Availability, Supportability and Cost

Delivering Better Availability was the theme of SupportNET 22. That laudable objective has been constant for decades so why is it still a vital target as CDLS strives to deliver Support Advantage? Perhaps we need to revisit what we mean by Availability and consider new ways to measure and drive improvement in an affordable, effective way.

What is Availability?

There are many meanings attributed to Availability depending on the context but all mention the utility of a System in a functioning condition for a period. Ultimately, Defense capability derives from ability to use the System rather than just constituent parts.

Sufficient Operational Availability (A_0) to meet the task is the ultimate criteria for commanders. This is the probability that items will operate satisfactorily at a given point in time when used in an actual or realistic operating and support environment. The simplest representation of Availability is the ratio of the expected Uptime of a system to the sum of Uptime plus Downtime.

$$\boldsymbol{Availability = \frac{Uptime}{Uptime + Downtime}}$$

System availability may be increased by improving reliability; increased reliability improves availability. But availability can also be improved by improving testability, accelerating diagnostics and improving maintainability. Importantly, restoring an unserviceable system to an operable condition depends on waiting time for resources. Thus, availability can also be expressed as:

$$\boldsymbol{A = \frac{MTBA}{MTBA + MTTR + PM\ Time + ALDT}}$$

MTBA is Mean Time between Arisings; MTTR is Mean Time to Repair; PM is Preventative Maintenance Time including Condition Based Monitoring; ALDT is Admin & Logistic Delay Time.

While A_o is the most common and useful definition for logistic support, it can be applied differently depending on the nature of the system:

- Using 4 submarines, the RN has delivered 100% availability of the UK's nuclear deterrent since the late 1960s. Individual boats and equipment systems require maintenance and incur faults, but the Continuous at Sea Deterrent capability has remained intact.
- For a system in constant operation (such as a ground radar system), the sum of Uptime plus Downtime is the total time period with no allowance for preventative maintenance or administrative and logistics delay time.
- Near-continuous System availability can also be provided by multiple platforms in planned shifts such as airborne early warning, maritime patrol and air-to-air refueling aircraft.
- Some systems such as Quick Reaction Aircraft and ready-to-use munitions must be constantly available on immediate standby even though not in constant use.
- Systems of systems such as multi-role ships can tolerate planned maintenance and some faults while achieving required operational tasks.
- Where multiple platforms deliver capability by operating together such as in Battle Groups, combat formations need a minimum number ready for use to remain combat effective.
- When systems are required can also vary between peacetime training and combat scenarios. Aircraft fleets are normally flown at high activity rates for training implying constantly high availability with only limited capability to surge. On the other hand, peacetime personal Land systems training normally needs only limited assets (Basic Unit Fleet) with uplifts for collective training (Training Uplift Fleet) but significantly more for operations. This implies tolerable low availability in peacetime, but very high availability needed during conflict.

Availability is often set as the top-level requirement for a system but must be set in appropriate context to deliver the activity level required. It is not a simple task to reflect the true operational need.

The Cost of Availability

Availability is often directly but incorrectly associated with cost implying a potential trade-off. However, cost is not directly affected by availability but rather by usage; for example, flying hours generate cost, not desired aircraft availability.

Cost is generated by the people, spares, tools and other resources, and time, needed to maintain and

repair the system and its components which fail as per their reliability characteristics.

Additional resources will certainly attract additional cost and may, or may not, improve availability.

