

Engineer, Bring Me a Map!

By Lieutenant Colonel Douglas Campbell

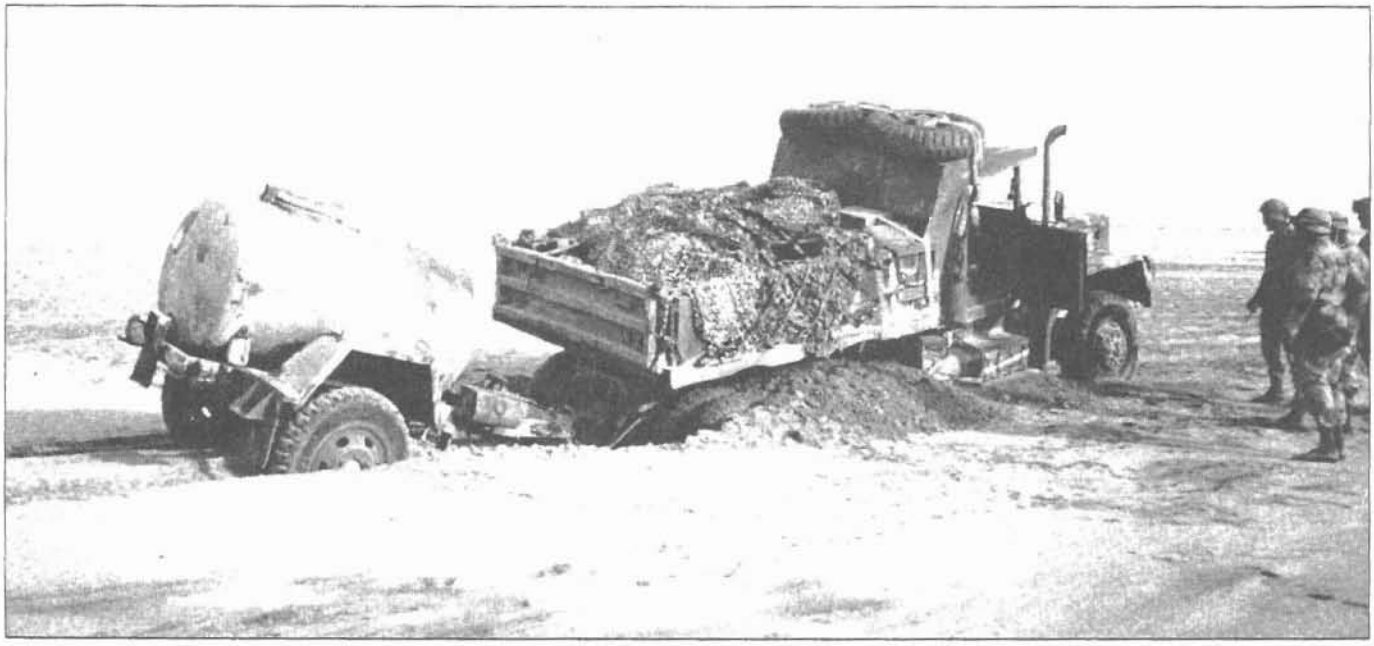
Engineers are experiencing many changes as the Army evolves to a smaller force. The well-publicized engineer restructure initiative has made restructure, reorganization, and deactivation the order of the day. A proposal currently under consideration at the Engineer School will reduce the number of engineer officer specialties by eliminating the topographic engineer specialty (21C).

The proposal supports the downsizing effort by reducing the number of engineer officer specialties from four to three, at a time when there are fewer engineer officers to go around. This course of action would require every engineer officer to be a topographic engineer, and every engineer would become, in effect, the commander's topographic support expert.

A Key Mission

This change would have an enormous impact because topographic engineers have a key role in a contingency army. For many years, the topographic community focused on strategic requirements and a few key geographic areas, such as Europe and Korea. Many maps exist for these familiar areas, but each new deployment to a place like Grenada, Somalia, or Southwest Asia sends the topographic community into a mad scramble to provide support.

It will take years for the Joint Chiefs of Staff and the Defense Mapping Agency (DMA) to shift from strategic support to conventional support in contingency areas. At the same time, the technology for



Mobility is more than just breaching and bridging. It's also keeping commanders off untrafficable ground.



Surveyors establish precise positions using GPS survey receivers.

providing topographic support is changing rapidly. Thus, engineer officers could be faced with the dual challenge of providing more topographic support to deployed forces and with maintaining technical competence as topographic engineers.

Although topographic support is an engineer responsibility, engineer officers have traditionally treated it as a separate specialty. In fact, topographic engineering was once a separate specialty (the 22 career field). Only a few engineers have filled topographic engineer positions. Of these, most have carried the 21C designation and have seldom served in other types of engineer assignments.

