



# Promoting a New Paradigm of Reliability Test and Evaluation: Lessons Learned & Policy Improvements

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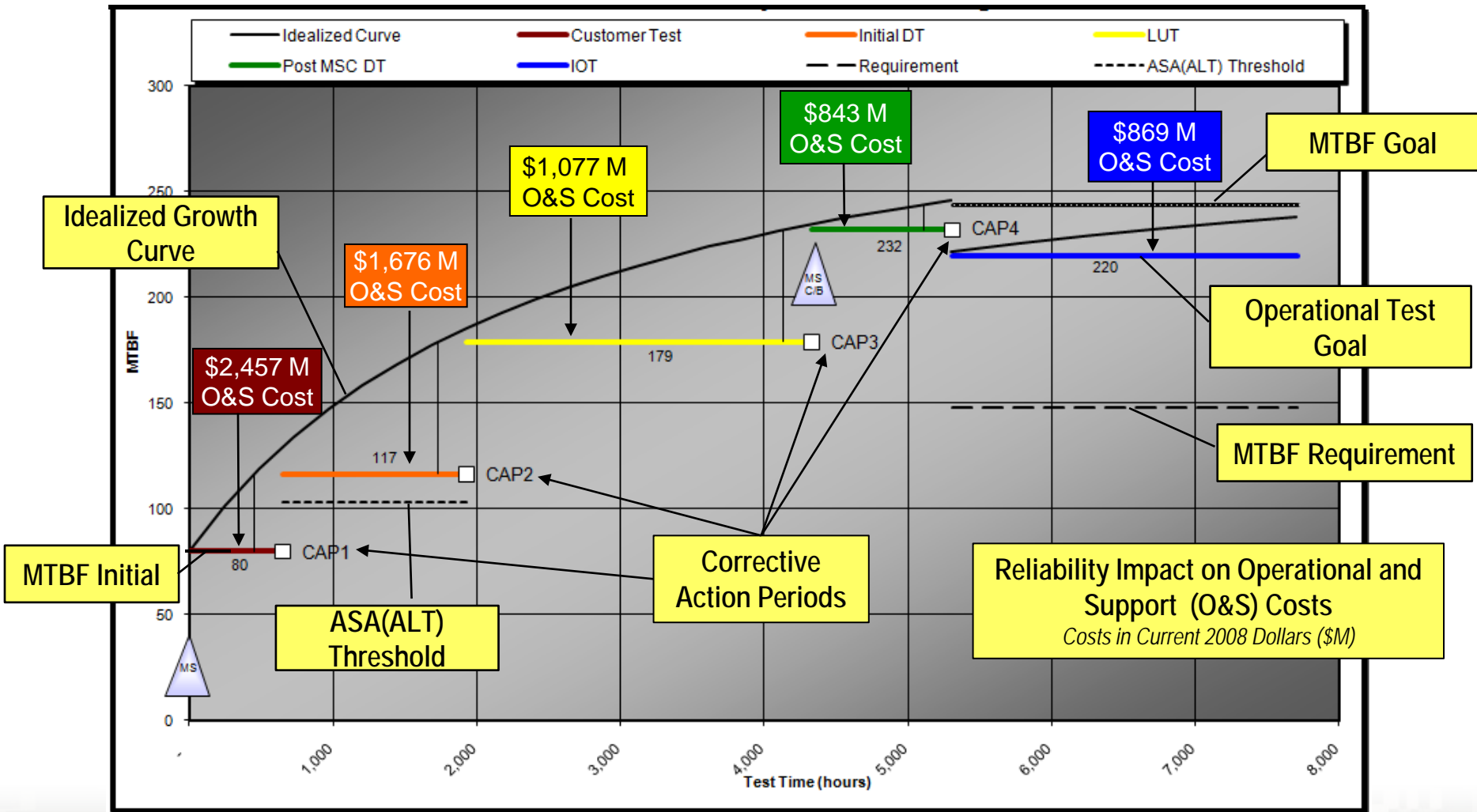
US Army Evaluation Center



# Key Army and OSD Reliability Policies

- Directive Type Memorandum 11-003 “Reliability Analysis, Planning, Tracking, and Reporting”
  - Issued on 21 March 2011 by USD(AT&L)
- “Improving the Reliability of US Army Materiel Systems.”
  - Issued on 26 June 2011 by ASA(ALT)
- Army Regulation 702-3 Reliability, Availability, and Maintainability (RAM)
  - Army-wide staffing of update planned for 1<sup>st</sup> quarter of FY14

