

# Key Issues with Airborne Electronic Attack (AEA) Test and Evaluation



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# Outline

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- DOT&E Background & Responsibilities
- T&E of Electronic Warfare
  - DoD EW Process
  - T&E Infrastructure
- Recent DOT&E Case Studies
  - Major causes of program delays
  - OT&E cost



# DOT&E Background

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- DOT&E was created by Congress in 1983.
- Director is appointed by the President and confirmed by the Senate.
- Director's reports, by statute, go directly to the Secretary of Defense and Congress
- Responsible for all operational test and evaluation, and live fire test and evaluation within DoD.
- Provides independent oversight and reporting.



# DOT&E Responsibilities

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- Prescribe Department of Defense policy for:
  - Operational Test & Evaluation (OT&E)
  - Live Fire Test & Evaluation (LFT&E)
- Approve test plans for OT & LF oversight programs
- Monitor/report on oversight programs
- Report on programs, before full-rate production decision to the Secretary, OSD, Services, & four congressional committees:
  - Adequacy operational and live fire testing
  - Operational Effectiveness
  - Operational Suitability
  - Survivability and Lethality
- Report annually to Congress
- Member of Defense Acquisition Board

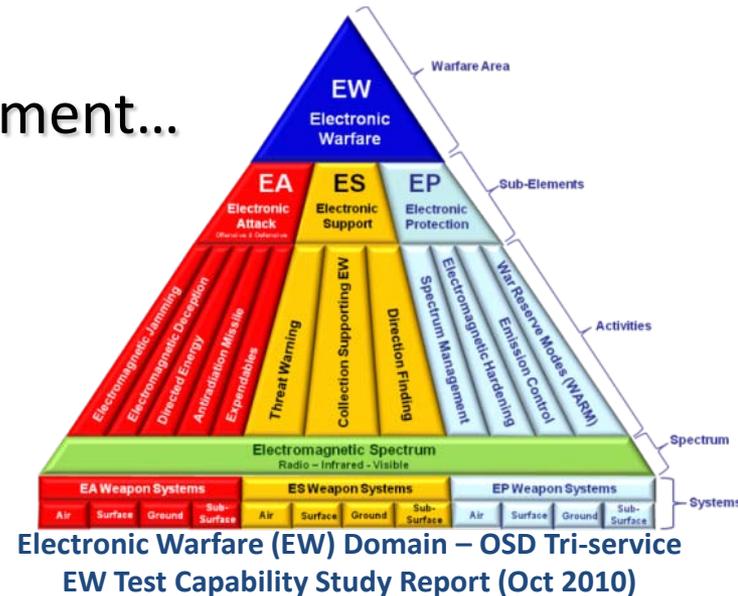


# EW (AEA) T&E Introduction

**EW Defined...** Military action involving the use of electromagnetic and directed energy to control the Electromagnetic Spectrum (EMS) or to attack the enemy. EW consists of three divisions: electronic attack, electronic protection, and electronic warfare support. (Joint Publication 3-13.1)

## Some Observations on EW (& AEA) Development...

- Inherently complex, interdependent technologies
- “Effect” is a bit of an enigma
  - Invisible and difficult to measure
- EW Performance is challenging to test & assess
  - Threat system availability and pedigree is key to performance validation

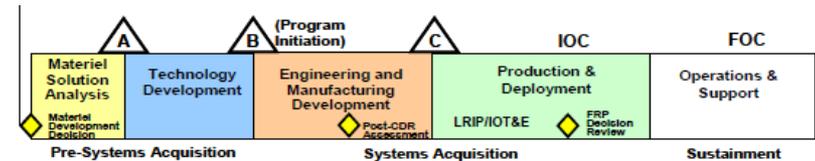




# Common EW Acquisition & Test Problems

- The Usual Issues...

