

Research Task / Overview

The discipline of systems engineering currently lacks a competency framework for verifying and validating complex systems through a test and evaluation process.

The complexity of our systems from increased software is increasing exponentially, the methods we use to V&V and T&E these systems needs a methodological framework to keep up.

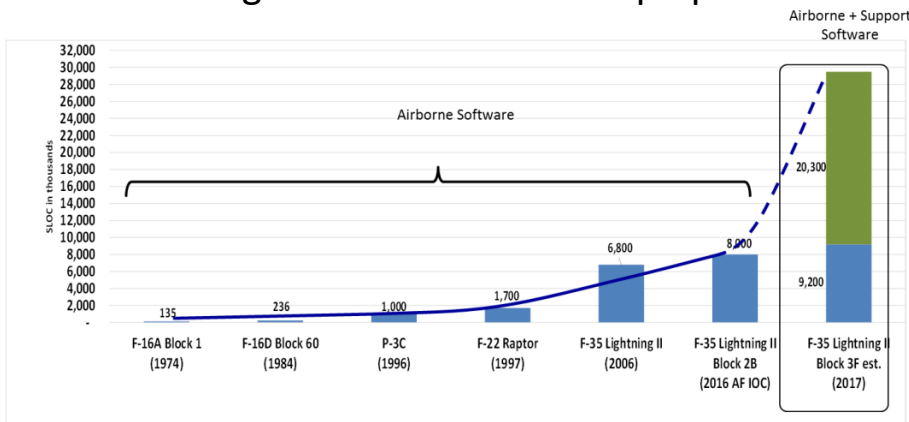


Figure 1. Defense Science Board, Design and Acquisition of Software for Defense Systems

Data & Analysis

Existing Models

- OSD T&E Competencies Model
- International Test and Evaluation Association – Certification Test and Evaluation Practitioner
- Practitioner Handbooks
- DT&E/DOT&E Guidance

Statistical Frameworks

- Design of Experiments (DOE) and Sequential test design
- Scientific Test and Analysis Methods (STAT)
- Human Testing / Experiments

Software Verification and Validation

- Software Engineering
- Axiomatic Approaches
- Formal Methods
- Design for Testability

Cyber-Physical Systems (CPS) approaches

- Verification: model checking, theorem proving, simulation, symbolic execution
- Validation: experimental validation, emulation

Systems Engineering

- Unit testing – potential environments in which the agents need to be demonstrated
- Evidence generation during design – Testing throughout the systems engineering and design process
- System modeling and simulation-based testing
- Compositional analysis

Emerging ML/AI Techniques

- Cognitive instrumentation
- Explainable AI
- Adversarial testing
- Negative testing: testing to ensure that some actions are not taken
- Evaluating Symmetries in ML

Goals & Objectives

Goals:

- Develop a model of the key competencies required for the DoD acquisition workforce to support V&V and T&E.
- Create a paradigm shift focusing on transforming engineering education and professional training in the areas of V&V and T&E.

Objectives:

- Develop an initial structure of a V&V and T&E competency framework
- Establish the research methodology to create and validate the framework
- Identify critical information sources

Methodology

Leverage background in T&E, Systems Engineering, and Engineering Education to develop the competency framework.

Steps:

- Define criteria for identifying and selecting core competencies.
- Establish initial/baseline structure leveraging data sources described on left.
- Identify additional data sources for inputs to framework.
- Develop data collection strategies for eliciting inputs to framework, including
 - Data collection protocol for focus groups.
 - Design analysis procedures for information artifacts.
- Design validation plan for the framework.

Expected Outcomes

Near Term:

- Develop competency framework
- Develop a validation plan
- Identify key academic disciplines

Long Term:

- Establish an academic degree program in T&E and V&V



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