Ship Reliability Growth – Guidance

Background

The necessity for a reliability growth program for Major Defense Acquisition Programs (MDAP) is well established. Despite this, it is often argued that Navy ship class programs are exempt from such requirements because the Navy's well established oversight of ship construction and pre-delivering testing makes it unlikely that ships will deliver with serious reliability problems. Additionally, some have argued that because new ship classes are often comprised of numerous, mature and reliable technologies (e.g. hull, mechanical, and propulsions systems) there is little risk that the ship will have poor reliability.

However, some recent ship-class IOT&Es have demonstrated that ship programs are subject to the same reliability problems, including reliability problems with mature systems, that other acquisition programs are subject to. Ships might be different from other types of acquisition programs, but they still need to be reliable. This guidance highlights the key aspects of a reliability growth program for ships that need to be documented in a TEMP.

Reliability Growth for New Ship Programs

For new ship class programs, the following steps should be included in the program's reliability growth plan:

1. Early-on, identify, in the context of the ship completing its primary missions, the ship's critical systems. This work is typically already done early during the detail design phase to support ship survivability studies.
2. Determine what the overall reliability and availability requirements for the ship imply about the required reliability of critical systems. This requires the construction of reliability block diagrams and modeling and simulation.
3. As construction begins, measure the reliability of critical systems at the factory, at the shipyard, or elsewhere in the fleet, to verify that the critical system reliability supports the overall ship reliability.
4. Record failures in a Failure Reporting, Analysis, and Corrective Action System, implement corrections as needed, and continue to monitor reliability.
5. At delivery, continue collecting reliability data and verify that the overall reliability is on track to meet its reliability requirements at IOT&E.
6. Confirm reliability at IOT&E and possibly rerun M&S with measured critical system reliability data instead of specification reliability data. Verification, validation, and accreditation of M&S should include a review of M&S assumptions to ensure that critical systems were not overlooked and to verify that reliability block diagrams are correct.

Reliability Growth for Mature Ship Programs

It is not uncommon to find a ship class program that pre-dates OSD's reliability growth requirement. In these instances, where there is no previous requirement, a strategy similar to the steps for a new ship program above should be implemented.

1. Map overall reliability requirements to critical system reliability using fleet standards to determine if system failures equate to ship failures (e.g., Status of Resources and Training System (SORTS) ratings). This analysis was likely done to support ship survivability studies.
2. Collect critical system reliability data wherever available (e.g., other ships using the same systems) and periodically review data collected with test and evaluation stakeholders.
3. When the ship is delivered, start collecting reliability data on critical systems and against overall reliability requirements whenever possible.
4. Correct reliability deficiencies before IOT&E.
5. Collect data through IOT&E and update M&S with observed component reliability to determine if ship meets its reliability requirements. Verification, validation, and accreditation of M&S should include a review of M&S assumptions to ensure that critical systems were not overlooked and to verify that reliability block diagrams are correct

TEMP Language

The TEMP must include language that describes the steps above and must include resources for the collection and analysis of reliability data. Additionally, the TEMP must include resources for the Verification, Validation, and Accreditation of whatever reliability M&S is used to assess requirements. If the ship has a reliability growth program, then it must be documented in the TEMP as it would for any other program. (See the Reliability Growth Section of this guide book and the included New Ship Example). The relevant TEMP language for an ongoing ship class program without a reliability growth program is provided as the Mature Ship Example.