- Cost, Schedule, Performance
- AT&L EW Program Management Study (2000)



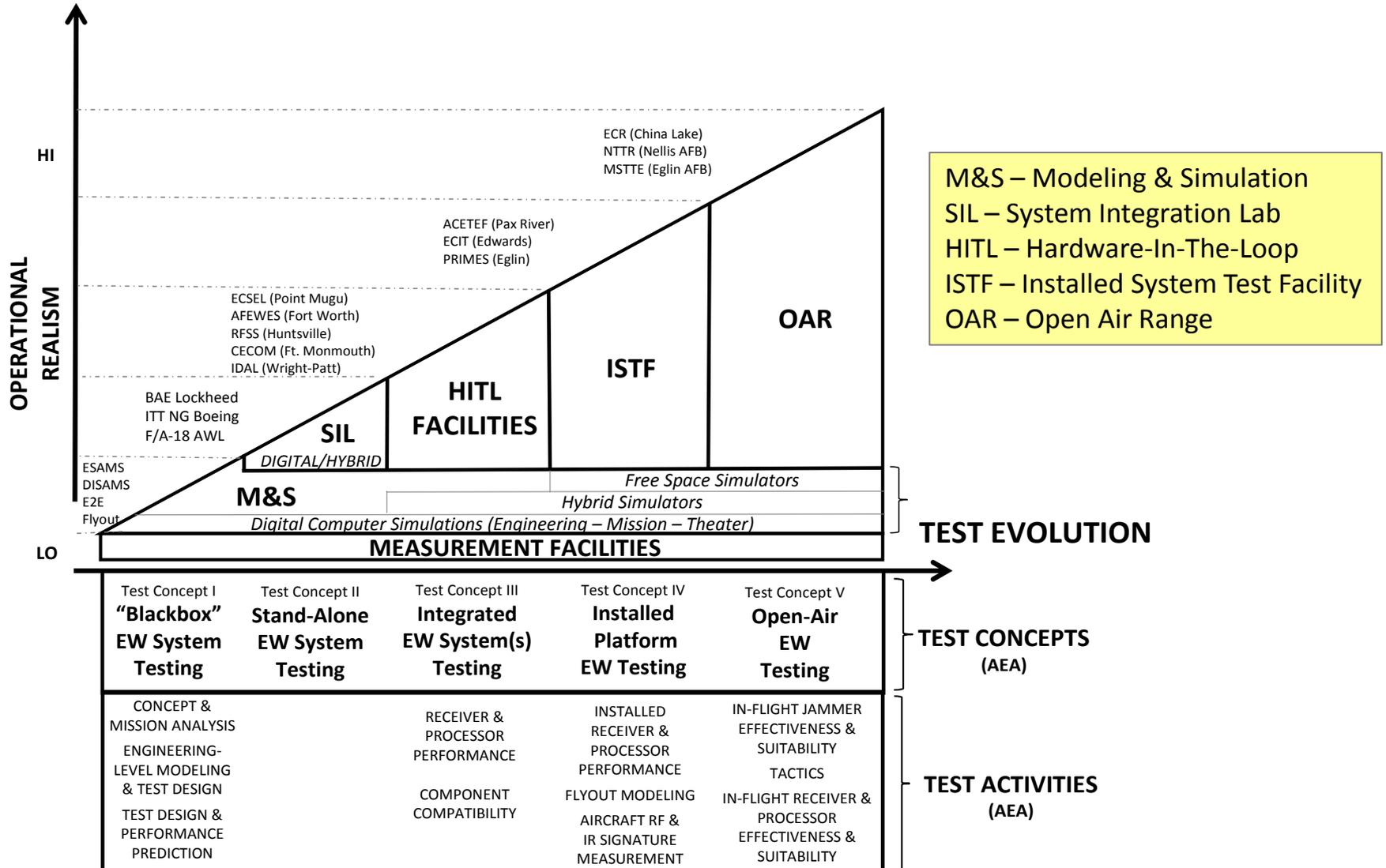
- In-attention to software development, system integration
- A rapidly changing threat which forces costly redesign of systems (i.e., dynamic requirements)
- Fluctuating budgets and lax oversight by senior leaders