Most nontopographic engineers don't view this group as "real engineers" or "warfighters." This is partly deserved because many topographic engineers have failed to maintain tactical competence or focus and have totally immersed themselves in the technical aspects of their work. As a result, many topographic engineers have been of little value to commanders whose needs they don't understand. At the same time, many nontopographic engineers have failed to appreciate both the tactical significance of topographic support and the difficulties of providing that support. Thus, eliminating the separate topographic specialty would require a significant change in attitude in both camps. And "real engineers" (who already have a lot to do) would have to learn what engineers must be, know, and do to become the commander's topographic expert.

Topographic engineers perform several key functions, which translate into a list of subjects that every engineer must master. Engineer officers, from lieutenant through colonel, support combined arms commanders who must synchronize several battle operating systems (BOSs). Each echelon of engineers, then, must master all or part of that list if engineers are to accomplish the topographic support mission. This list falls into three major categories. Topographic engineers must—

- ***Understand the basics of mapping, charting, and geodesy (MC&G) support.*** They serve as the Army's member of the DOD team charged with providing this support to the entire armed forces. Put simply, commanders need maps, and topographic engineers make sure that they get them.
- ***Be terrain analysis experts.*** They work closely with combat engineers and military intelligence officers to provide terrain analysis support to tactical commanders on the AirLand Battlefield. Every BOS requires some form of topographic support.
- ***Maintain the technical expertise necessary to manage MC&G and terrain analysis support efforts.*** Not only must they understand those requirements; they must also know how to focus essential support as commanders synchronize the BOSs. This means that topographic engineers must have a warfighter's perspective to anticipate the tactical commander's terrain analysis requirements. They must also have the technical competence necessary to acquire that support in time for it to be of use to the commander.

MC&G Support

In the role of MC&G staff officer, topographic engineers advise commanders on BOS requirements, standard products, nonstandard support, and geodetic support.

BOS Requirements. Topographic engineers must know what MC&G support each BOS needs to operate and advise commanders on how to get that support. This implies that engineers must understand how other BOSs operate. The engineer lieutenant must know the company team commander's

Military Aspects of Terrain (OCOKA)	Elements of Terrain Information	Examples of Terrain Analysis Products
Observation and fields of fire	• Vegetation (summer and winter) • Surface configuration • Obstacles (micro relief) • Battlefield environmental effects on terrain • Urban areas	• Horizontal line-of-sight for direct-fire weapons and radar • Emplacement suitability and performance ratings for ground surveillance
Cover and concealment	• Vegetation (summer and winter) • Surface configuration • Battlefield environmental effects on terrain • Urban areas	• Potential cover from direct and indirect fire (good/fair/poor) • Potential concealment from horizontal and vertical observations (good/fair/poor)
Obstacles	• Vegetation (summer and winter) • Surface configuration • Drainage characteristics • Natural and man-made obstacles • Micro relief • Surface materials (wet and dry) • Urban areas	• Location of existing natural and man-made obstacles • Potential mobility on the battlefield, expressed as GO, SLOW-GO, and NO-GO for tracked 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 landslide areas, bridges, choke points, high ground, and key military installations
Avenues of approach	• Vegetation (summer and winter) • Urban areas • Surface configuration • Surface materials (wet and dry) • Drainage characteristics • Lines of communication	• Identification of areas where movement of friendly and enemy forces may occur • Speed prediction • Drop zones • Landing zones • Landing beaches • Nap of the earth navigation

business, the engineer captain must know the task force commander's business, and the field grade engineer must know the brigade and higher commanders' business.

This is not a new concept. Engineers have always needed this perspective to accomplish mobility, countermobility, and survivability support. In the future, however, they will need to develop additional appreciation for topographic requirements not directly associated with those engineer missions.

Standard Products. Topographic engineers must know every standard topographic product used to support their echelon of combined arms operations. They must fully understand the specifications, uses, and limitations of those products and how to acquire them. However, most engineer officers lack this basic knowledge.

For example, many don't realize that three versions of the standard military 1:250,000-scale map exist. The Joint Operations Graphic-Air (JOG-A) has contours in feet and elevation tinting. The Joint Operations Graphic-Ground (JOG-G) has elevations in meters and standard map colors. The Joint Operations Graphic-Radar (JOG-R) is another form with specific applications and different shading. All three are made from the same base map, and each has a specific use. Without such basic knowledge, engineers cannot function well in the topographic arena.

Nonstandard Support. Since a contingency force is likely to deploy to areas where standard products

are not available, topographic engineers must know which nonstandard products they should expect. They must know what is available, the limitations for that support, and how to acquire it. They should be familiar with image-based map substitutes and understand the limitations of imagery. They need to know the characteristics and limitations of Landsat (multispectral scanner and thematic mapper), SPOT (a French satellite-imaging system), and other remote-sensing imagery.

Geodetic Support. Topographic engineers also need a grasp of some basic geodesy subjects. They must be able to use different coordinate systems, such as geographical versus universal transverse mercator (grid) (UTM) coordinates. They must also understand datums and coordinate transformations. Deploying forces will probably have nonstandard products generated from different datums and using different coordinate systems. Engineer officers must also be global positioning system (GPS) experts. As such, they must know the strengths and limitations of that system as well as how to navigate with it.

