SPARES PREDICTION

The principal reason for carrying spares is to mitigate the consequences of equipment failure. The process of spares stockholding prediction is therefore a logical extension of Reliability-centred Maintenance (RCM) activities. The consequence of a spare part stockout is intrinsically linked with the time taken to replenish that part, which in turn affects the operational availability of the host equipment.

Increasing the number of spare parts improves availability but also increases costs, suggesting that a defensible spares stockholding regime must be based on a balance between cost and asset availability. Spare part cost is a combination of capital cost, logistic and stockholding costs. The required asset availability is based on the value of platform-level operational availability, flowed down via the functional hierarchy to the asset in question.

Any cost-effective spares stockholding regime must also take account of the opportunities for spares rationalisation across a number of equipments (or, indeed, across the complete platform), requiring a knowledge of the hierarchical asset structure and of the asset management plan for the equipment(s). Both aspects are an inherent part of the RCM process.

Rmada has considerable experience with both the RCM process (which identifies the *range* of spares necessary) and with a number of optimising processes that determine the *scale* of spares required, taking account of the rationalisation issues above. These scaling processes include Reliability-centred Stockholding (RCS) and a derivative of that process based on genetic algorithm (GA) methods.

Such GA methods have been successfully used to determine the on-board spares stockholding requirements for a number of predominantly electronic ship systems where condition monitoring to forecast failure was not technically feasible. In such cases, comparisons between GA-predicted and actual stockholdings of carried onboard spares suggested significant cost reductions, together with improved availability.

Case Study (LPD PMS System)

The Platform Management System in the ALBION class of LPD within the Royal Navy consists of a number of workstations connected together by a dual redundant fibre-optical link. Since this system is used for ship control purposes under normal and emergency conditions there is a great deal of system redundancy.

The system was first outfitted during build with a range and scale of spares that was estimated to provide an availability of about 91% at a cost of £61k per ship. This availability value was considered to be unacceptably low for such an important system and the range of spares held was not sufficient to support failures that had been experienced during commissioning.

A spares review followed an RCM analysis of the system and firstly a more defensible range of spares was derived. An analysis of the scale of such recommended spares suggested the following availabilities and costs.

Availability	Cost	Comment
91%	£61k	(as originally supplied)
91%	£13.7k	(post spares review)
97%	£37k	(RCM recommended spares)

Summary: a review of the functional requirements of the host system followed by an analysis of spares necessary to support these functional requirements, capitalised on system redundancy features *(compared with a simple parts count)* and provided a more appropriate spares inventory. This offered improved system availability and at a reduced inventory cost.