- DOT&E Perspective

- Systems failing to demonstrate adequate suitability (...poor reliability)
- Requirements not testable, excessive hours needed to validate reliability thresholds
- Insufficient time, funding, and personnel allocated to accomplish thorough Operational Test
- Open Air Range (OAR) Limitations
  - Range Availability & Cost, Lack of Threat Resources, Operational realism not always available, Data Collection & Availability, threat VV&A



# DoD EW Development & Test Process





# EW (AEA) Test Resources

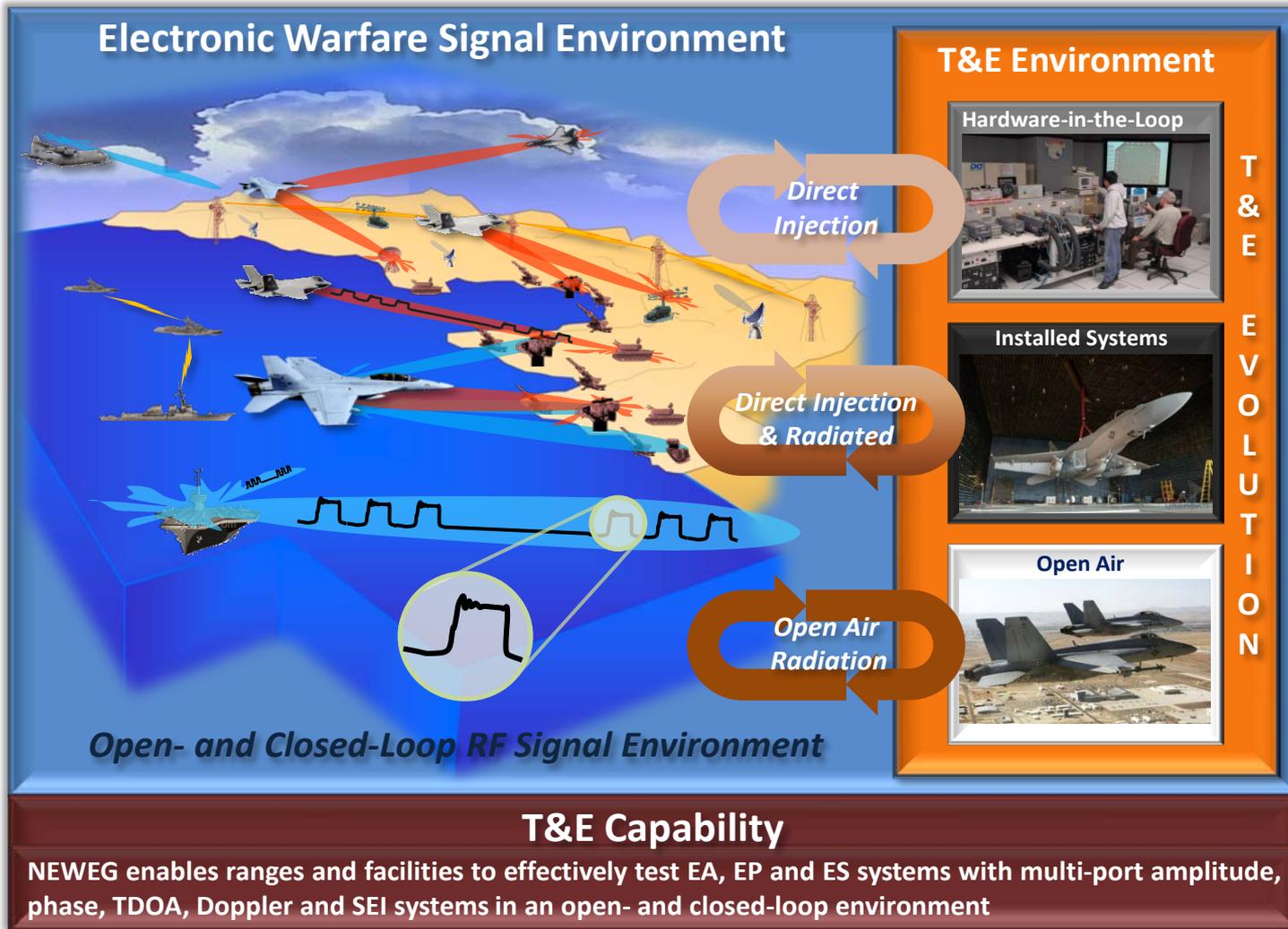
- EW test infrastructure adequacy a continuing challenge across DoD
- OSD-directed Tri-service EW Test Capability Study (TEWTCS) in 2009
  - Study in response to 2009 NGJ MDD ADM
- DOT&E submitted POM-13 Budget Issue Paper to address identified investment priorities in support of F-35 and NGJ

