Systems Innovation Engineering

Do Not Overlook The Complete Weapons Systems Profile During Design!

April 13, 2022

According to the Department of Defense (DoD) Directive 5000.1, "The Defense Acquisition System," the Program Manager (PM) is identified as the single point of accountability for accomplishing total life-cycle systems management, including sustainment. It also identifies Supportability as a key component of performance to be considered throughout the system life cycle.

So, with this in mind, how does the defense industry, or those wanting to do business with the DoD, implement best practices and strategies that demonstrate key capabilities and product supportability, and rapidly meet acquisition demands?

Essential to achieving these things is a government-provided program artifact called a Design Reference Mission (DRM).

The DRM enables government and contractor to agree on a complete design lifecycle and is a key step to understanding how the design specification correlates to actual use conditions. This allows for measurable life cycle functional design and sustainment margins to be established, implemented, and tested, which reduce equipment failures and minimize system downtimes.

Many times, the contractor is driven by and simply proposes against stated operational requirements. However, these operational requirements alone do not completely define the full functional and environmental profiles of the weapon system or platform. Operational profiles can lead the contractor to only use operational requirements (e.g. Probability of Kill (PK) against threat "X") instead of the mission profile (3-year deployment cycle between planned ship maintenance periods) to derive system requirements.

Below, Figure 1 shows the operational requirement PK contained in the Sustainment Phase Deployment cycle. The PK is a requirement in hours that is part of a recurring 36-month ship fleet response plan. This response plan also contains Maintenance and Training activities which make up the majority of the weapons system lifecycle. As you can foresee, the system would therefore be designed to an incomplete set of requirements without considering the full functional and environmental use conditions.

Often the tactical mission ignores transportation, storage, training, maintenance, etc., which leads to a failure to recognize significant system failure modes.
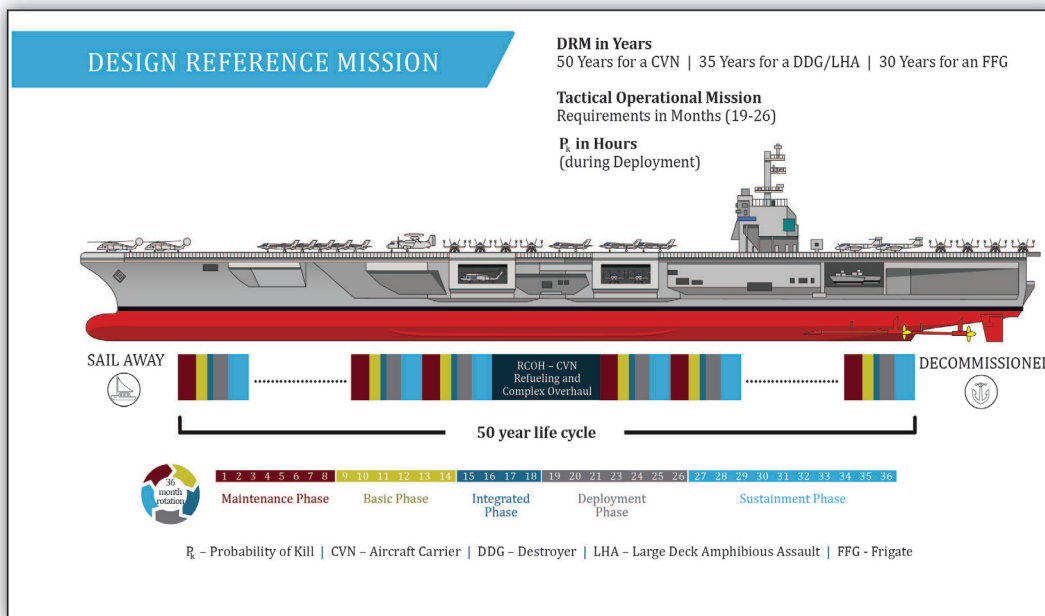

Figure 1. Design Reference Mission for a 36-month long ship fleet response plan that includes mission profile (maintenance and sustainment) and operational requirements (Pk) during a deployment cycle.

Mission profiles include both functional and environmental profiles. An environmental mission profile shows on a time scale the significant environmental parameters, including their levels and duration, that are expected to occur during the life of the weapon system. It defines the total envelope of environments in which the weapon system must perform to include conditions of storage, handling, transportation, and operational use. A functional mission profile shows on a time scale all the functions that must be performed by the system to accomplish the intended mission(s).

Both functional and environmental profiles are ultimately the government's responsibility but to be realized and understood by all Tier providers is pivotal. It is the contractor's responsibility to use the DRM to establish the system functional and environmental profiles that become the basis of the design requirements for the component parts of the system.

Communicating and maintaining the DRM is critical in meeting, as well as sustaining, the operational mission requirements.

While inherently it's a government activity to develop and produce the DRM, it's the contractors' responsibility, and in their best interest, to understand and use the DRM to properly dissect and communicate system-level design and verification requirements. As shown in the figure above, maintenance, training, and ready-standby periods encompass most of a weapons systems' lifecycle. The requirements for these phases must be clearly understood by all providers to ensure an effective support solution.