The Path to Effective, Affordable and Profitable Support

The previous White Papers in this series made 2 key points. First, **The Mystique of Availability** observed that while very commonly used, availability is not generally well understood, frequently wrongly specified, complex to measure, hard to forecast and difficult to manage directly. Actual availability is often worse than demanded but at increased cost. The second, **The Holy Grail of Supportability – Downtime**, identified Downtime as the undesirable facet of equipment use. Since it is easily defined and measured, it should be the IPS driver to achieve the required balance of availability and cost outcomes.

From these 2 premises, this third paper, **The Path to Effective, Affordable and Profitable Support** explains applying the Downtime approach as part of Supportability Modelling & Analysis (SM&A). It outlines 5 specific key areas in the IPS process to develop Support arrangements that will be both sufficient and affordable for customers while contracted profitably by suppliers. Used correctly, SM&A is the critical means of achieving and sustaining effective through-life Support.

1. USE DOWNTIME AS THE IPS DRIVER TO INFLUENCE AVAILABILITY AND COST

While an essential desired outcome, Availability can only be managed indirectly. Classic availability definitions do not reflect all the causes and consequences of non-availability. Actual availability is often worse than anticipated but at increased cost. Availability can be 'Emperor's New Clothes'.

Downtime is more useful as it can be quantified, modelled and measured directly as the sum of all time that a system is unavailable in a particular operating scenario. This may be due to preventive or corrective maintenance, condition-based monitoring, and Administrative & Logistic Delay Time (ALDT). Total Downtime is the product of frequency of events (which may be related to reliability and non-attributable arisings[1]), maintenance time (time to repair, maintenance duration, upgrade time) and ALDT awaiting resources. It can be calculated directly at system, sub-system and component level for any design, usage pattern and Support scenario. Reducing Downtime delivers more operational availability. It is ideal to identify, prioritise and direct management interventions that may have many varied causes. **Managing Downtime should be the IPS driver to achieve the required balance of demanded availability and cost.**

2. EXPLOIT THE ILS TO IPS TRANSITION

Traditional ILS delivers lists of bits, books, blokes and training – **Design The Support**. Early Support analysis conducted before design freeze risks significant rework for even small changes which incentivises delaying the start of ILS effort. Activity is often initiated too late to influence the design which means limited focus on **Design For Support.** FMECA and RCM are conducted from the safety perspective, but not to improve in-service Support burdens. Opportunities are often missed to reduce in-service Downtime through RCM packaging that optimises maintenance policies and non-attributable events. Logistic product data (LPD) is captured in Logistic Support Analysis Records (LSAR) but usually in one-off efforts and frequently as paper records[2]. TA-STD-0017A for product support analysis (PSA), GEIA-0007A and S-Series are now accepted Logistic Product Data (LPD) standards to capture and transfer data into documentation creation tools. But the end outputs of illustrated parts catalogues, maintenance manuals and training notes use separate publishing processes which become the masters for future amendments. LSARs are rarely maintained and quickly become redundant. Worse, Support solutions are rarely revisited comprehensively and regularly in practice but usually only in part when associated with specific contract renewals.

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1 Durability events such as bird strikes, weather, operator or maintainer induced, and battle damage.

2 Such as the Queen Elizabeth Class aircraft carriers!

IPS addresses these weaknesses by increasing emphasis on both early **Design For Support** and in-service management to **Support The Design**. Data feedback collection standards such as S5000F are still immature but, increasingly, ERP systems capture the necessary real-world, raw data for comparison and correction of assumed baselines. We must harness the transition to IPS and implementation of new data standards to improve sustaining engineering practices to re-visit and adjust Support solutions regularly. We must ensure this with mandatory, effective and regular use of Supportability Cases.

3. HARNESS SUPPORTABILITY MODELLING & ANALYSIS

LPD includes both inputs to and outputs from SM&A. Data comes from design inputs, assumptions or as outputs from engineering methods such as FMECA and RCM and results of SM&A techniques such as fleet and maintenance modelling, Level of Repair Analysis, spares and logistic resource modelling, training needs analysis, LCC and annual cost modelling.

The UK Defence SM&A Framework[3] sets the vision, ways and means for an integrated through-life, end-to-end SM&A capability that will enable optimisation of platform design; in-service Support decision making; upgrades/modifications and approvals; Support demand planning to improve Defence outputs and enhance supply chain resilience. Effective SM&A provides the foundation for informed evidence-based, decision-making to achieve performance, time, and cost targets, and will ensure that availability, capability and sustainment-based requirements can be met. Failure to exploit SM&A effectively will lead to reduced readiness and resilience; unsupportable platforms; resource misallocation; and limit use of modern AI methods.

4. CONDUCT SUPPORT TEST & EVALUATION

Equipment systems are subject to end-to-end, physical test and evaluation (T&E) prior to entry into service to provide evidence for the end user that they will perform as claimed. In contrast, Support is not subject to full T&E before entry to service which is usually years and sometimes decades after contracts were awarded. PSA and LSA used to develop Support packages and arrangements are based on initial data and assumptions. Although required by IPS standards and good practice, comprehensive T&E of Support is frequently curtailed or ignored.