TEWTCS IDENTIFIED AREA <sup>1</sup>	PROPOSED SOLUTION	NEED DATE	COST EST.(\$M) <sup>2</sup>	STATUS
1. Electronic Warfare Environment Generation	Next Generation EW Environment Generator (NEWEG) Open Air Range (OAR) Capability	2Q15	\$4	HITL funded in CTEIP FY11-15 project. OAR not currently funded.
2. Instrumentation/Measuring Multiple Beams	Multi-Beam Characterization and Measurement System for OAR	4Q16	\$13	HITL funded in CTEIP FY11-15 project (NEWEG). OAR not currently funded.
3. Next-Generation SAMs Open-Closed-Loop Environment	Scientific and Technical Intelligence (S&TI) Centers' Analytic Models and Contractor-built Threat Simulator Hardware Installed system test Facility (ISTF) HITL, and OAR	2Q15	\$62	Two key threats not currently funded.
1. Program management to be spread across all services 2. Costs are all preliminary estimates (ROM's) 3. The text of the TEWTCS final report states \$17M vice \$22M in their table. We have used the \$17M estimate. <b>This Table is UNCLASSIFIED</b>				

Table adapted from *Tri-Service Electronic Warfare Test Capabilities Study* (TEWTCS) (U) Report Summary, page xii



# EW (AEA) Test & Evaluation Operational View (OV-1)



Source: NAVAIR Next Generation EW Environment Generation (NEWEG) Project brief, Oct 2011

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# EW (AEA) Test & Evaluation