Terrain Analysis

Topographic engineers serve as commanders' terrain analysis experts. Terrain visualization, the essence of terrain analysis, is more than simply "seeing" the battlefield. It also involves interpreting the impact of what the commander sees on BOSs. To perform this role, topographic engineers must fully understand both tactical decision making and how to acquire the required terrain analysis support for the decision-making process.

Topographic engineers cannot anticipate commanders' needs for terrain information unless they become full participants in several critical processes:

- ***Intelligence preparation of the battlefield (IPB).*** Topographic engineers must be IPB experts. Terrain affects every BOS (enemy and friendly), and terrain analysis is a key step in IPB.
- ***Command estimate.*** Topographic engineers support the commander and staff as they develop and wargame friendly courses of action. They must fully understand the impacts of terrain on each course of action considered and provide the information needed to visualize that terrain influence before the wargaming process begins.
- ***Intelligence collection.*** Topographic engineers must advise commanders and intelligence officers (S2/G2) on terrain intelligence requirements as well as on which units should be tasked to collect that information.

Technical Proficiency

Engineers must also understand some technical aspects of topographic support, especially digital topographic support and existing support systems.

Digital Topographic Support. Many forms of topographic support are in digital form. Moreover, given the difficulties of map distribution, the future means of sharing topographic information will probably be based on one or more digital systems. To perform well in such an atmosphere, topographic engineers must be familiar with computer, collection, and data systems. They must understand what a geographical information system is, the concept of an integrated data base, and the implications of both of them for providing support to a contingency army. They must also understand the temporal nature of some topographic information—after all, engineers routinely alter the terrain.

Finally, topograpic engineers must know a data set's resolution (level of detail) and the accuracy associated with it. For example, many systems use digital terrain elevation data (DTED), which permits commanders to visualize the impact of terrain on operations. There are two levels of DTED, with level II providing a much finer resolution than level I. There are also several sources of DTED data. DMA manufactures most DTED from photogrammetric sources, but they have used less accurate cartographic sources in many areas.

Existing Support Systems. Topographic engineers must know how to use the TerraBase, TerraCAMMS, the battlefield planning system on the Maneuver Control System (MCS), the MCS-engineer software, and the analytical photogrammetric positioning system (APPS).

All engineers should know how to exploit topographic support elements. Terrain teams, surveyors, cartographic capabilities, and map reproduction capabilities are available throughout theaters. However, engineers must also know how map distribution should work and how to get special support to those who need it in time for that support to be useful.

The Road Map

So, how do engineers become topographic engineers? The Engineer School must first develop a training and education program to make every engineer a competent topographic engineer. Then, engineers need a mix of institutional training, operational assignments, and self-development to make the program work. But a cultural change is also required. Those who have been topographic

engineers must develop a better warfighter perspective. In turn, warfighters must develop a topographic perspective.

To accomplish all this, the Engineer School needs a strategy or master plan for eliminating the 21C specialty. It should address four key areas: the topographic engineer task list, a developmental plan for that task list, key positions requiring special training, and assession standards for engineers.

The Task List. A system already in place articulates what an officer should be, know, and do—Military Qualification Standards (MQS). The Engineer School must develop for MQS a comprehensive set of topographic engineer tasks that spell out the required topographic skills. The task selection board should be balanced between topographic and nontopographic engineers.

A Development Plan. Next, the Engineer School must decide which mix of institutional training, operational assignments, and self-development is required for topographic engineer training. The Engineer Officer Basic and Advanced programs of instruction are already full. Consequently, operational assignments and self-development will be critical to a topographic engineer's development.

To avoid recreating a "de facto" topographic specialty, assignment officers at PERSCOM must ensure that they do not assign officers in back-to-back assignments dealing exclusively with topographic engineering. In addition, the Engineer School will have to ensure that materials are available to make self-development a practical reality.

Key Positions. The Engineer School and Engineer Branch must designate key topographic positions that require extra training and education. Officers in such positions would then attend either graduate school or a Defense Mapping School course en route to the assignment. These positions include joint MC&G staff jobs, Army Education Requirements Billets (AERBs) with DMA, and topographic engineer program managers in the Engineer School.

Assession Standards. Finally, the Engineer Branch needs to recruit new officers who already have engineering backgrounds. That would free a number of hours in basic and advanced courses now dedicated to engineering subjects for covering basic topographic subjects. Currently, many engineer officers in basic and advanced courses have neither the aptitude nor the inclination to perform relatively simple calculations, procedures,



GPS: The commander's new compass

and analyses associated with construction engineering. If one engineer officer must be all engineers to all commanders, then the Engineer Branch must have a head start when new officers arrive. Like it or not, each future engineer officer will need to be much more a technician but no less a warrior.

Not Done Yet

Change for engineers is inevitable. The pressure to reduce the force, consolidate functions, and redefine roles will continue. Hopefully, the new Army will still get the quality of engineer support in all areas, including topographic engineering, that it deserves. Whether or not this happens will depend, in large part, on how well we tackle issues such as eliminating the topographic engineer specialty.

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