Impact of GIS Modelling in Military Operational Planning

KRP Rowel[1], KTRB Kodippili[2] and
HW Wasantha Ranasinghe[3#]
wasanthahwr@gmail.com

Abstract- The operation planning process takes considerable time and requires sound intelligence regarding the battlefield in preparing a successful operation plan. It is a globally accepted fact that sound planning and preparation well before an operation gives an immense advantage to the success of any battle. The Intelligence Preparation of the Battlefield (IPB) process is an important aspect in the operation planning process in the modern battlefield. Speed of the output, flexibility, timeliness, accuracy and future usage are essential parameters in this process. The IPB process is conducted using manual overlay drawing methods in Sri Lanka at present. The research proposes a Geographic Information System (GIS) model in conducting the IPB process using ArcGIS software. It was found that the proposed GIS model has the advantages of time saving, easiness, accuracy, flexibility and future usage than the manual method which is used in carrying out the IPB process in the country. The research also introduces a Model Builder Application to conduct terrain analysis as part of the IPB process which increases the speed of the proposed GIS method. However, Defence authorities in Sri Lanka are still lagging behind in introducing GIS to the operational planning process. The research also focused in finding the reasons for not using GIS and identified that lack of training on GIS, lack of knowledge on GIS application and lack of IT resources are the reasons for the limited usage of GIS in the military. Finally, the research recommends introducing GIS based platform not only for conducting IPB process but also other operational planning processes.

***Keywords*-GIS, IPB, Battlefield**

I.INTRODUCTION

It is globally accepted fact that sound planning and preparation well before an operation would give an immense advantage to the success of any battle. The operation planning process takes a considerable amount of time and requires sound intelligence about the battlefield to prepare a successful operation plan (Creveld, 1985). Terrain analysis plays a vital role in military operational planning process and requires considerable time. Though commanders have a well-trained staff at their headquarters they face numerous difficulties in operation planning process due to these reasons.

In Sri Lanka IPB process is conducting by manual overlay drawing methods. Traditional 1:50000 printed maps

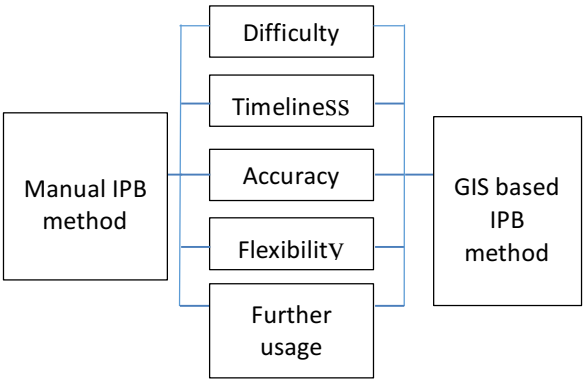
published by the Department of Survey and various overlays prepared on talc sheets fulfil the requirements of ingredients required for the IPB process in the military. This study focused to introduce a method to conduct the IPB process using GIS. The research could be useful for the Sri Lankan forces to adopt digital overlay drawing methods for the IPB process.

A. Research Problem

In the context of Sri Lankan military, Information Technology (IT) plays a major role in most of the sectors such as communication, logistic, human resource management, etc. However, there are some lapses towards its applications to operational planning. The Sri Lankan military is far behind in using digital technology in comparison to defence forces of other countries.

In the modern battlefield, the IPB process is an important aspect for the MDMP. In this process, speed of terrain analysis and accuracy of the overlays are immensely important. Basically, the IPB process in Sri Lankan military is done by using manual overlay drawing methods. Preparing overlays manually for IPB takes considerable time and it generates a heavy workload to the staff since the battlefield is subject to rapid changes in time and space.

Further, the enemy would change the COA according to the changes in the battlefield and continuing with the IPB process make it uncomfortable to the staff during the operations. Flexibility of editing overlays according to the changes in the battlefield is important factor to consider in this regard. Preparing manual overlays for rapidly changing enemy situations of a battlefield casts a heavy workload and editing manual overlays generates lot of difficulties to staff officers in hectic situations. Moreover, manual overlay drawings are personnel dependent and these drawings vary from person to person. There is a very little possibility to use manual overlays for another operation. These manual overlays can be used for only one operation. If the area of operation changed, it requires to



conduct a new IPB process.

GIS is basically used to analyse the geospatial data. It is an analytical software which can be effectively used for spatial analysis. The reason for not using GIS for IPB process in the Sri Lankan military is worthy of study. It is expected to develop a GIS model which shows the potential of conducting IPB process using GIS. The research will facilitate to reduce the uncertainty and enrich the reliability of incorporating spatial data with enemy doctrinal concepts and Commanders Critical Information Requirements (CCIR) in the IPB process.

B. Research Objectives

The objectives of the research are as follows:

- Primary Objective.

Demonstrate the potential and investigate the impact of GIS modelling for the IPB process as an operational planning tool.

- Specific Objectives.

Are as follows:

- Develop a GIS model for the IPB process.
- Develop a 'Model Builder Application' to automate the terrain analysis of the IPB process.
- Derive the advantages of using GIS in the IPB process.
- Identify the barriers in using GIS for the IPB process.

II.METHODOLOGY

The research conducted in two stages. In the first stage, it was developed a GIS model and a 'Model Builder Application' using ArcGIS software. This requires the collection of relevant data from the government establishments.

The second stage is for conducting a questionnaire survey among the officers involved in the IPB process. The questionnaire examined whether officers of different educational qualification could understand and use the proposed GIS model. The result of the questionnaire used to identify the pros, cons of the suggested method and identify the barriers of using GIS in the IPB process. The method will consist of quantitative and qualitative analysis.