## Case Study: Joint AEA Systems of Systems (SoS)

- **Joint AEA Concept**

- JROCM AEA ICD NOV 2004
- USAF Lead Component

- **Multiple Integrated Assets & Services**

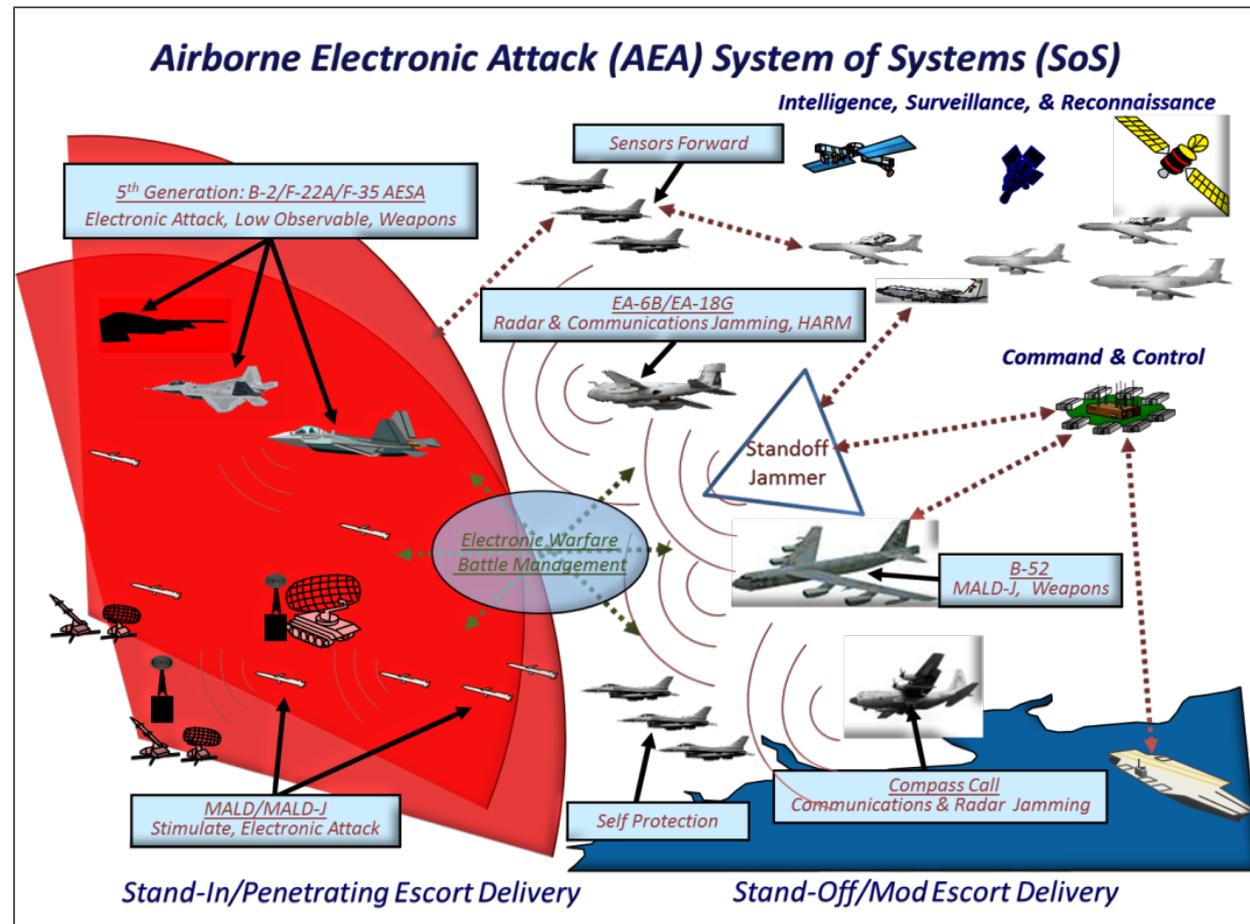
- Requires EWBM (FCD)

- **Development Challenges**

- Service-level Acquisition
- Independent Development
- Independent T&E

- **VV&A of threat environment & CONOPS**

- **M&S effort required for full operational realism**



AEA – Airborne Electronic Attack; FCD – Functional Capabilities Document (through JCIDS); JROCM – Joint Requirements Oversight Council Memo ; VV&A – Verification, Validation & Accreditation; EWBM – Electronic Warfare Battle Management; M&S – Modeling and Simulation

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# EW (AEA) Test & Evaluation

## Modeling & Simulation (M&S) for Operational Test

- Objective (i.e., challenge): Create operational (T&E) AEA battle-space environment not available or feasible in the Open-Air-Range (or any other) environment
- Air Warfare (OT) Examples (some currently in use, in work and/or planned for future)
  - F-22—ACS, MALD/MALD-J—(DIADS), F-35—Vsim
- Overarching Challenges
  - Integration of myriad M&S models and software protocol to run real-time
  - V&V of System of Systems (SoS)
    - Components are V&V'd by source, but entire SoS requires dedicated V&V as well.
    - V&V strategy must be thought out and crafted early in planning process
    - Real-world comparison often lacking fidelity to support SoS confidence level
  - Blue system and threat model fidelity, density and pedigree
    - Are threat (red) models available and integrated?
    - Are friendly (blue) models not restricted by OEM proprietary rights?