# Notional Reliability Growth Planning Curve

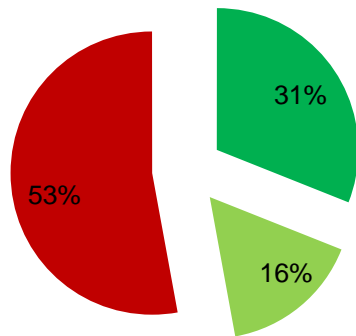


# Reliability Trends

## 2004-2011 Operational Testing

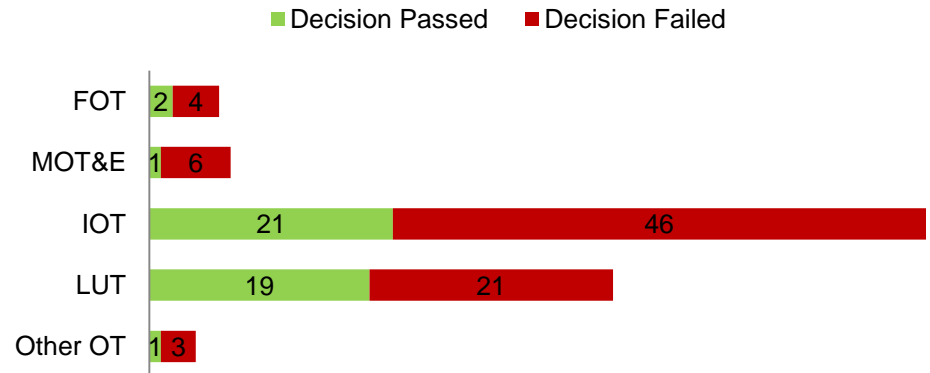
### Reliability Requirements Demonstrated in Operational Testing 2004-2011

- Systems demonstrated at least one requirement on first try
- Systems eventually demonstrated at least one requirement
- Systems never demonstrated any requirement

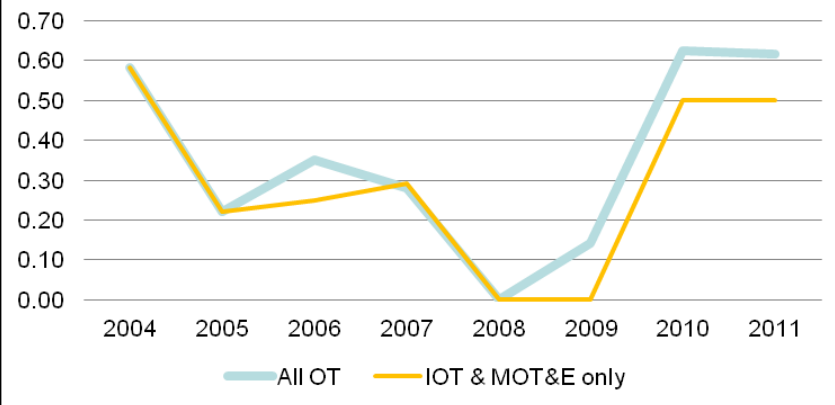


System reliability maturity level tends to be lower than anticipated at the start of the T&E program

