Optimising the Structure of Engineer Forces for a Peacekeeping Mission

Karl A. Bertsche

Defence and Civil Systems
Dornier GmbH
Friedrichshafen Germany
Postal Address: 88039 Friedrichshafen/Germany
E-mail address: bertsche.karl@dornier.dasa.de

Mr. Bertsche is a project leader and is presently completing a study for the German army engineers considering explosive demolition in a Peace-Keeping Mission in the military OR-Section of Dornier (a company of DaimlerChrysler-Aerospace). He has written object oriented Programs concerning minefield effectiveness, and an analysis tool for the sustainability of German forces. He has also programmed an object oriented dynamic model of Infantry Combat. He was previously a nuclear engineer at Babcock & Wilcox in Virginia, U.S.A. He has a Masters of Engineering degree in nuclear engineering from New York University.

Introduction

Ever since the fall of the "iron – curtain" in 1989, German forces have been participating in multinational peace support operations to resolve regional conflicts. Due to this fact, the German army initiated a study in 1994 to investigate the sustainability of crisis reaction forces for such missions. Each mission of this type has its own unique characteristics, which usually consists of a complex political, economic and military situation. Therefore a standardised force composition may seldom be an optimum for the situation encountered in a particular host nation. An attempt to apply a universally applicable list of requirements with respect to force structure, training, and materiel may be a futile undertaking since the base force structure considered for national defence tasks may prove be totally inadequate for the actual situation encountered.

Mission requirements must based on political objectives and reliable reconnaissance data, which must be obtained from a detailed reconnaissance mission performed by qualified personnel within the host nation.

System analysis allows personnel structure and materiel of a task force to be varied to find the most suitable force structure, which will meet the specific mission objectives set forth by the political decision.

In this study the emphasis was placed on the reconstruction and improvement of the basic infrastructure (improving living conditions) within the host nation. The required tasks for safeguarding adequate living conditions are performed by different army engineers units.

The study was separated into two phases. In the first phase the basic analysis approach for such missions was established and the level of detail required to perform such a mission analysis was determined. One major goal within the study is to represent the tasks and subtasks analytically. Basically all major tasks were broken down into a number of subtasks (top-down-approach). These subtasks were then analytically represented, which allows the analyst to evaluate such parameters as required time of personnel and equipment and the amounts of

materials and fuel needed. By summing the individual parameters of all the subtasks, the mission requirements are determined (bottom-up-approach).

This basic top-down/bottom-up approach led to the development of an analysis tool called SiLC (Safeguarding of Living Conditions for rapid reaction forces) which computes the level of effort, material requirements and equipment necessary to perform the various subtasks occurring within a mission. In order to test the analysis model SiLC, a predefined scenario called in German "Rasches Handeln" which translates in English to "quick response" was obtained from the army engineer school in Munich. Within this scenario the army engineers have the extraordinary task to convert a former police station into a make-shift hospital. The results of the study showed, that SiLC can accommodate any level of detail for tasks, which is necessary for analysis. With SiLC engineer personnel and associated materiel can be computed for a mission and with the help of a project management tool like MS-Project the subtasks can be transferred to generate the required schedules for the individual object. The successful completion of this study led to the initiation of the second phase. Here more typical army engineer tasks were analysed.

Objective

This paper concerns its self with the second phase on the study of sustainability of German forces in a peace keeping mission scenario. Here the objective is to demonstrate, that the model is capable of simulating conventional army engineer tasks. Within the study the effect of parallel tasks requiring the same resources is to be investigated. An important parameter is to determine the possible scheduler delays associated in performing the tasks in parallel rather than in sequence. Within the scenario which was developed by German army engineers, the following basic tasks are to be analysed:

- Construction of a base camp,
- Drilling of three water wells,
- Construction of a landing strip,
- Construction of a wooden make-shift bridge and
- Repair of four road sections.

Model Development SiLC

One of the most important results of the study has been the development of the analysis model SiLC. A modular development approach was chosen in order to facilitate the development and maintenance of the model. SiLC consists basically of five separate modules and is object oriented which means that all tasks/subtasks to be performed are related to a specific object represented on the graphical display. The graphical display also has a background whereby various graphics of the file format (i.e. BMP, TIF, JPG and more) can be included in the model. For the analysis performed in this study the background consisted of a map of Southern Germany with a scale of 1 to 50,000 (a map of any arbitrary scale can be chosen and integrated).

Within SiLC's main module, objects can be either generated directly or objects can copied from another application with a drag & drop procedure. Through a reconnaissance mission objects are identified which have to be either constructed, repaired or modified. Such identified objects can be graphically drawn as a transparent geometric objects on the map within

SiLC. A separate application contains typical drawing information for a set of predefined objects such as buildings, roads, runways, campsites and more. The drawing information is the type of object to be presented (i. e. form, line thickness and fill colour). In addition the application contains typical reconnaissance aspects for the predefined objects.

