WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Geographic Information System (GIS) As a Force Multiplier

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ABSTRACT

Geographic Information System (GIS) plays a pivotal role in military operations. It brings geography and terrain into the mainstream of military decision making. It enables spatial information to be created, queried, analyzed and visualized in real or near real time and can be tailored to the requirement of the user. GIS, in brief, is essential to obtain common operational picture. Armour being a manoeuvre element in the army depends mostly on terrain and weather. Thereby, during peacetime, if the terrain and weather data is compiled and updated in the form of digital tank going maps, it will reduce the time of physical reconnaissance. Integration of GIS will thus facilitate in performing staff jobs, make the spatial referencing available, war gaming more efficient and less labour intensive thus acting as a force multiplier to increase combat efficiency. The research focuses on the issues concerning the usages of GIS as a force multiplier and how to integrate the various governmental and non governmental organizations (which have terrain data) to fit in the tailored military need.

Keywords: Geographic, Information,System, Integration, multiplier, military, command, control,project.

1.Introduction

1.1 Military history is full of examples wherein a small army having a good knowledge of the terrain defeated a much larger and well equipped army. In the period of antiquity, the great military commanders like Hannibal, Chenghiz Khan and Napoleon relied on first hand terrain information for demonstrating their classic indirect approaches. Collecting terrain data and collating information therefrom to create battlefield awareness were not an easy task for them. They developed indigenous techniques of command and control (C2) to suit their requirements. That is how; all military activities become terrain sensitive and need careful planning and reconnaissance to ensure success. The parameters like topography, soil type and land use have a direct bearing on key military activities like; mobility of both men and machines, methods of crossing obstacles, selection of tactically important areas etcetera.

1.2 Present day maps that contain information of restricted and unrestricted terrain are either compiled earlier or became redundant due to recent changes of surfaces. It is equally difficult to incorporate the changes of features on paper maps. Rapid urbanization is also adding complicacies in planning and executing the tactical exercises by diminishing the training areas which severely degrading the battle efficiency. These phenomena are not only applicable to corps of armour, rather it is identical to all the combat support (CS) and combat service support (CSS) echelons of the army.

1.3 Future battlefield environment will demand rapid acquisition, collation and dissemination of information to enhance battlefield transparency, thereby enabling quick decision making by commanders both at tactical and operational levels. The fog of war will never be lifted unless DMP keeps pace with rapid tempo of battlefield. This tempo is determined mostly on the faster response of the participants in observation-orientation-decision-action (OODA) loop. The inherent weakness of our present command, control, communication and intelligence (C3I) structure lies in gathering and processing of vast amount of information to arrive at a logical solution within a specific time. At present, the adoption of intelligence preparation of battlefield (IPB) and DMP is almost complete in most of the C2 hierarchies of the army. The system developed and discussed in this paper is capable of taking inputs form various sources like; satellite images, aerial photographs, digital terrain model (DEM) or other ancillary data to assist the dynamic process.

2.GIS and Its Components

2.1 GIS is a system for capturing, storing, checking, integrating, manipulating, analysing and displaying data which are spatially referenced to the earth. In other way, it is a system of computer software, hardware, data and personnel to help manipulate, analyze and present information that is tied to a spatial location (usually a geographic location), information (visualization of analysis of data, system linking software, hardware, data)

and personnel (a thinking explorer who is key to the power of GIS).

2.1 Mapping Techniques: It is a fact that, military needs maps for conducting operations and each operational requirement differs from others. To meet these requirements the digital base map comes into being, which facilitates the creation of different types of maps to meet specific situation without clustering with unwanted details. This also aids in viewing of spatial information on need to know basis either at headquarters or in the field.

2.3 **Military GIS Requirements are Different:**GIS based civil application focuses on specific requirements while military commanders would be performing analyses on variety of types of information. However, the key question is to acquire information superiority as was amply demonstrated during the Gulf War by Allied forces. 'The lessons gained from military history indicate that the key to military victory lies in remaining ahead of the enemy in time sensitive SCORE loop of C4I process.

2.4 **A GIS Assisted an Armour Regiment**. Being a manoeuvre element, an armour regiment relies mostly on information of ground and weather. During peace time, terrain information would thereby needed to be stored and regularly updated keeping in view its probable deployment. This terrain database will cut short the time of physical reconnaissance to a large extent.

3 An Integrated GIS Solution For C3I Support

3.1 Organizational Issues of GIS in Team Support Decision Making

3.1.1 **IT as the Foundation**. The introduction of IT into a headquarters demands a top-down approach. This should examine the top level demands and then design to meet the requirements. This approach cannot work until there is an acknowledgement of IT and its inevitability to change the way we do planning. At present, the armoured brigade headquarters focuses on map board around which group decision support take place and where the commander's intent is passed to his staff. The talc paper on the map board has primacy for displaying the current and common operational picture (COP).