### Reliability Requirement Decision Attempts in Operational Testing 2004-2011

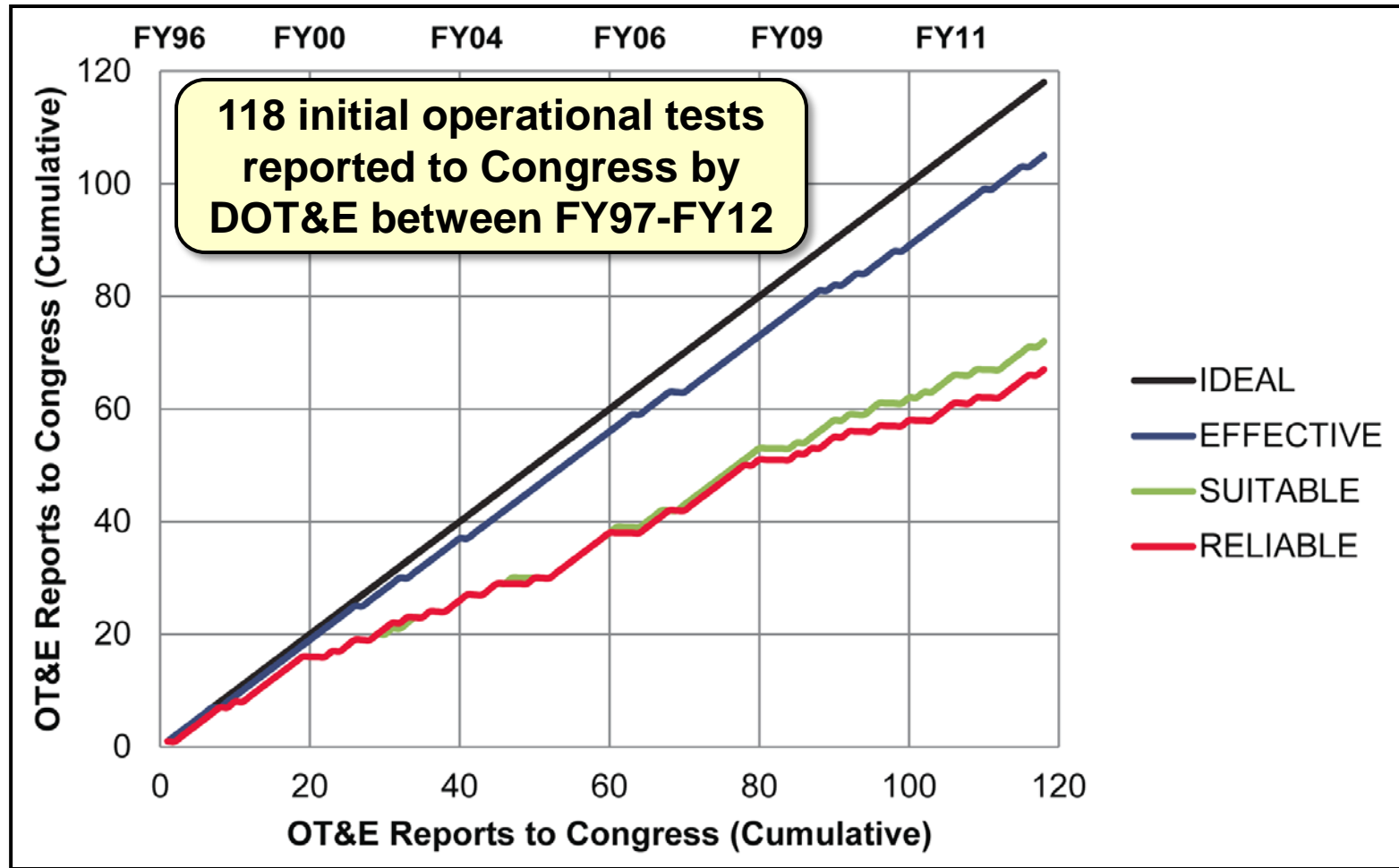


### Operational Reliability Requirement Demonstration Pass Percentage 2004-2011



# DoD Reliability Trends

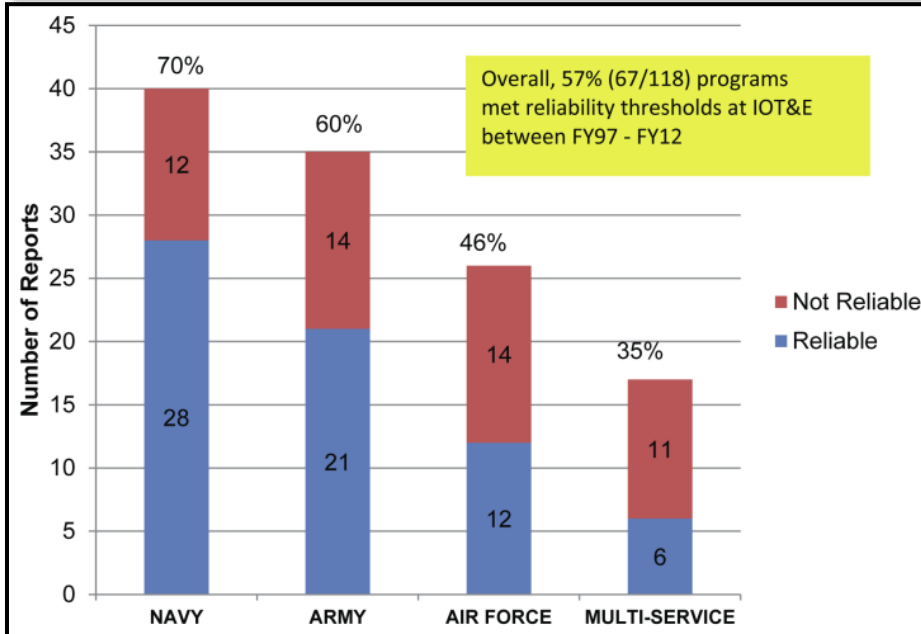
Source: DOT&E FY2012 Annual Report



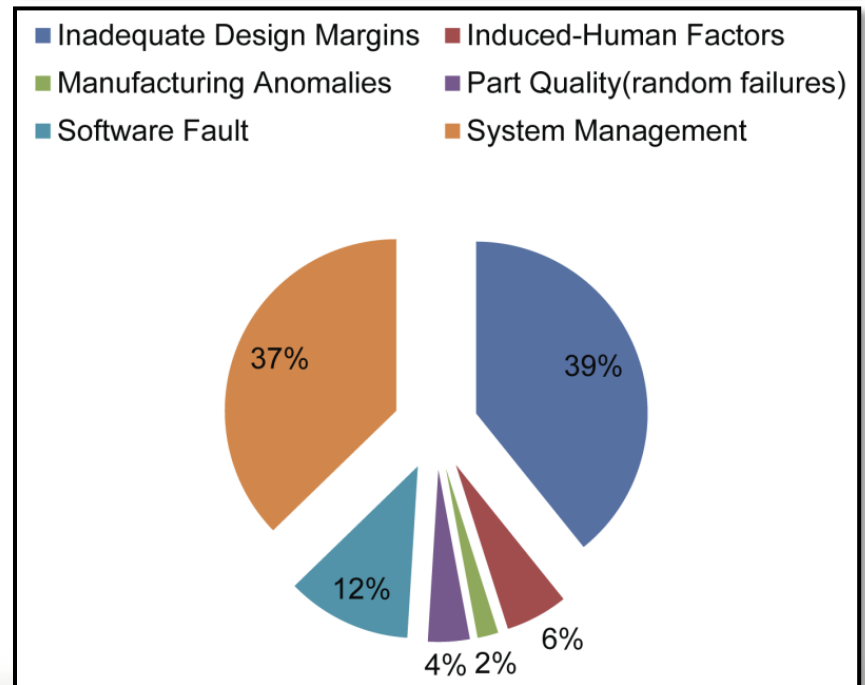
# DoD Reliability Trends

Source: DOT&E FY2012 Annual Report

Fraction of Programs Meeting Reliability Thresholds at IOT&E, by Service (FY97-FY12)



Root Failure Causes for the 51 Programs Not Meeting Reliability Thresholds between FY97 and FY12





# Reliability T&E Program Lessons Learned

- ❑ Reliability growth programs are appropriate for small number of elusive failure modes that only surface when hardware, software, and Soldiers use the system under operationally-realistic conditions.
- ❑ Reliability predictions (e.g., MIL-HDBK-217) and chamber testing estimates are highly optimistic.
- ❑ Systems entering system/subsystem reliability growth test programs with too many failure modes.

# Reliability T&E Program Lessons Learned

- Contract for closed-loop, continuous-improvement effort to identify & mitigate failure modes likely to occur under operationally-realistic loads & stresses using techniques including:
  - Engineering- and physics-based failure-mechanism models
  - Accelerated and low-level testing of components and assemblies
  - MANPRINT analytical methods (for failure modes that may be charged to users, maintainers, or software)
  - Lean Six Sigma methods (for failure modes that may be induced by manufacturing variation or errors)
  - Assess before start of system-level RG testing with the Army Materiel Systems Analysis Activity (AMSAA) Reliability Scorecard



# Reliability T&E Program Lessons Learned

- ❑ Execute system/subsystem-level reliability testing to surface and mitigate the modeling-resistant failure modes that remain.
- ❑ Achieve a shared understanding of all system RAM requirements.
- ❑ Perform up-front sensitivity analyses to determine the operational impact of not demonstrating a requirement.
- ❑ Formulate a feasible reliability growth program plan; do not simply create “refrigerator art”

# Concluding Remarks

- ❑ The majority of Army systems struggle to demonstrate their reliability requirements.
- ❑ The shortfall in system reliability has resulted in DoD and Army policies that promote reliability best practices aimed to improve the success rate.
- ❑ Improvement in system reliability can result in savings on the order of billions of dollars during the sustainment phase.
- ❑ By applying reliability engineering best practices, it is possible to simultaneously improve system reliability and reduce O&S costs.
- ❑ There are a wide range of tools and techniques available to assist practitioners in all phases of the Defense Acquisition Management System.

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