting the command. Effective stockage and issue of MC&G products depend upon timely knowledge of impending operations,

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threats, and command movements. Explain detailed responsibilities of commanders, staff, and topographic units. In separate numbered subparagraphs, list the topographic tasks assigned to each element of the command and for those units that provide support to the plan. Each of the tasks should be spelled out in a concise statement. Every task statement should include a mission to be performed in terms of further planning or execution of the overall plan. These task assignments should be sufficiently detailed to ensure that all elements essential to the concept of the operation are described properly. Ensure that responsibilities are assigned to establish, validate, and submit MC&G requirements and to task topographic engineer units supporting the plan State responsibilities for defining and adjusting command stockage levels at map supply points. Specify map and data storage and distribution responsibilities for pick-up and storage.

c. ( ) Coordinating Instructions. The final subparagraph, lettered appropriately, should be in separately numbered subparagraphs. List those instructions that apply to the entire command or to two or more elements of it that are necessary for proper coordination of the MC&G support. Specify points of contact within the command who can authorize the release of war reserve stocks held or who can resolve command MC&G problems. At division level, the DISCOM operates the map supply points; at brigade level, distribution is from forward support battalion supply company through the supply officer (US Army) (S4). You must state whether a *push or pull* system will be employed. You must also specify any restrictions or quantity of the special products which may be required. Also, give an explanation of the command's system for setting priority and for allocating resources to deal with demands on limited resources. Include a brief description of how notification of forces and agencies will be carried out and how notification will be time sequenced. Provide the conditions under which contacts with host nation agencies are authorized and identify those points of contact.

4. ADMINISTRATION AND LOGISTICS

a. ( ) Supply and Storage.

(1) ( ) MC&G Products. Provide instructions on the MC&G supply and storage procedures and requirements. Give guidance for obtaining routine and emergency replenishment of MC&G products. Address any expected constraints on this replenishment Include the planned locations of command and supporting MC&G storage sites and facilities. Specify the type and quantity of MC&G products to be held by the supporting command's units. Give guidance for lead times that are required for furnishing nonstandard special-purpose product support or responding to large quantity orders.

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(2) ( ) Support of Topographic Engineer Units. Topographic engineer units normally rely on supported units for the majority of logistics support. Specify the requirements needed for the provision of nontopographic as well as topographic logistics supports.

b. ( ) Transportation.

(1) ( ) MC&G Products. The MC&G products are normally provided on a supply-point basis, whereby units which need products are responsible for picking up those products from established supply points. Supply guidance for the movement of MC&G products from supporting supply points to the ultimate users. List as a minimum, the time-phased transportation requirements list (TPTRL) portion of the TPFDD reflecting movement of MC&G materials. List any transportation shortfalls in the required support of topographic operations. Also, list contingency plans to fully carry out and sustain topographic operations in the event that full transportation requirements cannot be provided. An appendix may be used, if necessary, to list detailed transportation requirements and procedures.

(2) ( ) Topographic Engineer Units. Topographic engineer units may also require assistance from supported commands to move organic equipment. Supply guidance for integrating the topographic engineer unit's transportation requirements into the command's movement plan.

c. ( ) MC&G Support. Supply instructions for obtaining planned support Itemize the division of responsibilities between organic units and supporting topographic engineer units to ensure that actions to procure and stock MC&G products are complementary. Identify points of contact for emergency procurement. Normally, access to the DMA support is only available through the supporting command.

d. ( ) Reports. If reports are required, specify how they are to be formatted as well as what time limits, methods, and classification apply to their submission. Enter this in the appendix. Follow local procedures for format.

5. ( ) COMMAND AND SIGNAL

a. ( ) Priorities. Delineate the priority of MC&G support to supported units and the priority of production for MC&G products.

b. ( ) Command Relationships. Include primary and alternate locations of all major topographic engineer units and supporting the DMA organizations. Specify the command and control relationships between the command and its attached or supporting MC&G units and organizations if this has not previously been addressed.

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c. ( ) Command and Control. Provide a statement describing the scope and types of any special signal support that is required for MC&G operations. With the exception of survey units, most topographic units have few communications capabilities. Thus, explicit tasks are assigned to ensure that these units are effectively supported by the command's assets. This is especially critical in the case of distribution platoons operating map supply points. The Communications-Electronics Annex to this OPLAN must be referenced.

s/
General
Commander in Chief

CLASSIFICATION

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OFFICIAL:

(APPROPRIATE LEVEL) ENGINEER

Appendices:

1 - Mapping, Charting, and Geodesy Requirement List

2 - Mapping, Charting, and Geodesy Transportation Requirements (Optional)

3 - Mapping, Charting, and Geodesy Reports (Optional)

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(FORMAT: Mapping, Charting, and Geodesy Requirements List Appendix)

HEADQUARTERS ORIGINATING UNIT
ADDRESS
DATE

APPENDIX 1 TO TOPOGRAPHIC ANNEX TO HQ OPLAN (NUMBER) (U)

MAPPING, CHARTING, AND GEODESY REQUIREMENTS LIST (U)

REQUIRED ITEMS 1/	COVERAGE REQUIRED 2/	COVERAGE AVAILABLE 3/	Quantity 4/
1. STANDARD AEROSPACE PRODUCTS			
2. STANDARD HYDROGRAPHIC PRODUCTS			
3. STANDARD TOPOGRAPHIC PRODUCTS			
4. STANDARD AIR TARGET MATERIALS			
5. SURVEY REQUIREMENTS			
6. STANDARD MULTIUSE DATA BASES			

1/ Generalized description such as a map series, scale, or digital data. Stock number of a specific item is not required.