3.1.2 **Iterative Decision Making.** The whole mechanism of decision support within the headquarters relies on the mechanism to iterate toward optimum course of action (COA). Each individual cell (operation, intelligence and logistics) conducts its own OODA cycle that interacts with all the other cells' OODA cycles. Presently the interaction is based on human contact; visiting other cells to determine how a particular action may impact others.

3.1.3 **Urbanization and its Effect on Training/Operations.** It is evident that, the present modus operandi of warfare is leaning towards asymmetry. Rapid urbanization in most of the parts of BD poses a serious threat in finding ideal places for practicing battle drill in peacetime. 'Dhaka metropolitan area is now expanding and urbanizing without any plan due to the reason of rapid increase of population in this area. Furthermore, necessary countermeasures such as urban planning, urban management and so on cannot be executed due to the lack of precise large scale topographic maps'.

4 System Requirements and its Affiliated Complexities

4.1 Compatibility of GIS Based System. The diversity of requirements of a GIS based tactical information system has a rich variety of GIS applications and no single GIS software can meet all the requirements. The need for seamless integration to a heterogeneous GIS data sources demands an interoperable system. Further, an operational information system data will need to be propagated to and fro across a large number of service users.

4.2 **Cell-based Decision Making**. The proposed solution distributes decision support processes to individual cells within this headquarters. There is a danger that the human interaction which provides the current checks and balances will be diminished as a result. The individual cells will provide better individual solutions but the overall solution may not be better because of the lack of interaction among cells.

5. GIS AS A Force Multiplier

5.1 **Automation of Information System:** The manual information processing system is not suitable for future conflicts for two main reasons; firstly, the dynamics of fluid battlefield will demand near real time combat intelligence and secondly, the proliferation of sensors and fluid battlefield situation will generate enormous volume of information which will be impossible to process without computers. It is therefore, imperative to develop an automated system for data processing which can receive information directly from interfaced sensors, carry out target identification and situation

assessment and present a cohesive picture.

5.2 **Intelligence and Reconnaissance**. Modern techniques in handling and processing vast information are getting more users friendly. Global positioning system (GPS) and GIS also brought into existence a powerful tool that has location and visualization aspects and can be effectively utilized in battle field surveillance systems. GIS allows data to be displayed in such a way that patterns can be easily recognized that otherwise may have gone unnoticed. In addition, the intelligence requirement will be more for conducting operations other than war like; counter terrorism, in aid of civil war and obviously in peace keeping missions.

5.3 Battlefield Surveillance. Battlefield Surveillance is one of the most important force multipliers. GIS has been developed into powerful system with various functionalities which make it easier for the user to utilize spatial and non spatial data. Specific GIS functionalities in battlefield surveillance are:-

6 Design of the Proposed Implementation Plan

6.1 Current military IT planning tends to be based on fitting the technology to the existing doctrine. This approach ignores the revolution that IT will cause in the battlefield. Many will counter saying that, IT is merely an evolution from paper and GIS is an evolution from map. But unless IT is taken seriously, the difficult components of IT are the first to be neglected. Similarly, GIS is a complex component that exposes some potentially expensive questions. More so, technology cannot be just placed into a void. It has to meet a stated need. What must be recognized is that, the need will rapidly evolve. IT life cycles are measured in months and this is the pace that defence organization must maintain. GIS demands a sound IT infrastructure to build upon, and it is only recently that processing power on the desktop has been able to support GIS. Now that an increasing number of users are appreciating the benefits that spatial referencing brings, the spreading network through defence is beginning to grow rapidly. The key question is one; how to keep pace in the most cost effective way and common perception is that; evolution of software capability will demand over specified hardware.

6.2 An Analysis of Present System and the Proposed Design

6.2.1 **Maintaining a Command Post/Operation Room**. A survey was carried out to find out the relative expenditures involved in maintaining a command post/operation room. At present, managing these is a cumbersome affair which entails recurring expenditure.

6.2.2 **Commercial off the Shelf (COTS) Resources and Government Agencies**. There are many civilian organizations in BD which sells GIS based solutions. These organizations possess skill manpower to support a GIS system. ESRI's ArcGIS Military Analyst software is a unique example which manages all possible military issues. Besides, the government organizations like; SOB, LGED and SPARRSO contain vast amount of terrain data and requisite infrastructure to manage a GIS based solution. The proposed system envisages that, for the time being, a capital investment is not necessary to collect terrain data. Though a tentative investment is required to build the infrastructure but major investment will be reduced if the data sharing is ensured among these organizations.