But improved reliability and additional resources are not the only way to improve availability

Addressing poor availability through better Supportability may be a better way than expensive reliability improvement and additional resources

Resilience and Supportability

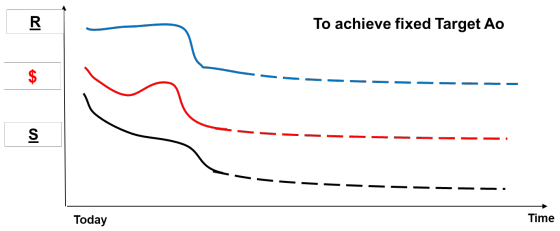
The term Resilience is being used increasingly including by the UK Chief of Defence Staff in calling for improves readiness and enhanced resilience. The Coronavirus pandemic has also reinforced the need for resilience which can be defined as *the capacity to recover quickly from difficulties - to spring back into shape.* For many years, resilience has been synonymous with large spare parts inventory but, in practice, is far more complex with multiple factors.

Additional contingency reserves of resources can provide more capacity or resilience for surge. Spending money on stock does not, by itself, make a system more available although it may help to mitigate some operating impacts.

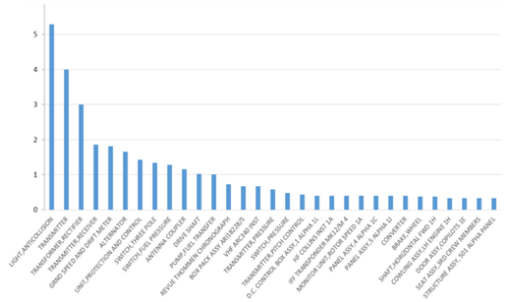
To address this conundrum, TFDE defines the term **Supportability** as *the responsiveness to unreliability that prevents a system's use*. In other words, *'when there's a problem on a system, how quickly can its utility be restored'*. In essence, resilience.

The **Supportability** (S) of a System can be measured directly as the sum of all downtime in a particular operating scenario due to preventative and corrective maintenance, condition-based monitoring, and delay times; less downtime means more operational availability. Improving S always has positive effects for useable Systems.

Although linked to availability and maintainability, **Supportability** is independent of both reliability and cost. Improving reliability does not make a system more supportable. That said, reduced failure rates will reduce the cost. They may reduce planned maintenance burdens but not inevitably. The graphic below suggests how these independent but related metrics can inform Support decisions to deliver better availability affordably.



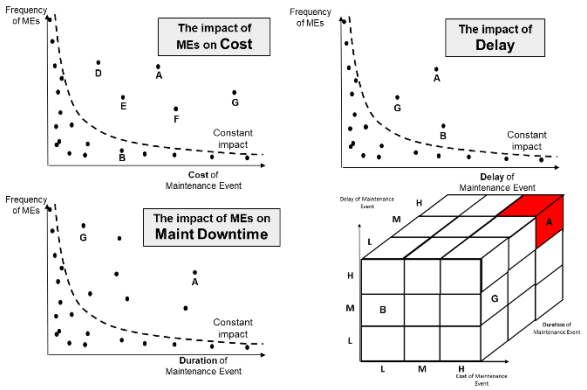
While measuring Supportability at System level is vital to understand the maintenance and logistic impacts, , Supportability can equally be measured at the equipment and individual LRU level and ranked to identify components with the greatest impact on downtime.



Reliability, Supportability and Cost

Using TFD's tools and the Supportability Workbench, will help to disentangle the various Supportability drivers, inform their relative significance and, in parallel with both reliability and cost for both investment and subsequent savings. enable evaluation of potential remedial measures.

Reliability can be expressed as frequencies of consequential maintenance events. In turn, these will take time, attract resource costs, and possibly incur delays covering all aspects of the Availability and Cost equations that define System Support performance. The objective should be to identify and address the specific events with the highest impact in all dimensions, either through reliability improvement to reduce frequency of downtime improvement or improved **Supportability**. These will have the greatest impact on availability at best value for money.



Availability and cost are intrinsically linked for a specific scenario. To achieve more availability for less money, alternative maintenance tasks, Support arrangements and resources are needed. These must be optimized together to ***Do More for Less.*** TFD's integrated Supportability Workbench, novel analysis techniques and expert consultants can identify how to reduce downtime and thus improve Operational Availability, Resilience and reduce Cost.