Terrain as a Force Multiplier in Operational Planning - Role of the Engineers

Lieutenant Colonel Yogesh Nair*

Introduction

Since time immemorial, terrain has played the most significant part for planning of any military operation. In executing operations on land, the study and analysis of ground is the key, as terrain configuration plays a major role in influencing the operations of ground forces. It is a must for all military commanders to understand the terrain they operate on as it deals with all physical and geographical features of a given area. The study of terrain or terrain analysis is the process of interpreting a geographical area to determine the effect of natural and man-made features, including the influence of weather and climate on military operations. In the contemporary era, as part of information dominance, the knowledge of terrain allows commanders to obtain superiority in shaping the battle space. It is thus imperative for all military commanders to visualise the terrain and its effects on the battle's outcome so that own courses of action can be structured accordingly.

Relevance of Terrain for Planning Military Operations

Terrain is a permanent and important aspect of all military operations. For ground operations, terrain information provides an important context. Key terrain is any location whose control is likely to give distinct military advantage to the force that holds it. It also identifies areas where intelligence collection efforts should be focused. In operations conducted by mechanised forces, it will be the attacker's aim to get to the sensitive objectives in the depth area the fastest; while the defender on the other hand will try his utmost to prevent the attacker from doing so. In the achievement of their respective aims, both the attacker and the defender will have to traverse and make use of the same terrain. The side which can read and analyse the terrain better and draw the right conclusions from such an analysis may well carry the day. A correct analysis of the key terrain area(s) becomes critical, because more often than not such areas may not be occupied ab-initio, by either side. Success will go to the side that identifies these areas and seizes them before the adversary can do so. Thus, the layout of terrain is a determining factor in arraying of forces, both friendly and enemy, and to orient one's own likely design of battle.

Key terrain features that allow observation of the opposing forces line of advance, is likely to give a big military advantage to the force that occupies it. Combining information about terrain features with knowledge about enemy assets can lead to inferences about possible avenues of approach, areas that provide cover and concealment, locations that are vulnerable to enemy observations, or the choke points. In addition, if force movements are observed, terrain features give additional information with respect to the intent of the enemy forces that have been observed on the move, thus confirming or negating hypotheses about enemy's likely aim1.

In the context of internal security, the study of terrain assumes importance for planning operations against insurgents / militants. The terrain aids the insurgent by providing concealment and negating many of the manpower and technology advantages of the counter-insurgency force. To achieve success, the commander needs to first overcome the terrain constraints; making terrain study and analysis imperative for planning operations in counter-insurgency scenario.

In the modern-day warfare, with the backdrop of nuclear vulnerability, terrain study becomes more relevant as troops' safety will necessitate greater accuracy of terrain intelligence concerning the areas to be occupied by own troops. Troops can be protected from thermal radiation by prominent terrain features, and other ill effects of nuclear radiation can be considerably reduced by using the folds in ground configurations. Hence, detailed terrain study is significant and inescapable.

Engineer Officers as Terrain Experts

The Engineers' responsibilities primarily pertain to enhancing tactical and strategic mobility of own forces, denying mobility to the enemy and ensuring survivability of own troops on the battlefield. Execution of these tasks requires knowledge of terrain. Thus, terrain expertise is a key element in executing engineer tasks; since, virtually all of them do involve use of ground. In fact, terrain appreciation and terrain evaluation are skills that should be second nature to an Engineers officer. Although, terrain analysis is essentially carried out by all arms and services, as also by the staff at various headquarters, Engineers are best suited for integrating data received from higher echelons with information collected from field reports and tactical sensors, to produce an integrated view of the terrain. Engineers, because of their intrinsic involvement with the layout of ground, are better poised to resolve the differences between various reports to render a single common representation of terrain configuration.

The study of terrain or topography, thus becomes an enduring combat responsibility of the Engineers. Conventionally too military engineers have been pioneers in the field of terrain mapping2. For a military commander terrain evaluation is a critical component of battlefield visualisation. Engineers officers are trained to assist their commanders in accurate terrain analysis by identifying and evaluating the potential of various terrain features on the battlefield, both during the planning and executive stages of military operations.