C. Conceptualization

Presently the IPB process is accomplished in the Sri Lankan Military by using the manual overlay drawing method. There are some factors to be considered when conducting the IPB process, such as difficulty level, accuracy, timeliness, flexibility and further usage. The researcher introduces a new method to conduct IPB process by using the GIS software. In order to compare the manual IPB process and proposed GIS based method it considered above mentioned variables and compared both the manual and GIS methods as shown in Figure 1.

Figure 1 - Conceptualization

D.Operationalization

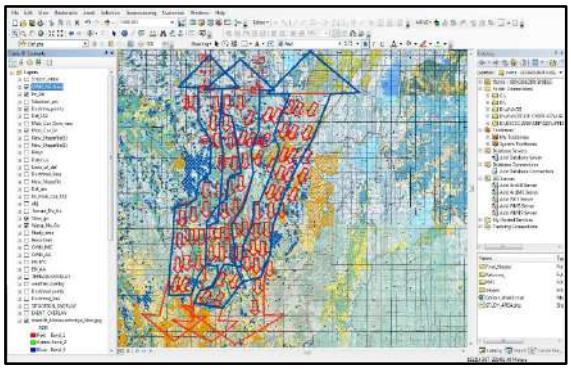
The operationalization of the concept was done through a questionnaire, which consisted of two main parts. The questionnaire focussed in obtaining the user views about the manual overlay drawing method and obtaining the user views about the GIS based IPB method. The questionnaire also focused in obtaining demographic data of the sample, which determine the educational background, GIS knowledge, computer literacy, etc. Other than the demographic data the questionnaire focused in deriving from the differences of manual IPB process and GIS based process. Questions were focused to find out the user views of flexibility, accuracy, difficulty level, further usage and time saving factors.

III.RESULTS AND DISCUSSION

Applying GIS technology for the operational planning process was demonstrated by developing a model for IPB process. Relevant terrain data was collected from Department of Survey and UDA by the researcher and it was observed that these institutions have a very expansive spatial data base. Developed GIS overlays were included in Chapter Three under the GIS model development sub topic. A picture of the GIS model is depicted in Figure 2. The objective of develop GIS model for the IPB process was achieved successfully.

Handling various overlays faces myriad of difficulties in the manual IPB process. The visualization of top most overlays are cluttered due to overlapping of overlays and only a limited area of operation can be seen due to space constraints. Handling GIS overlays required only a mouse click and it offers facilities to consider overlays separately for clear visualization. Further the GIS model offers vast flexibility in selecting area of operation due to the digital nature. A user can handle overlays of entire Sri Lanka in the digital screen. This technology can be used not only to conduct IPB process but also all the operational planning processes linked with maps and overlays in the Sri Lankan military. Silva (2007) also indicated the possibility of using GIS for the Sri Lankan military covering logistical activities, to locating, collecting and compiling military related information, etc.

Figure 2 - GIS Model



The developed 'Model Builder Application' further reduced the time required for the GIS based IPB process. It also reduced the workload of the staff. This application was developed for preparing the Terrain Overlay of the IPB process and would be benefit the users who do not have a fair knowledge regarding GIS. However, it is not possible to develop the 'Model Builder Applications' to prepare other overlays since the user uses a part of it to form decisions. Figure 50 indicates the developed model builder application.

E. Advantages of Using Geographic Information System for the Intelligence Preparation of Battlefield Process

The questionnaire survey focused in finding the difficulty level, timeliness, accuracy, flexibility and further usage. It was found that all these parameters gave a positive value to the GIS method in comparison to the manual method. As per the results the GIS based method has the following advantages:

- Difficulty Level**:** In comparison with the manual method over 63 percent of the study sample mentioned that the GIS method is easy. Only 12 percent mentioned that the manual method is easier than the GIS method. Nearly 60 percent of the study sample mentioned that the manual method is difficult while only 16 percent mentioned that the GIS method is difficult when comparing the difficulty levels of the manual and GIS methods.

- Time Saving: Considering the time required in conducting the IPB process using the manual method and the GIS method, only 20 percent completed the process in less than 4 hours using the manual method. Over 66 percent of the sample completed the process in less than 4 hours when using the GIS method.

- Accuracy: According to Figure 40, 76 percent cannot assure the accuracy of the manual method. 73 percent mentioned that the manual IPB method is personnel dependant.

- Flexibility: When comparing the flexibility level of the manual method and GIS method 66 percent of the study sample mentioned that the flexibility of the manual method as low and 70 percent mentioned that the GIS method is flexible.

- Further Usage: Seventy three percent of the study sample mentioned that the further usage of manual overlays have little possibility and 70 percent mentioned that the further usage of GIS overlays have greater possibility than the manual overlays.

IV.CONCLUSION

The IPB process is an important aspect in operation planning in the modern battlefield. Speed of the output, flexibility, timeliness, accuracy and further usage are essential parameters to depict the advantages of this process. Presently, the Sri Lankan military carries out the IPB process manually using overlay drawing methods.

The research proposed a GIS model to conduct the IPB process using ArcGIS software. The research also introduced a Model Builder Application to conduct terrain analysis as part of the IPB process, which increases the speed of the proposed GIS method. This model demonstrates the potential in using GIS for operational planning in the Sri Lankan military. It was found that the proposed GIS model has the advantages of saving time, easiness, accuracy, flexibility and further usage than the manual method. The results clearly indicate the positive impacts of GIS modelling in military operational planning. Hence, it is important to use GIS for operational planning towards achieving success in the 21st century.

BIOGRAPHY OF AUTHOR

Major HW Wasantha Ranasinghe obtained MSc in GIS and Remote Sensing from the University of Sri Jayawardanapura and MSc in Defence and Strategic Studies from the General Sir John Kotelawala Defence University. Currently he works as a Staff Officer of Headquarters, 23 Division, Punani