Verification & Validation (V&V) / Test & Evaluation (T&E) Competencies

Sponsor: OUSD(R&E) | CCDC

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- 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 software enabled technologies is increasing exponentially, the methods we use to V&V and T&E these systems need a methodological framework to keep up.
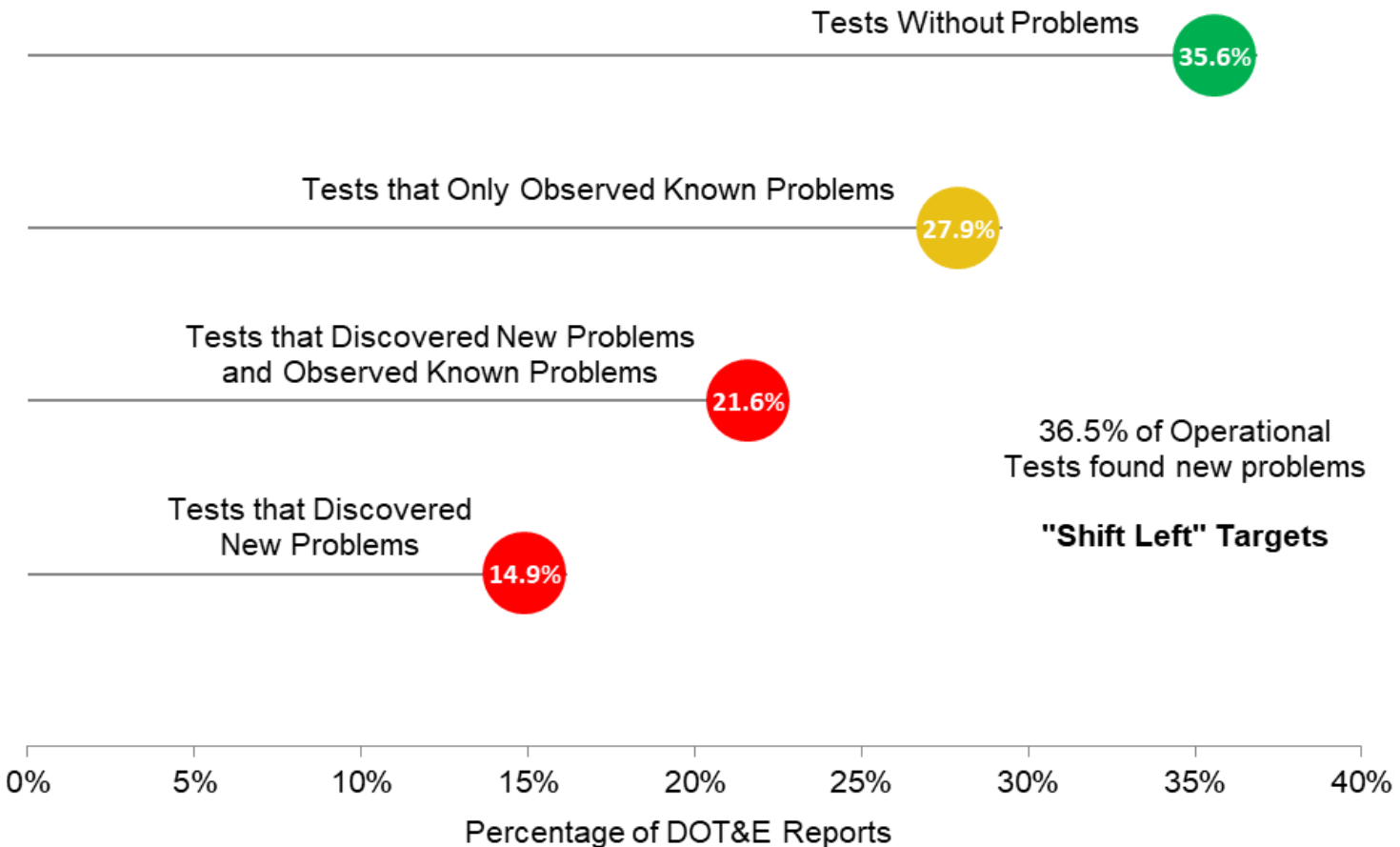
Goals and Objectives