Historically, there have been no practical means for comprehensive end-to-end T&E of Support. System trials tend to use early pre-production equipment in limited, non-representative trials that provide only limited evidence of Support performance. Stand-alone tests can confirm specific Support activities such as maintenance procedures or tool use, but holistic end-to-end physical testing of the complete Support system is prohibitively expensive, lengthy and late. As a result, initial operating units have been left to identify Support omissions and weaknesses which inevitably creates dissatisfaction, lengthy delays and large additional cost before resolution.

Model-based Systems Engineering (MBSE), Digital Engineering, Model-based Product Support and modern simulation tools now provide the means to eliminate this long-standing problem. End-to-end simulation of all maintenance events reflecting their frequency, duration, probability, resources, delay times and cost can evaluate pre-defined and procured Support arrangements and resource packages in the principal and many alternative operating scenarios. The analysis will encompass, quantify and rank all maintenance and logistically significant items and reflect causes that interact to suppress or amplify effects. Where outcomes indicate shortfalls, the causes can be explored in the data, and potential engineering and Support remedies evaluated quickly for their likely benefit before incurring considerable expenditure. This is the best way to inform balanced risk-based Support solutions, including their resilience, with confidence-based data of probable performance.

5. USE SM&A TO PREDICT SUPPORT CONTRACT PERFORMANCE

Simulation can also project the time-based status and location of every system, sub-system and part, and resources such as people, tools, test equipment and facilities, to determine overall output characteristics such as system availability, cost and resource utilisation. Evaluating these performance indicators against proposed contract payment mechanisms will indicate likely performance with cost and revenue outcomes. Simulation prior to contract award is invaluable in determining likely contract behaviour, identifying potential perverse incentives and provide essential

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[3] Support Modelling and Analysis Framework - Enhancing evidence-based decision making to improve Support to the Front Line. Defence Support Modelling and Analysis Framework - GOV.UK

timely feedback to contract negotiations. Best, it confirms that the proposed Support is achievable and affordable under the proposed contract terms.

MODELLING A WICKED SYSTEM

Support of advanced equipment systems in dynamic scenarios is intrinsically complex. High-level availability metrics have value but simplifications typically erode or conceal the reality. Pulling a single lever as previously envisaged by ESCIT and the FR&P initiative does not work because of the inevitable interactions. Support systems are so large and complex that the many individual cause and effect loops identified in System Dynamics approaches cannot be specifically and independently metricated; military judgement (guesswork) cannot correctly or fully compensate. In essence, they are Wicked Problems in which doing anything, including doing nothing, changes the problem. In these circumstances, bottom-up, end-to-end modelling and simulation of all appropriate events and their frequencies, resources, timings and costs is needed to reflect inputs, dependencies, resources.

Fortunately, the LPD sources, data standards and computing power now exist to develop the necessary models. Well-proven techniques exist, the data exists, and capable tools exist. In most cases, they are already owned by MOD and suppliers. What does not exist is sufficient SQEP with the will and the mandate to conduct SM&A.

SUMMARY

Previous papers established that availability is not generally well understood, frequently wrongly specified, complex to measure, hard to forecast and can only be influenced indirectly. Actual availability is often worse than demanded but at increased cost. Reducing Downtime delivers more operational availability of useable Systems. This paper highlights 5 specific areas where using Downtime through SM&A will be very beneficial.

Downtime can be quantified, modelled and measured directly as the sum of all time that a system is unavailable in a particular operating scenario due to preventive and corrective maintenance, condition-based monitoring, and delay times. **Managing Downtime should be the IPS driver to achieve the required balance of demanded availability and cost.**

The transition from ILS to IPS requires greater focus on early **Design For Support** and in-service management to **Support The Design.** The new data exchange standards will help to re-visit and adjust Support solutions regularly assured through mandatory, regular use of Supportability Cases.

The Defence SM&A Framework seeks an integrated, through-life, end-to-end SM&A capability that will enable optimisation of platform design; equipment upgrades; in-service Support decisions; approvals; and Support demand planning to improve Defence outputs and enhance supply chain resilience. **Effective SM&A will provide informed, evidence-based, decision-making to achieve performance, time, and cost targets.**

Support is not subject to T&E before systems enter service. Failure to identify omissions and weaknesses early inevitably creates dissatisfaction, lengthy delays and large additional cost. **SM&A using dynamic simulation of various operating scenarios including all maintenance events reflecting their frequency, duration, probability, logistic resources, delay times and cost will evaluate the cost and effectiveness of Support arrangements, even prior to contract award.**

Bottom-up, end-to-end modelling of appropriate events, their frequencies, resources, timings and costs is essential to reflect inputs, dependencies, resources and interactions. LPD sources, data standards, tools, techniques, sufficient data computing power all now exist to develop the necessary models. **What does not exist is sufficient SQEP with the will and mandate to conduct SM&A.**

Support is a classic Wicked Problem. **SM&A focused on Downtime and its causes, with dynamic simulation of Support packages and contract arrangements prior to contract award and through-life, provides the solution.**

Implementing IPS in these 5 areas is the Path to Effective, Affordable Availability and Profitable Support.