**M&S environment must be credible, with documented pedigree, to be “believable” for use in OT**



# Study of Major Program Delays

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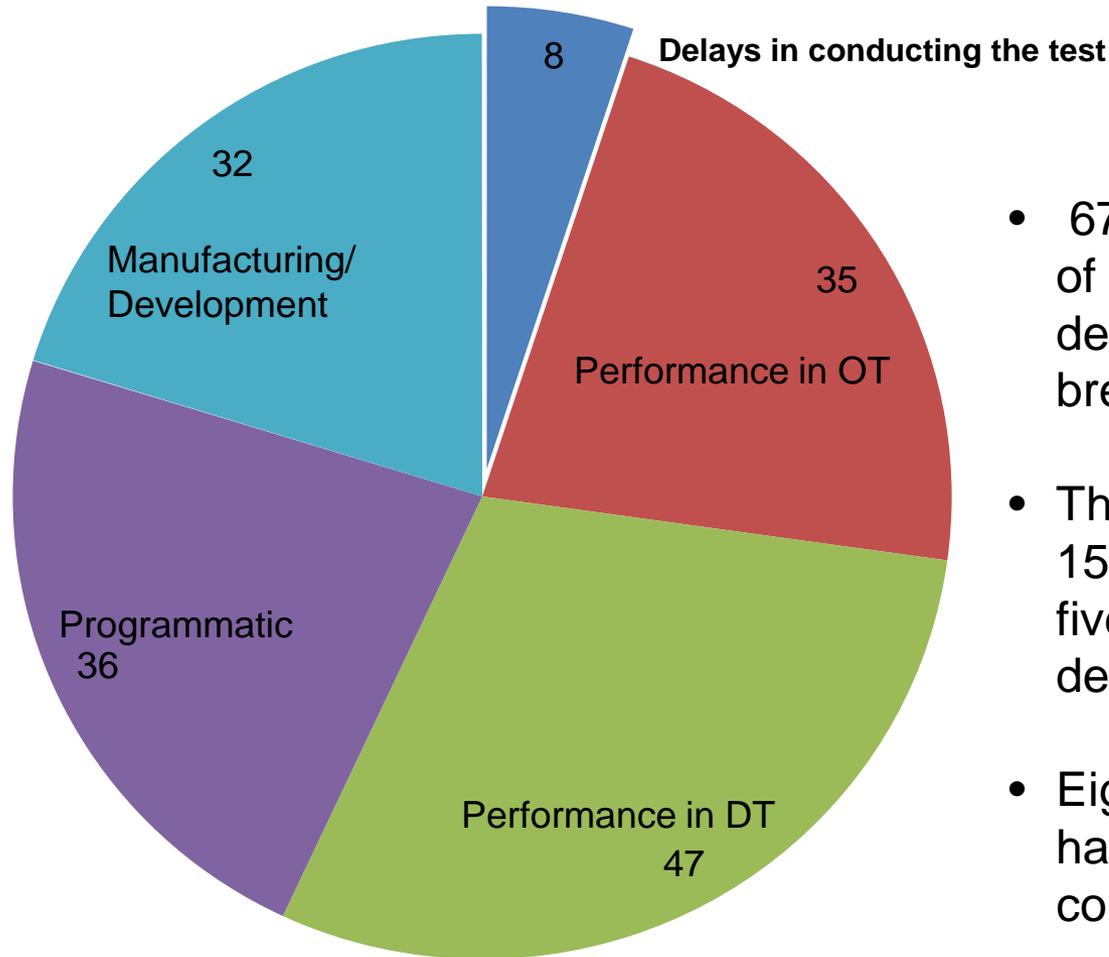
Of 67 programs with 1+ years milestone delay:

- **No** program had **only** test-related delays
- 8 programs (12%) had some test-related delays
  - Test delays set programs back weeks or months
- 56 programs (84%) had delays due to problems discovered during testing
  - Fixing problems takes longer than scheduling range time
  - Problems can take years if redesign is required
  - Test early. Test often. Don't assume it will work

**Testing does not cause major delays.  
The problems found by testing can cause major delays**



# Reasons Behind Program Delays



- 67 selected case studies of programs with  $\geq 1$  year delay or a Nunn-McCurdy breach
- The case studies showed 158 instances of issues in five categories resulting in delays
- Eight of the 67 programs had delays because of test conduct issues

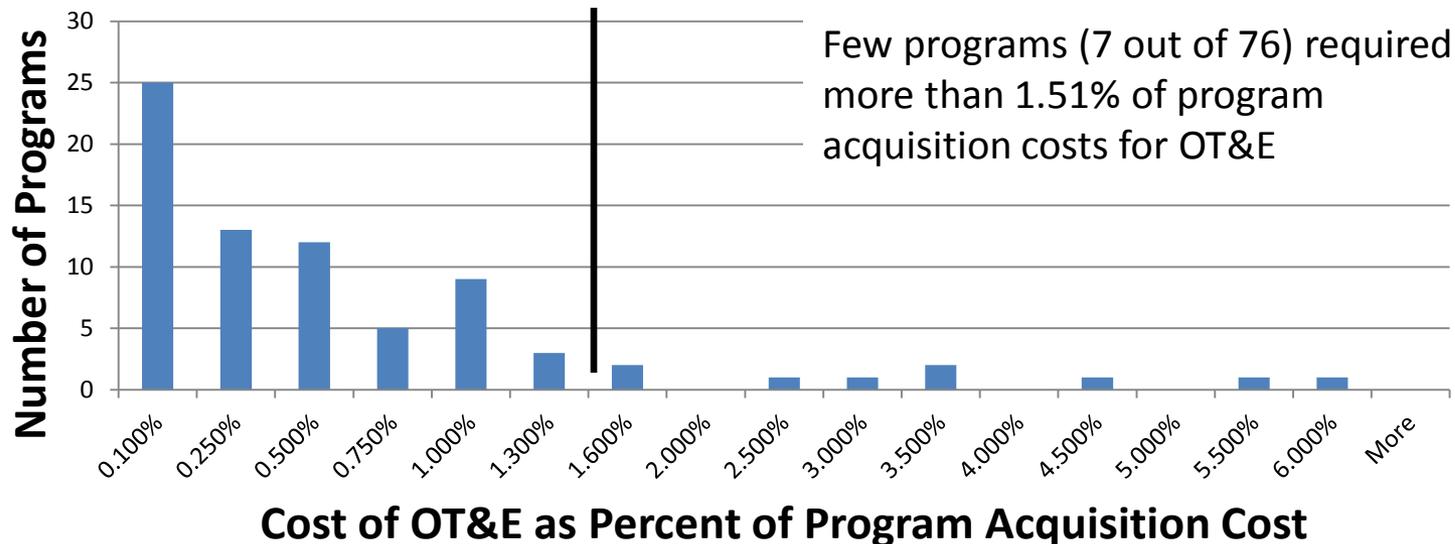
*“T&E cost issues in a program are typically the result of under-estimating the impact of system complexity; inadequate cost estimating; and/or inadequate/immature engineering”*



# Cost of OT Relative to Program Cost

*“...the cost of [testing] is a small portion of the overall program budget; it is a large percent of the budget in the year(s) in which it occurs...[and] by being at the end of the development process, testing occurs when the program has few degrees of freedom left to work issues.”*

- Review of 76 recent programs showed an average marginal OT&E cost was 0.65%
- Low Program Acquisition Cost is dominant source of high relative OT&E cost
- Expense of test articles and their expendability is a major driver



**OT&E is usually 1% ± 0.5% of Program Acquisition Cost**