- **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.
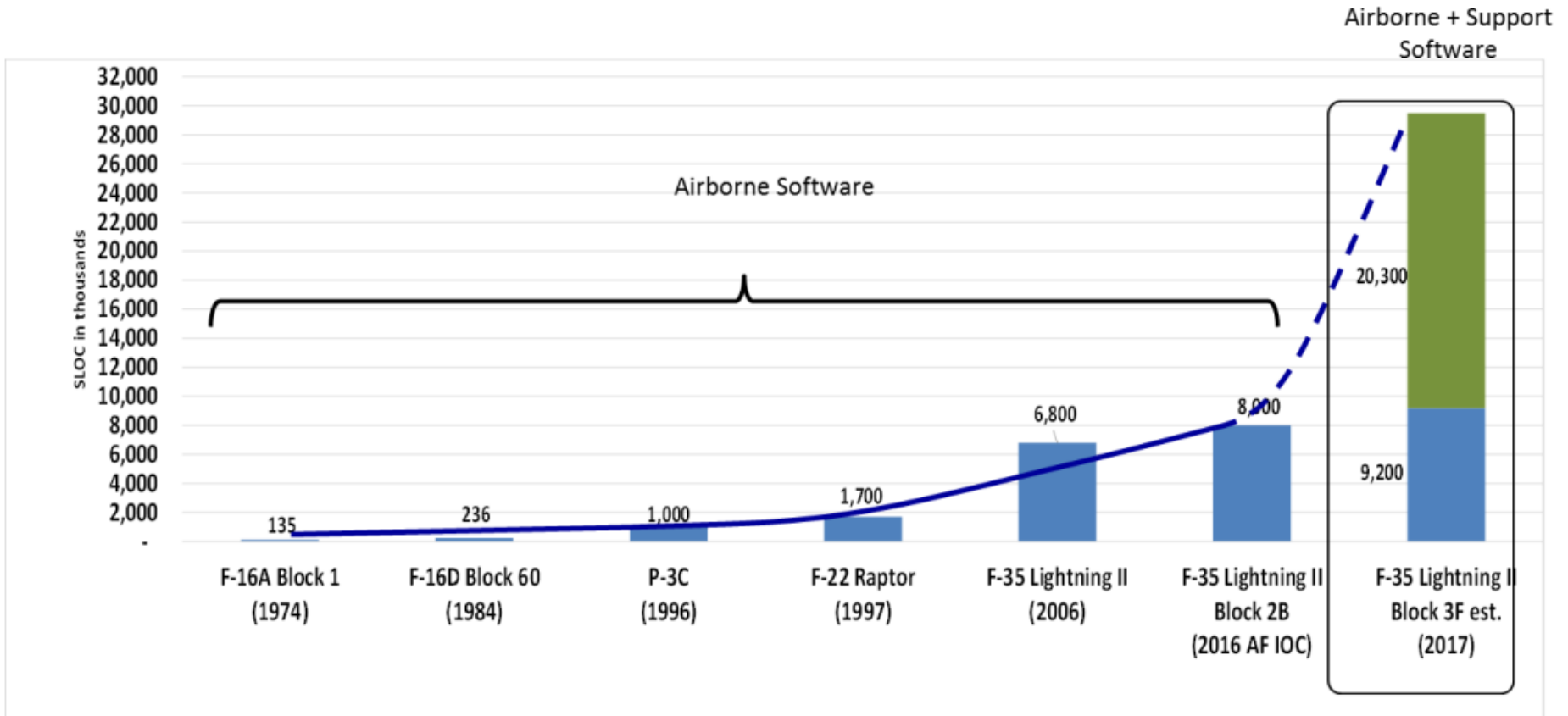
- **Objectives:**

  - 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

**Significant Problems Observed in Operational Testing**
DOT&E Reports 2015 - 2017

Tests Without Problems — 35.6%

Tests that Only Observed Known Problems — 27.9%

Tests that Discovered New Problems and Observed Known Problems — 21.6%

Tests that Discovered New Problems — 14.9%

36.5% of Operational Tests found new problems

"Shift Left" Targets

Percentage of DOT&E Reports (0% – 40%)

Why a Competency Model is Needed

Establishing a Competency Model

- 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

- Systems Engineering
  - Unit testing – potential environments in which the agents need to be demonstrated
  - Evidence generation during design - Testing needs to be carried out throughout the systems engineering and design process
  - System modeling and simulation-based testing. Need to develop standards for modeling
  - Compositional analysis
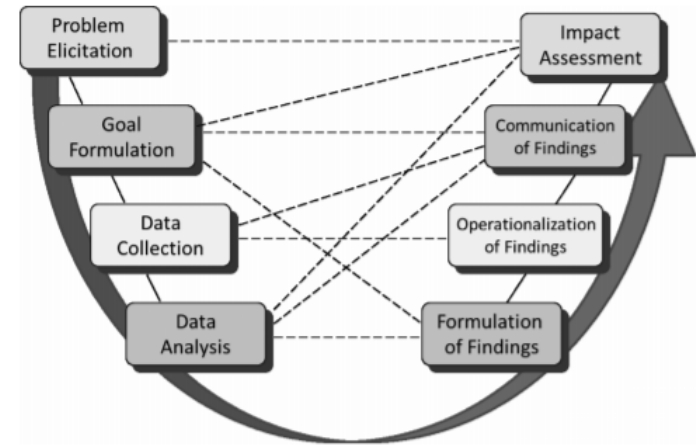
- Cyber-Physical Systems (CPS) approaches
  - Verification: model checking, theorem proving, simulation, symbolic execution
  - Validation: experimental validation, emulation

- Emerging ML/AI Techniques
  - Cognitive instrumentation and Explainable AI
  - Adversarial testing
  - Negative testing
  - Evaluating Symmetries in ML

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