2/ Area to be covered described by geographic coordinates, political boundaries (identified by geopolitical codes), and recognizable geographic area. Display in a TAB as a graphic or list.

3/ Display status in a TAB as a graphic or list related to coverage required, or source for special-purpose products.

4/ Number of copies of each sheet, chart, or item needed to support the OPLAN. A list by stock number is attached as a TAB.

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DECLASSIFY ON_____

CLASSIFICATION

30 SEPTEMBER 1993

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
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GLOSSARY

ACE	Assistant Chief of Engineers
ACCS	Army command and control system
ADE	Assistant Division Engineer
ADRG	arc digitized raster graphics
AR	Army regulation
ARAPS	area requirements and products status
ATTE	Assistant Theater Topographic Engineer
CAS	close air support
CCM	cross-country movement
CERL	Construction Engineering Research Laboratory
CINCs	Commander in Chiefs
COMMZ	communications zone
COMSEC	communications security
CONPLAN	contingency plan
CONUS	continental United States
CRREL	Cold Region Research Engineering Laboratory
DA	Department of the Army
DADMS	Defense Mapping Agency Automated Distribution Management System
DCSINT	Deputy Chief of Staff for Intelligence

DCSOPS	Deputy Chief of Staff Operations
dept	department
det	detachment
DFAD	Digital Feature Analysis Data
DIA	Defense Intelligence Agency
DISCOM	division support command
DMA	Defense Mapping Agency
DMAINST	Defense Mapping Agency Instruction
DMIS	Defense Mapping Agency Management Information System
DMMC	division materiel management center
DPPDB	digital point positioning data base
DOD	Department of Defense
DTED	Digital Terrain Elevation Data
DTSS	Digital Topographic Support System
EAC	echelon above corps
ENCOM	engineer command
engr	engineer
FLIP	flight information publication
FM	field manual
FSO	field support office
G2	Assistant Chief of Staff, G2 (Intelligence)
G3	Assistant Chief of Staff, G3 (Operations and Plans)
G4	Assistant Chief of Staff, G4 (Logistics)
HNS	host nation support
HQ	headquarters

HQDA	Headquarters, Department of the Army
HTF	how to fight
IPB	intelligence preparation of the battlefield
ITAC	Intelligence and Threat Analysis Center
ITD	interim terrain data
JCS	Joint Chiefs of Staff
JOG	Joint Operations Graphic
JSCP	Joint Strategic Capabilities Plan
JSOP	Joint Services Operations Plan
LAD	latest arrival date
LOC	lines of communications
MACOM	major Army command
MBT	main battle tank
MC&G	mapping, charting, and geodesy
METT-T	mission, enemy, terrain, troops, and time available
MGID	military geographic information and documentation
MNS	mission needs statements
MOUT	military operations on urbanized terrain
MSI	multi-spectual imagery
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological, chemical
NMC	nonmission capable
NOE	nap-of-the-earth
OCOKA	observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach

OPLAN	operation plan
OPORD	operation order
PMS	product maintenance system
PPDB	point positioning data base
PTADB	planning terrain analysis data base
S2	Intelligence Officer (US Army)
SAEDA	subversion and espionage directed against United States Army
SBI	special background investigation
SIGINT	signals intelligence
SOF	special operations force
SOP	standing operating procedures
STANAG	standard NATO agreement
SWO	staff weather officer
TA	theater Army
TAC	terrain analysis center
TAACOM	theater area commander
TAP	Terrain Analysis Program
TDA	tactical decision aid
TEC	Topographic Engineering Center
TM	technical manual
TOC	tactical operations center
TOPO	topographic
TPFDD	time-phased force deployment data
TPTRL	time-phased transportation requirements list
TRADOC	United States Army Training and Doctrine Command

TS	top secret
TSCM	technical surveillance countermeasures
TTADB	tactical terrain analysis data base
TTD	tactical terrain data
(U)	unclassified
US	United States (of America)
U&S	Unified and Specified
USACE	US Army Corps of Engineers
USAES	United States Army Engineer School
USGS	United States Geological Survey
VOD	Vertical Obstruction Data
WES	Waterways Experimental Station

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PREFACE

This manual provides the principal doctrine for topographic operations in support of military operations. It describes the functions of topographic operations as they relate to extended operations in terms of depth, time, synchronization, and unity of effort. It is designed to be used by Army unit commanders and staffs, primarily at corps and division levels.

Topographic operations consist of an interrelated flow of information and products through the various Department of Defense (DOD) agencies. The Defense Mapping Agency (DMA) is the primary agency involved. Through agency intelligence and other engineer channels this flow of information is passed onto the tactical units. These operations provide the commander with an effective means to evaluate the battlefield in terms of mobility, countermobility, and survivability; gain knowledge of the battlefield; visualize the terrain; and apply all available topographic information on each unit's areas of operations and interest.

The proponent for this publication is the United States Army Training and Doctrine Command (TRADOC). Submit changes and comments for improving the publication on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Blank Forms). Arrange comments in sequence by manuscript page, indicating exactly how a portion should be reworded with a brief reason for the change. Send comments to Commandant, United States (US) Army Engineer School, ATTN: ATSE-TDM-P, Fort Leonard Wood, MO 65473-6650.

Unless otherwise stated, masculine nouns and pronouns do not refer exclusively to men.

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