

Simulating the Operational Sustainability of BOWMAN

Modelling support chain solutions for UK Armed Forces communications



SPAR Modelling

BOWMAN is the tactical and secure, voice and data communications system for UK MOD fitted to approximately 20,000 vehicles, 160 ships and 300 aircraft.

As part of the risk reduction element of the procurement process, LSC Group developed on behalf of the MOD a BOWMAN system support model. Using SPAR technology, the model was built to investigate the sustainability of BOWMAN for the support solutions proposed by industry, and hence provided valuable information to the tender assessment activity.

The project required LSC Group to analyse the possible support chain solutions for BOWMAN, in order to determine the effectiveness and efficiency against real world operational scenarios. The project required the representation of each entire solution including some 500,000+ items of equipment operating in multiple supply environments.

Model Development

Sustainability is a dynamic quantity associated with the minimum potential level of equipment availability. It is a measure of the lower boundary of operational readiness for the system configuration, utilisation and support. To consider a system's sustainability is to investigate the likely

worst-case availability at any moment in a mission profile. Sustainability is therefore a more information-rich and relevant indicator of capability than traditional measures such as steady-state average availability. Consequently, the core output of the BOWMAN sustainability model is the quantity of equipment operating, or available to operate, in each deployment at all times.

In addition to tailoring the outputs to measure sustainability, the model was also required to accurately reflect the deployment, utilisation and support structure associated with the land-based element of BOWMAN. Included in the model were:

- All main equipment elements of the BOWMAN land solution – in excess of 250,000 fielded items
- Multiple brigades and units - including operational units, non-operational units, training units and territorial units
- Time dependent usage profile for each brigade and unit
- Finite military repair and storage facilities for each deployment
- A common 4th line repair and storage facility (Industry)

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.

- Deployment and equipment dependent transportation times
- Prioritisation of support for operational brigades

The BOWMAN sustainability model was developed using Clockwork Group's performance and resource prediction tool SPAR. With its efficient model development environment and powerful simulation engine, SPAR provided a framework to describe the system-level and component-level properties, the dynamics of the system's usage and support, and the interactions inherent in the proposed solutions.

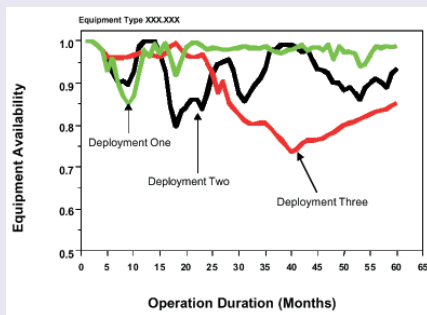
The discrete-event simulation approach employed by SPAR allows the consequences of an event (such as a failure event or a repair event) to be modified, and thereby enables dynamic and user-defined attributes and performance metrics to be considered.

Sample Model Output

Presented below are examples of the output obtained from the BOWMAN Sustainability 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.

Equipment Availability And Operational Readiness

A core output of the BOWMAN Sustainability model is the time dependent availability of equipment. Shown below is an example of such an output for a particular element of BOWMAN that is operating within various deployments. The availability depicted in this Figure is the proportion of fielded equipment either operating, or available to operate.



An example of equipment availability response

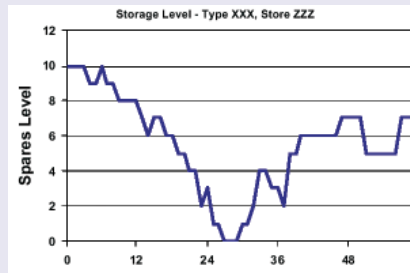
This dynamic measure of availability aids the identification of operational periods that are at risk from equipment shortage. Furthermore, by investigating how changes to support provision influence this critical performance measure, resource allocation was realised in the most appropriate and cost-effective manner.

Spares Provisioning

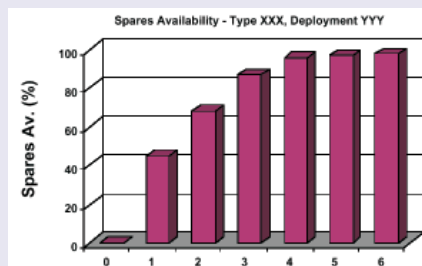
Maintaining the BOWMAN system above a minimum level of operational capability was dependent upon the level of spare equipment provision. Furthermore, investigation of the optimal distribution of spares was required to provide this support in the most cost-efficient way.

To achieve the optimal sparing solution for BOWMAN the sustainability model enabled a performance-focused trade-off between spares provisioning and spares distribution. Moreover, this was undertaken within a whole system environment, where the

interactions that influence the requirement were accounted for. The figures below, provide two examples of spares associated performance metrics.



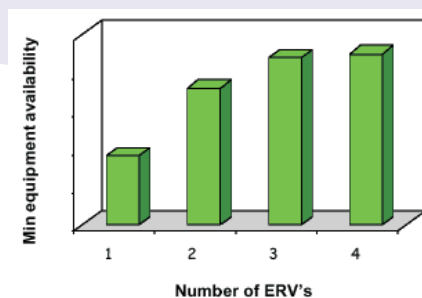
Spares availability



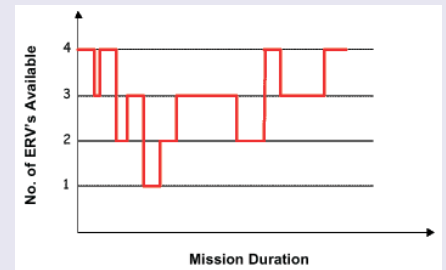
Spares level

Repair Capacity

The sustainability and spares requirement for BOWMAN will be influenced by the capability of military and industry repair organisations to identify components causing system faults and to undertake the appropriate repair actions. The figures below show two model outputs relating to military repair capability (as given by the number of ERVs). The first output shows how the minimum quantity of equipment available (for one equipment type in one deployment) depends on the number of ERVs in the deployment. The second output shows the time dependent utilisation of ERVs. This second metric provides a more direct reference for optimising repair capacity and avoiding unnecessary delays (if waiting for repair) or costs (if utilisation of ERVs is low).



Equipment availability dependence on ERV quantity



ERV usage profile

Event Counters

For system capacity analysis, and for life cycle costs, each simulation provided 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

SPAR was an invaluable tool in assessing the merits of logistics parameters that allowed for the 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 integrates the different aspects of a real life situation. It allowed for "what if" scenarios in order to enable full investigation of all elements of a project within a reasonable time frame. SPAR achieved this capability through its inherent feature-rich menu, flexibility, and adaptability, and through the formidable power of its simulation engine.