The effect of Logistics on High Level Land Campaign modelling

Dr Simon Collander-Brown and Sharonjeet Clair

Dstl Policy and Capability Studies Department, Lanchester Building, Ively Road, Farnborough, Hants, GU14 0LX, United Kingdom

Why Campaign Analysis?

Any decision about defence capability needs to be placed in the context of campaign outcome. In other words, does spending money on this system, process or resource benefit the principal task of the military which is to achieve their overall campaign level objective. In large war fighting scenarios there needs to be a method impartially assessing this outcome. One method of delivering the necessary impartial and auditable advice is the use of simulation modelling. This includes joint actions, air, ground and naval forces, as well as the use of coalition forces. Campaign modelling usually occurs within a single theatre, although some models do allow simultaneous conflicts in multiple theatres to be represented. This type of modelling also considers many of the most important determinants of the outcome of a war and the associated price to be paid including associated attritional aspects. It is also used to study the interactions of strategy, force allocation and system capabilities.

Why CLARION?

When developing a simulation model of campaign outcome the most important issue to be considered is the level of aggregation in the model. It is self evident that a campaign is too complicated to model with respect to a detailed representation of all conceivable aspects and therefore aggregation of the processes represented is required. The greater the level of aggregation, the simpler the model but the relationship with the "real world" becomes more complex. It is relatively easy to understand and gain data on processes which have a simple analogue with the "real world" such as Probability of Hit. It can be more difficult to understand and gain data on other aggregated processes such as the appropriate representation of the factor driving the overall performance of a battlegroup or brigade in combat across the range of situations that it may face in a campaign. The attempt to achieve the optimum level of aggregation has lead to a wide variety of different models from the simple analytic approaches such as Lanchester Equations to the very complex models such as the US JWARS model. The primary land campaign model used within the Defence Science and Technology Laboratory (Dstl) is CLARION. This is a relatively highly aggregated model designed to allow a quick examination of the overarching features which affect campaign outcome.

CLARION (Combined Land Air Representation of Integrated OperatioNs) is a high level campaign model that focuses upon the land battle, but also has a simple representation of the air campaign and a capability to represent the effects of the maritime dimension upon the land battle including littoral manoeuvre. CLARION is a data driven command and control based model that was initially designed to study the attritional battle. Figure 1 shows a typical force lay down for a CLARION scenario.

Limitations of previous version of CLARION

Because of the high levels of aggregation and simplicity of the design of CLARION it does have a number of limitations. One of the most pressing has been the lack of explicit representation of logistics; this has had a number of effects on the modelling of campaigns:

1. The campaign could run too quickly unless explicit pauses were built in to represent logistic constraints.
2. The growing importance of effects based and asymmetric operations has increased the likelihood of attack on the potentially vulnerable logistic tail.

In order to address these problems it was decided to implement a representation of logistics in CLARION funded by DG(S&A) P&P.

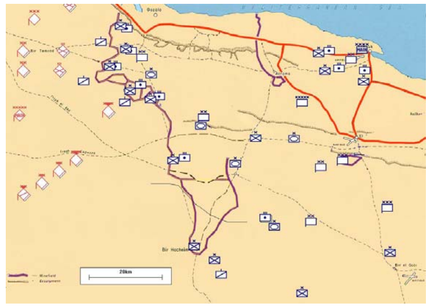

Figure 1: CLARION screenshot showing forces lay down.

How CLARION Logistics works

It is important to note the purpose of the representation of logistics in CLARION. It is designed to represent the effects of logistics on the process of the campaign not to be a detailed model of logistics processes themselves. To this end a simple representation of a logistics chain has been designed which is comprised of an Arc-Node network depicting the transport of various commodities from the Airport of Debarkation (APODs) and Sea Port of Debarkation (SPODs) to the locations where the resources are required.

The new logistics representation contains a user definable rules based system which gives the model flexibility allowing investigation of the many different types of supply such as push and pull. This representation also allows the examination of a number of aspects of the effect of logistics on the campaign such as disruption of an opponent's logistics network which may provide an alternative means to dislocate key enemy elements, thus increasing the model's ability to represent manoeuvre warfare.

Representation of Logistics in CLARION

Below is a description of the aspects which make up the CLARION logistics operations and how they interact with one another to allow the modelling of logistics within CLARION.