Having analysed the responsibility of the Engineers in providing terrain evaluation, it is pertinent to mention that the Engineers need to be equipped suitably to accomplish their assigned tasks efficiently. One of the solutions could be to include 'Topographical Engineering' in the curriculum of the Engineers training, as skills and tools associated with topographic engineering begin with an understanding of terrain data and its uses. Terrain data may range from scanned digital map displays, elevation statistics, imagery and records of ground features3. However, for a broader perspective and an all inclusive analysis, the study of 'Geospatial Engineering' would be more relevant in the present day warfare.

Geospatial engineering combines the engineering capabilities and activities that contribute to a clear understanding of the physical environment by providing information of terrain in three dimensions with detailed

analysis to the commanders and staff. The Engineers officer can be correctly oriented to connect the geospatial engineering with tactical operations in order to take advantage of the battlefield space environment. Structured training on geospatial engineering is essential to accomplish geospatial tasks in detail and to be able to generate, obtain and / or use geospatial products to the fullest. In fact, geospatial engineering needs to form a key component of the Engineer Force Modernisation Strategy4. The proposed expansion of geospatial-support capabilities needs to be managed and controlled by the Engineers rather than the staff.

Understanding Geospatial Engineering

The importance of terrain analysis has been recognised for hundreds of years in military science. Currently, such analysis is called the Intelligence Preparation of the Battlefield (IPB). IPB is a process that starts in advance of operations and continues during operational planning and execution. It provides guidelines for gathering, analysing and collating intelligence. The purpose of this intelligence is to provide relevant inputs to the commander in his decision making process during the various stages of an operation. Engineers play a major role in the IPB process by anticipating and providing terrain analysis products to the commanders. It is then integrated with tactical inputs to ensure success of the mission. Today's integrated battlefield environment presents new challenges to the Engineers with increased emphasis on terrain data and terrain based analysis. An Engineers officer with the knowledge of field engineering and skills of topographic assessment fits into the bigger picture. He should therefore be made responsible for geospatial engineering architecture to maximise its effect for achieving meaningful results.

Geospatial engineering is in fact just a functional name change from topographic engineering and is not a new engineer concept. Engineers were hitherto still carrying out the analysis and synthesis of various military attributes and their likely effects on military operations viz. the terrain going, roads/tracks, rivers/canals/other obstacles, covered approaches, dominating features, villages/built-up areas, local resources etc to facilitate better battlefield visualisation. However, as the Army expands its capabilities through automation, the role of the terrain analysis has expanded significantly. Aerial and satellite remote sensing imagery, Global Positioning Systems (GPS), availability of UAVs and computerised Geographic Information Systems (GIS) are increasingly becoming the driving force for operational planning. Accurate information about the enemy and own dispositions, terrain features and weather pictures promise better digital command and control of military operations. The commanders need an accurate depiction of the terrain/battlefield to conduct military operations successfully, therefore, they do bank heavily on geospatial information. Digital geospatial information is the basis for a superior view of the battlespace and provides the framework upon which all other relevant strategic, operational and tactical information can be layered.

Geospatial engineering is generating, managing, analysing and disseminating positionally accurate terrain information that is pertaining to some portion of the earth's surface. These actions provide mission-tailored data, tactical decision aids, and visualisation products that define the character of the battle zone for the operational commander. Key aspects of the geospatial engineering missions are databases, analysis, digital products, visualisation and printed maps. Geospatial information that is timely, accurate and relevant is a critical enabler for the operations process. Geospatial engineering provides commanders with comprehensive terrain visualisation, which improves situational awareness and enhances decision making. Thus, geospatial engineering is indelibly linked to information dominance and is one of the key elements in the success of any operation in a sophisticated and highly digitised battlefield environment today and in the future5.

Geospatial solutions involve systems in accessing, displaying, analysing and presenting spatial data across the spectrum. They are capable of providing two and three dimensional analyses; thus, providing support to commanders in assessing offensive and defensive solutions for timely planning and effective decision making. The system capabilities6 would include the following:-

(a) Display of Map with Military Grid. Ability to seamlessly use geodata available from military mapping agencies and display map with military grid.

