# Support System Modelling

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## Introduction

Support modelling and analysis has gained greater relevance in recent times to coincide with realisation that more effort must be concentrated on getting better return on support investment. By way of an example, UK MOD has recently (March 2024) published a support modelling and analysis framework policy document to provide a discipline foundation going forward. (Defence Support Modelling and Analysis Framework - GOV.UK (www.gov.uk))

Modelling and analysis tools have existed in the defence and fleet management arena for more than 30 years, however in my opinion, is yet to be used widely to its full potential. The advent of performance-based contracting arrangements 25 years ago, complete with initiatives like Product Life Cycle Support (PLCS), was the springboard for support modelling and analysis, but it is only in recent times that the necessary computing power has become available to fully exploit the in-service data.

Spares modelling tools do what they say on the packet, however the accuracy and usability of the results can depend on many factors including data integrity, understanding of the underlying algorithms, understanding of the support system and the logistical build of the system.

Support optimisation models now go far beyond the sparing models of early years. Today, we can model the entire support solution using modern techniques developed from digital twins, digital threads and digital shadows. To achieve this, we draw on foundation techniques like AR&M (Availability, Reliability and Maintainability) analysis, level of repair analysis, maintenance task analysis and others, operating in an MBSE (Model Based Systems Engineering) and MBPS (Model Based Product Support) environment, However, the overarching challenge has not changed – how does defence achieve and deliver cost-effective operational availability?

Of course, the way of achieving this is through the right software product. More importantly however, the right people/processes/procedures to best gain value from the analysis.

## Data Integrity

Rubbish in = rubbish out.

It is an expression most reading this article will be familiar with, but data integrity can be easier said than done. For example, most spares and operational modelling tools will require a Mean Time Between Failure (MTBF) for the candidate items that make up the system. This seems simple, but ask yourself the following:

- What systems are in place to collect failure data?
- How accurate are these systems?
- How accurate is the data?
- How is the data communicated between the User, support staff and the OEM?
- How is this failure data being sanitised to collect actual failures?
- Is there enough data available to calculate an accurate MTBF?
- Is MTBF the right system performance measure to meet your needs?

Even after that, calculations on MTBF may not be as straightforward as most people think. For more information, see Mark Willis' article on Mean Time Between Failure & Reliability – Allaying The Myths. - Pennant International Group plc (pennantplc.com)).

If you place the same scrutiny on the data integrity of other key metrics such as Mean Time to Repair (MTTR), Repair Turnaround Time (RTAT), Logistic Delay Time (LDT) etc, it becomes quite clear how a focus on data integrity takes effort and can drastically affect modelling results.

### Decision Making vs Decision Support

It is easy to fall into the trap of taking the output of a modelling tool for granted, or as 'the answer'. Although most software tools do what they say they do, some being more capable than others, none will replace the decision maker and the subjective input from the subject matter experts.

*"All models are wrong, but some are useful"* – George E. P. Box

*"The final stage of mathematical modelling is the human rationalisation of the output"*
– Professor Nira Chamberlain

Modelling outputs are not predicting the future, nor are they all-encompassing. The data that is presented from these tools should be communicated in such a way that encourages constructive scrutiny, with an understanding that mathematics and stochastic analysis will only go so far.

That said, when used effectively, modelling and analysis techniques can greatly improve operational availability through data driven decision making.

### Analysis in Sustainment

As previously mentioned, generally, the way that 'spares modelling' is used is not maximising the value of these tools and capabilities. Certainly, creating a spares requirement list is important; however, the refresh of support data as fleets age and adapting its uses as operational requirements change, is much more valuable to sustaining a capability.

This is not to simply update spares requirements – but use this support data to drive decisions that will maximise availability. Again, this is not to take the mathematical answer as the only answer, but to inform decisions through subjective analysis to complement the objective.

In addition to general spares requirements, a good modelling tool and analyst can quantify risk and benefit of, but not limited to, the following key questions:

- Where is the optimum location for spares to be stored?
- Where should maintenance be carried out to maximise availability?
- What is the biggest driver of system downtime?
- What variables do I have control over, and what is the sensitivity of those to mission success/availability?
- What is my support solution going to cost?

### Conclusion

Modelling tools are not there to simply fulfil a spares list requirement in systems acquisition; although, that is how they are widely used. The more effort that is put into managing these tools, the data that drives them and the people that use them, the more value will be gained.

In a world where adaptability, agility, and the ability to 'do more with less' is becoming ever more important, a modelling and analysis capability is incredibly valuable and should attract focus from senior decision makers to better develop.

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