6.3 The Proposed Design. The proposed design is discussed below:

6.3.1 **A Three Tier System**. Firstly, the business tier would provide the required platform suitable for developing the background through which rest of the enhancement would proliferate. Secondly, the required terrain data would be provided through an integrated effort of various governmental andnon governmentalorganisations.In the third tier, the distributed users located in different places would be using a customised solution specifically designed to meet the need of a particular tactical situation.

6.3.2 **What We Can Do Indigenously?** The technological advancement in the field of data transmission (wireless) and sharing has leaped to such a limit that the potential seems to be limitless. Even a low cost solution is feasible in our country using various commercial sources and tailoring it to fit with the military requirements. Once the network is built to share data, a distributed environment will be created keeping a central map bank as the nucleus which would be connected to field formations.

6.3.3 Managing Hardware and Software. The system envisages a wide spectrum of hardware and software acquisition. Presently though the price of the hardware is manageable but the software purchase is as an expensive matter. In this paper few COTS software (ESRIs ArcView) has been mentioned but there are many software designers in our country who are apt and skilful both in managing and producing similar software.

6.3.4 **Managing Skill Manpower**. The survey indicated that, computer literacy among the officer corps of the army is gradually increasing. Formation of IT directorate and imparting advanced training on IT subjects have ushered a promising future.

6.4 **Related Problems Associated With the Proposed Integration**. Since BD Army doesn't have a network for distributing and storing such data, at this moment it would pose a major barrier. Inter-ministerial level coordination to accept data sharing might also entail a long time frame to implement. On the other hand, market forces drive commercial software and there are some serious limitations of developing a GIS based tactical information system for military use based on COTS software. Purchase of good GIS software does not guarantee a good military tactical information system

application. There is high dependency on the tailor (in this case the customising agent) thereby increasing the risk factor.

6.5 **Cost Analysis of the Proposed Implementation Plan**. The implementation methods fall into four main categories; direct conversion from the old to new, parallel conversion - where both old and new systems run alongside on another for a short time period, phased conversion - where some of the functions of the old system are implemented first then other follow and trial and dissemination, for example the running of a pilot system then appropriate conversion to a new system

7. Conclusion

7.1GIS offers a virtually unique ability to aggregate, automate, integrate and analyse geographic data which further enhances the intelligence base for defence and security operations. Its parameters include software, hardware, human explorer and a defined organisational requirement. In the military, maps are used for different purposes and each requirement caters for a specific purpose. The digital base map facilitates the creation of different types of maps to meet specific user needs without clustering with unwanted details. This also facilitates the viewing of spatial information on need to know basis either at command headquarters or in the field. Usually, military commanders would like to know terrain conditions, elevations for manoeuvring APCs, tanks and for deployment of various weapon systems.

7.2 The future battlefield scenario would be vastly different from its traditional version. Technological superiority, weapon effectiveness, capabilities for rapid response and precision strike will be more important than numerically superior but inferiorly armed armies. The existing C3I structure of the armoured bde HQs is not capable enough to handle fast paced flow of information and managing a fluid battlefield as the commanders not only remain baffled with the mundane queries like; the layout of the terrain for units' deployment and weather's effect on it, let alone visualize the future move of the enemy. Recent adoption of IPB and DMP has further compounded the problem of storing, analysing and displaying various data. The potentials of GIS based system are limitless as it can combine various sources like; DEM, terrain model, 3D view, spatial analysis, use of MOLE and satellite imagery. Such system will also help in preparing forces in the peacetime by using simulation. A GIS based tactical battlefield system would also provide a comprehensive solution and a step ahead where commanders and soldiers would be able to see and operate within a COP. Hence the command post driven by the power of GIS would be better equipped to rapidly respond to changing battlefield scenario and aid in deciding to employ the assets in hand.

7.3 The rapidly growing concept of RMA basically derives its driving force from IT. The effect of technological RMA can not remain unnoticed even being a third world army. Incorporation of IT based solution to ease up regular intelligence activities and command/staff training is hereby to stay. It has also to be understood that, the digital divide should be narrowed by developing some indigenous means within the limited resources to increase the efficiency of conventional capabilities. The concept of force multiplier is, a capability that, when added to and employed by a combat force, significantly increases the combat potential of that force and thus enhances the probability of successful mission accomplishment.In this regard, GIS to be viewed as a force multiplier once super imposed on existing planning procedure of the movement of armour regiment and C3I functionalities of the armoured bde HQs.

Recommendations

8.1 Based on the facts and probabilities stated in this articlesfollowing are the recommendations:

8.1.1 A pilot project can be undertaken to validate the feasibility of the system through a two tier programme:

8.1.1.1 By preparing tank going maps for an armour regiment.

8.1.1.2 By automating C3I functions of the armoured bdeHQs.

8.1.2 An initiative to be pursued at army headquarters level to integrate various organisations and resources to share terrain data.

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