(b) Preparations of Overlays. Overlay capabilities that include insertion/deletion of specific topographical features, terrain attributes, tactical overlays, military symbol library etc to reduce clutter and for a better assimilation of cartographic features required by the user.

(c) Analyse the Terrain. Use terrain analysis tools to determine optimum sites for bridging, crossing of obstacles system, landing sites etc.

(d) Dissemination. Inbuilt export functions for sending the overlays instantly to other formations/units over low bandwidth WAN/LAN communication.

(e) Three Dimensional Visualisation of Battlefield. Three dimensional view, fly-throughs, visibility analysis, terrain profiles, going maps etc.

Geospatial Intelligence is a new intelligence discipline emerging out of the convergence of geospatial engineering and imagery information. The convergence is due to tremendous technological advances in digital data processing, precision geopositioning systems, remote sensors and imageries. These advances allow data to be moved and manipulated interchangeably between imagery products, maps and charts. With the advent of GIS software tools, digital databases rather than vulnerable paper maps and charts, have become the key medium for visualising geospatially referenced information. Therefore, geospatial intelligence can formally be defined as the exploitation and analysis of imagery and geospatial information to describe, assess and visually depict physical features and geographically referenced activities on the earth. It is the merger of geospatial data with imageries so as to arrive at layers of information that depict the physical and cultural features of the area of interest in three dimensions and allow users to visualise inaccessible terrain. Through accurate three dimensional visualisation, geospatial intelligence allows rapid understanding of the physical environment and rapid evaluation of adversary's courses of action. Geospatial reference data, such as digital terrain elevation and terrain feature data provide the environmental context, while latest

satellite or aerial imageries of the area of interest gives the dynamic perspective.

In the context of military operations, the growing demand for battlefield transparency has been the most important factor behind the emergence of new geospatial intelligence discipline. The evolving rapid pace of operational targeting cycle and the massive volume of targets and rapid targeting needs have placed immense stress on the intelligence production process. The timeliness required for rapid, precision oriented engagement of targets demands closer integration of the tools and processes of the imagery specialists, who detect and characterise targets, and the geospatial specialists who characterise and measure the battle space. Decisions at the highest level, including when and where to launch combat operations are getting more and more dependent on geospatial intelligence. To create the basic picture of the environment in which the forces are going to be deployed is crucial; both, for military operations across the border and in the internal security context. Geospatial intelligence embraces the concept of IPB covering the layout of the terrain and environment, the infrastructure, roads, bridges, railway system and many more features that are relevant to operational planning.

Two types of products can be thought of towards generation of geospatial intelligence. One can be called the global reference data sets on any given area of interest and the other product type can consist of mission-specific data sets. The target should be to provide automated, realistic, three-dimensional, fly-through, drive-through and walk-through representations of areas of interest.7 Highly accurate terrain-visualisation tools will be of great value to decision makers, strategists, special forces etc, particularly for mission planning and rehearsals. There is also a need to develop a wide knowledge base so that an image analyst or a military planner in future could access the database through a secured web portal and look for what one needs with the help of user-friendly tools.

Conclusion

Terrain is a permanent and unconditional component of all military operations. Military commanders have long realised the interdependence of the earth's land features and success on the battlefield. Military strategists and commanders of yesterday and today recognise that the side which gains mental and physical dominance of the terrain has a decisive advantage. Yet, terrain is often far more complex than meets the eye or is portrayed by a map. Dominating it requires additional study and analysis in geospatial engineering; and the Corps of Engineers is best suited to take on the responsibility in this field for the Army. Engineers are the commanders' immediate guides; they provide the knowledge and tools of all three engineering battlefield functions so that the commander can wield the ground as a weapon against the enemy and as a combat force multiplier for the friendly forces. Therefore, just as the Engineers officers must be combat engineers and operational works specialists, they must also be the commanders' terrain experts.

***Lieutenant Colonel Yogesh Nair** was commissioned into the Corps of Engineers on 10 Dec 1996 and is a graduate in Civil Engineering. He is an alumunus of Defence Services Staff College, Wellington. Currently, the officer is posted as GSO1 (Ops) at HQ 24 Infantry Division.

Journal of the United Service Institution of India, Vol. CXLI, No. 584, April-June 2011.