

ABSTRACT

EXTENDED LIFECYCLE SYSTEM ENGINEERING: Principles and a strategy for an improved approach to high consequence system sustainment

Many complex, high consequence system lifecycles are being extended well beyond their original design life. While the preference often exists to develop new replacement systems, many system engineers are faced with the task of managing the health of aging systems. Further, the systems are expected to meet most of the requirements established when the systems were first deemed operational. System surveillance for state of health assessments may collect data that was relevant during initial qualification, but that data may become meaningless. One common approach is to continue collecting qualification data and simply monitor the data for change. In contrast, factors and environments in the context of an extended lifecycle, that could influence state of health, may not be evaluated properly. Material inspections may detect change in the form of discoloration, but tracing the change in color to a consequential impact may not be possible. Assumptions with respect to the correlation between time and the probability of failure modes can be misleading and be an oversimplification of credible failure modes.

Communication and collaboration across multiple agencies supporting the system can further complicate effective lifecycle management. The purpose of this paper is to introduce a proposed set of principles and a broad strategy for implementation of Extended Lifecycle System Engineering (ELSE). An approach is described that couples risk analysis with failure modes and effects analysis. Distilling risks into more specific failure modes sets the stage for testing and evaluation that is traceable to high impact needs. It is argued that such an approach can facilitate more proactive, less budget-centric, and more programmatically defensible sustainment and system engineering. The approach has been in development for several years in the nuclear weapons domain. Examples, data, and lessons learned from the nuclear weapons domain will be included.