By generating an object, additional record fields are automatically generated in SiLC for 'reconnaissance information', 'guidelines/safety regulations', 'subtask definition', 'subtask evaluation', 'summation of consumed material', 'summation of man hours', 'summation of equipment hours'. After an object has been generated the record fields are still empty and must be filled by the analyst. Reconnaissance information and safety regulations are usually text information which will later define the specific requirements for the subtasks. Guidelines / safety regulations help to specify the subtask in greater detail. The subtask definition are imported from a separate application, where all tasks are analytically represented. The subtasks are usually simple equations relating, time and material to physical parameters such as length, width, height, density and more. Once an object has been defined the parameters of the equations representing the physical parameters are replaced with the actual values for a particular object. The equations can then be evaluated, whereby the results are displayed in the record field 'subtask evaluation'. In addition the summation of man hours, summation of equipment hours as well as the summation of consumed material are stored in their respective record fields.

Not only stationary objects but also force structures are also objects which are copied from another application to the graphical display of SiLC. By dropping different force components such as companies, platoons and squads, record fields like 'subtask definition', 'subtask evaluation', 'summation of consumed material', 'summation of man hours', 'summation of equipment hours' are assigned to the particular force object, which is represented by it's tactical symbol. SiLC allows the various subtasks of defined stationary objects to be assigned to different force units available on the display of SiLC. The equations describing the subtasks in the record field 'subtask definition' of the stationary object can be directly copied to the record field of 'subtask definition' of the engineer unit intended to perform the task. Automatic checks are carried out to see if the engineer unit has the capability to fulfil the assigned subtasks.

The results of the SiLC analysis can be transferred to MS-Project™ to display and schedule the individual tasks for the stationary objects and for the participating units executing these tasks. The schedules of the stationary objects are interrelated to the schedules of the engineer units. These reason is that all defined tasks related to the various objects must eventually be executed by the units within the mission force. Therefore two different views of the mission schedule are generated. One schedule shows the tasks and executing engineer units for each defined object in a mission, while the other schedule shows the number of objects and tasks that a particular unit will execute during a mission.

Results of Phase II of the Study "Sustainability"

Each of the five main tasks: construction of a base camp, drilling of three water wells, construction of a landing strip, Construction of a wooden make-shift bridge and repair of four road sections were broken down into a number of subtasks. These subtasks can be represented by a number of standardised equations yielding level of effort and materiel. These equations are then copied into the corresponding record field for 'subtask definition'. The variables of the equations are now replaced with actual values corresponding to the particular object. In a

second step the equation reflecting the subtasks can be assigned to the various engineer units which are a part of the mission force.

The results of the following analysis: Construction of a base camp and construction of a landing strip showed that at least 18 7t-3-sided-dump-trucks compared to the standard of 8 contained in the 'technical engineer platoon' are necessary to carry out the required tasks. The number of skimmers could be reduced form standard of 12 to 4 for the technical platoon. If such large tasks are to be carried out, a specialisation of individual squads within the platoon to execute a particular task may be advantageous. One or more squads would be responsible for transportation and other squads would each be responsible for loading or grading. This would certainly increase the efficiency of the individual engineer squads.

The standard engineer force structure for such tasks as building a make-shift bridge or drilling and maintaining water wells seem quite adequate and no alternative or optimised force structure of the responsible engineer units could be recommended.

The required repair of four damaged road sections requires the following pieces of equipment: 1 7t-3-sided-dump-truck, 1 swivel loader, 4 skimmers. The estimated time to complete the road repair was calculated to be 1.5 weeks. The 7t-3-sided-dump-truck and swivel loader are used to fill the bomb craters and pot holes. Four skimmers are used to clear a section of road which was covered through a landslide. The road repair tasks were considered to run parallel with the construction of the landing strip. Therefore the task road repair is competing for the same resources as the construction of the landing strip. This scenario allows the scheduler delay for the construction of the landing strip to be computed. Since the utilisation of the skimmers is low (large skimming capacity) no scheduler delays were considered due to their partial redeployment to perform road clearing. The only scheduler impact was caused by the redeployment of one 7t-3-sided-dump-truck. Here an approximate 2 day delay was the result.

By implementing SiLC, the planning activities have been significantly simplified and greater transparency of the planning activity could be achieved. The results of this study have shown, that every mission must be analysed separately and that the force structure of the engineer units have to be complied based on the mission objectives and the sound reconnaissance data.

SiLC runs on any PC under the operating systems Windows 95/98 and Windows NT.