Physical Structure

Arc & Nodes

The logistics network is defined by a set of Arcs which are connected together by Nodes (see Figure 2). The Arcs represent the arteries for the transport of logistics for example roads, air routes or shipping lanes (see Image 1). The positions of the Arcs are user defined and produced by military judgement. The Nodes are simply a way of connecting the Arcs and have no physical reality beyond that.

Image 1: Trucks moving across a road i.e. an Arc

Dumps

These represent stockpiles of commodities used to re-supply units (see Image 2). The user is able to position logistics Dumps at Nodes in the logistics network.

Image 2: A logistics Dump.

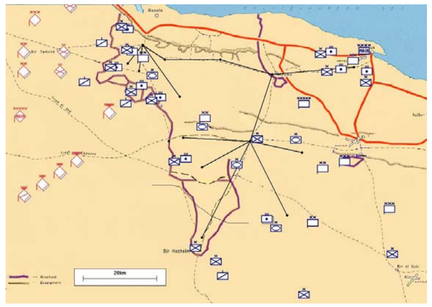

Figure 2: CLARION screenshot showing forces lay down with Arcs and Nodes overlaid.

Commodities

The basic building blocks of CLARION logistics are commodities. These are user defined items which are used by front line units, stored at Dumps or transported along Arcs. For example commodities could be ammunition or fuel. In addition commodities can be used to transport other commodities for example trucks and tankers are be considered as commodities. At the start of a scenario all units and Dumps start with a user defined level of each commodity (which could be zero). These commodities are then used at a rate (defined by the user) which depends on activity. These commodities can be assigned a specific colour allowing the analyst to track the progress of re-supply of different types of commodity if required (see Figure 3).

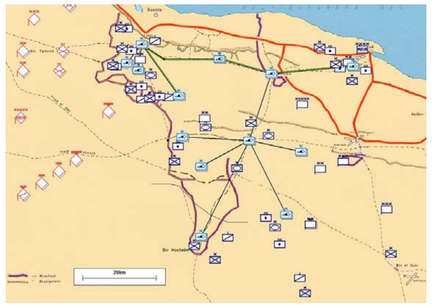

Figure 3: CLARION screenshot showing forces lay out with commodities flowing along Arcs to Dumps. Here fuel has been assigned the colour green and is shown moving from the logistic Dumps to Dumps which are closer to the combat units requiring re-supply of fuel.

Command and Control

As CLARION is a Command and Control (C2) orientated model the most important aspect of logistics is C2. The C2 of logistics is primarily rules based which allows the user to define reactions to given events.

Rules

The user is able to define rules to be applied at decision points within the logistics process. Each individual rule will consist of a set of rule conditions and an action that will be performed if the rule conditions are met. This rules-based approach allows considerable flexibility in how logistic operations are conducted for example it can be used to simulate different logistical doctrines by modifying the CLARION rules that describe the behaviour of the various units involved in the re-supply process. It also allows the model to react to enemy actions, for example attacks on an Arc. The rules are also used to define the reactions of units to their unit supply levels. It is important to note that the level of supply only affects behaviour and not performance. So in other words a unit with limited ammunition will not be less effective than a unit with ammunition as long as ammunition remains though it will try to avoid combat.

Although the Arcs are used to represent the arteries of transport, in order to represent the units flowing along them they also have the ability to communicate with their chain of command and to sense the environment around them.

Attacks

Arcs and Dumps can be made vulnerable to enemy attack. They will be damaged at a defined rate and recover at a user defined rate. If an Arc or Dump is damaged then any commodities at the Dump or at the Arc are also damaged proportionally. If an Arc is damaged to such an extent that it can no longer carry the requested supplies the model can seek to find an alternative route for the supplies. If no such route exists then the lack of supplies can affect the units in a number of different ways. They can for example stop where they are and wait for re-supply, or head to a logistics re-supply area.

The effects of Logistics on Campaign Outcome

The model described above will allow the effect of logistics on campaign outcome to be assessed. This will:

- reduce the tempo of operations as the speed of advance is constrained by logistics
- allow commanders to target the logistics tail
- allow the examination of some aspects of asymmetric attacks
- force commanders to allocate resources for the protection of the logistics network
- allow an examination of events which change the logistics requirements unexpectedly

Summary

This new CLARION logistics representation will become a core part of the CLARION model and it is expected that all studies will use this functionality. This will allow both a more realistic representation of the tempo of campaigns and the potential for greater representation of effects based and asymmetric operations.