

# Simulating Spares Delivery and Operational Readiness of BGTI

Modelling support chain solutions for UK Armed Forces thermal imaging sights



Battle Group Thermal Imaging (BGTI) was a UK MoD programme to fit thermal imaging sights to approximately 700 vehicles.

The procurement process involved a substantial degree of risk sharing between industry and MoD. There was a requirement for valuable information to be used during the tender assessment exercise. An element of this risk-sharing approach involved linking the contractor payment to the successful provision of spare parts. By managing the availability of spares through such a payment mechanism, the objective was to achieve a high and predictable level of operational availability.

LSC Group developed a SPAR based simulation model of the BGTI system to enable an accurate investigation and comparison of industry proposals, thereby providing the MOD with valuable information for use during the tender assessment exercise.

## Model Development

The model was based on two measures-of-effectiveness:

- Operational readiness of the system. Operational readiness was defined as the number of vehicles, having fully functioning BGTI systems, in each deployment, at any moment in time.

- Spares availability and delivery capability. Evaluating the probability of a spare being available at a particular location when requested, and the associated delay in delivery to that location, if a spare was found not to be readily available.

During the tendering process potential suppliers were asked to submit proposals that provided a spares availability service at particular Primary Stocking Points (PSPs). On a defined number of occasions, MOD could also request direct delivery of spares to Secondary Stocking Points (SSPs). Closer to the field of operation, direct industry delivery to a SSP reduces the supply time for serviceable LRUs when compared to military supply from a PSP. Direct delivery to a SSP could happen at any time throughout an operational cycle, and the predictive model was required to reflect this realistic and random demand, and the resulting influence on the stability of the proposed support solutions.

In addition to the core requirements described above, the BGTI model was also developed to include other real-life military procedures, such as:

- Prioritisation of Support. If at any time spare equipment inventory falls below

## The Challenge

To reduce the MoD's exposure to risk during the BGTI programme tendering process.

## Solution

A simulation model that predicted real life system performance to inform tender decision making.

## Customer Benefits

Provided vital decision making data that informed the tender assessment process enabling better decision making.

Helped identify real life system performance in terms of operational readiness and spares availability.

predetermined priority levels, then supply is restricted to favour those deployments carrying out operational activities.

- **Batching.** Upon failure or repair, equipment may experience a delay in returning back to the contractors repair facility or the field of operation. For each storage location, delivery may only occur when a specified number of items are ready for transportation.
- **Surge Period** A surge store is included at the fourth line of support. These spares will only be available upon activation of a surge trigger. At this trigger, utilisation will increase and the surge spares be made available and utilised if necessary.

The performance and resource prediction tool SPAR™ was selected for the development of the BGTI model. The main advantages of SPAR over other simulation packages are:

- Inherent rich feature menu, flexibility, and adaptability, and through the formidable power of its simulation engine
- A realistic model containing system-level and component-level information, component interaction, system operation through mission profiles, and the associated system support infrastructure can be developed quickly;
- Powerful model creation tools and a fast and comprehensive Monte-Carlo simulation engine. It can handle real-world phenomena such as uncertain or incomplete data, variable demands on the system, component interactions, and variable mission lengths;
- The implementation of time dependencies during the running of the model, for example, component reliabilities, or dealing with lifed components or aging issues, or variations in support. Logic structures can be created that are executed automatically by the simulation engine only under certain conditions;

- Output can be tailored to monitor and display particular measures of effectiveness.

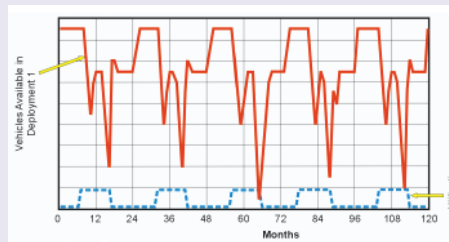
## Sample Model Output

Below, we present three examples of the outputs obtained from the BGTI SPAR model. It should be noted that the outputs shown are a representative sample only, and are in no way indicative of the actual results obtained for any of the industry solutions.

### 1. Operational Readiness

One of the core measurements of the BGTI model is the number of vehicles available in each of the deployments at any point in time.

The following graph shows a typical system availability response, with the dashed line showing the utilisation of vehicles in the deployment under investigation and the solid line the resulting time-dependent number of vehicles available for operation.



### Operational availability as given by the time dependent number of vehicles available

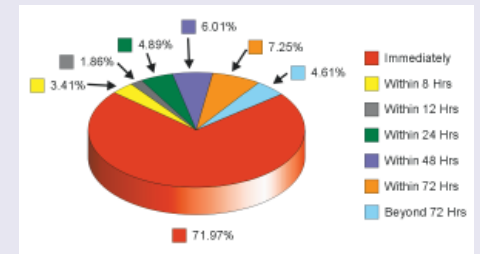
It is interesting to note that even if a similar utilisation pattern is repeated on an annual basis, for example, the deployment availability does not necessarily reach a steady state situation even after 10 years of operation. This important (and common) property regarding the availability of military systems is a consequence of the interactions inherent in their deployment requirements and support structure. Such interactions can only be comprehensively investigated using a simulation-based approach, as outlined in this case study.

### 2. Spares Demand Satisfaction

Spares demand satisfaction is used as a performance measure in the tender assessment activity. It allows MOD to measure the total number of spares demanded and the proportion of those demands that are fulfilled within given delivery times (8 hours, 12 hours, 24 hours,

etc.) at up to 20 stocking points.

This key output provides a clear picture of the contractor's ability to meet MOD requirements and provides a good indicator for the payment mechanism to be set up. Spares demand satisfaction is measured on a monthly basis and therefore can point to bottlenecks in the spares flow over the service period.



**The distribution of spares demand satisfaction for a particular stocking point. The elements of the chart indicate the delay in satisfying a request for a spare at that stocking point.**

### 3. Event Counters

For system capacity analysis, and for life cycle costs, each simulation provides a number of counters to record system events, such as:

- Total number of transportations between each storage location;
- Total number of repairs per equipment type at contractor level;
- Total number of on request deliveries;
- Total number of spares queuing at each stocking point.

## Conclusion

The LSC model was a valuable tool in assessing the merits of the industry logistics solutions. It provided a large variety of output parameters that allowed for a thorough comparison of the advantages and disadvantages of each contractor's proposal.

The analysis presented in this case study could only be performed using a model that integrated the different aspects of real life situations. It allowed for "what if" scenarios in order to enable a full investigation of all elements of the project within a reasonable time frame.