Office of the Under Secretary of Defense (Research & Engineering)

Test Doesn't Need to be a 4-Letter Word

(but we can be more effective and efficient)

34th Annual NDIA Test & Evaluation Conference

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OUSD(R&E)/AC/DTEP/DT&E

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Agenda

- Video
- Office of the Deputy Director for DTEP
- Developmental Test History
- What Delays Program Execution?
- Shift Left
- Developmental Evaluation Framework and STAT
- Progress in Cybersecurity T&E
- Advancing the DT&E 'State of Practice'

Video Place Holder

DD(DTEP) Lines of Effort

Major Program Engagement (DT&E)

- Engage Early – Help programs develop innovative and effective strategies and capabilities
- Maintain program engagement throughout the acquisition lifecycle with the goal of helping programs to succeed
- Provide decision/quality assessments to inform production or modernized capability fielding decisions

Policy, Guidance, Congressional Reporting & T&E Workforce (DT&E / P&CE)

- Streamline policy to reduce cost, schedule, and performance risks
- Support sufficiency assessments and milestone summary reporting
- Improve the T&E Workforce to support priority emerging technologies
- Develop, improve, and certify DAU T&E curriculum
- Increase the number of qualified chief developmental testers

Technology Insertion and Rapid Acquisition Support (DT&E / P&CE)

- Assist Military Services with technology development, including DT&E
- Advance a DT&E enterprise approach for Mission Engineering / Integration
- Help Military Services develop tailored DT&E for rapid acquisition systems
- Improve state-of-the-art planning, execution, and reporting for the developmental activities of USD(R&E)'s modernization priorities, including DT&E and Prototyping

Prototyping and Concept Experimentation (P&CE)

- Execute Joint and Interagency prototypes and experiments
- Facilitate Military Service and CCMD prototyping and experimentation efforts
- Anticipate emerging threats and develop counters
- Leverage ally and partner investments by assessing and fielding foreign capabilities that support U.S. Joint warfighter needs

A Brief History of Developmental Test

When did we lose our way?

- **President Nixon's Blue Ribbon Defense Panel – July 1970:**
  - Concluded that "functional testing" (today we use the term developmental testing) is "well understood and faithfully executed." and "functional testing is not considered to be a major problem area."
  - Also concluded that operational testing is inadequate and the services do not conduct enough Joint T&E.
- **Defense Science Board – 1999:**
  - Recommended "compressing the developmental test schedule wherever practical."
- **Defense Science Board – April 2007:**
  - USD(AT&L) chartered a DSB review to establish a task force on Developmental T&E when 50% of the programs were found not to be operationally effective or suitable. It further stated that "IOT&E failures suggest deficiencies in the DT&E processes."
  - The final report recommended the DoD "consolidate DT-related functions in AT&L to help reestablish a focused, integrated and robust organization"
  - Congress took note in 2009 and enacted the Weapon Systems Acquisition Reform Act, creating the position of Director, DT&E.

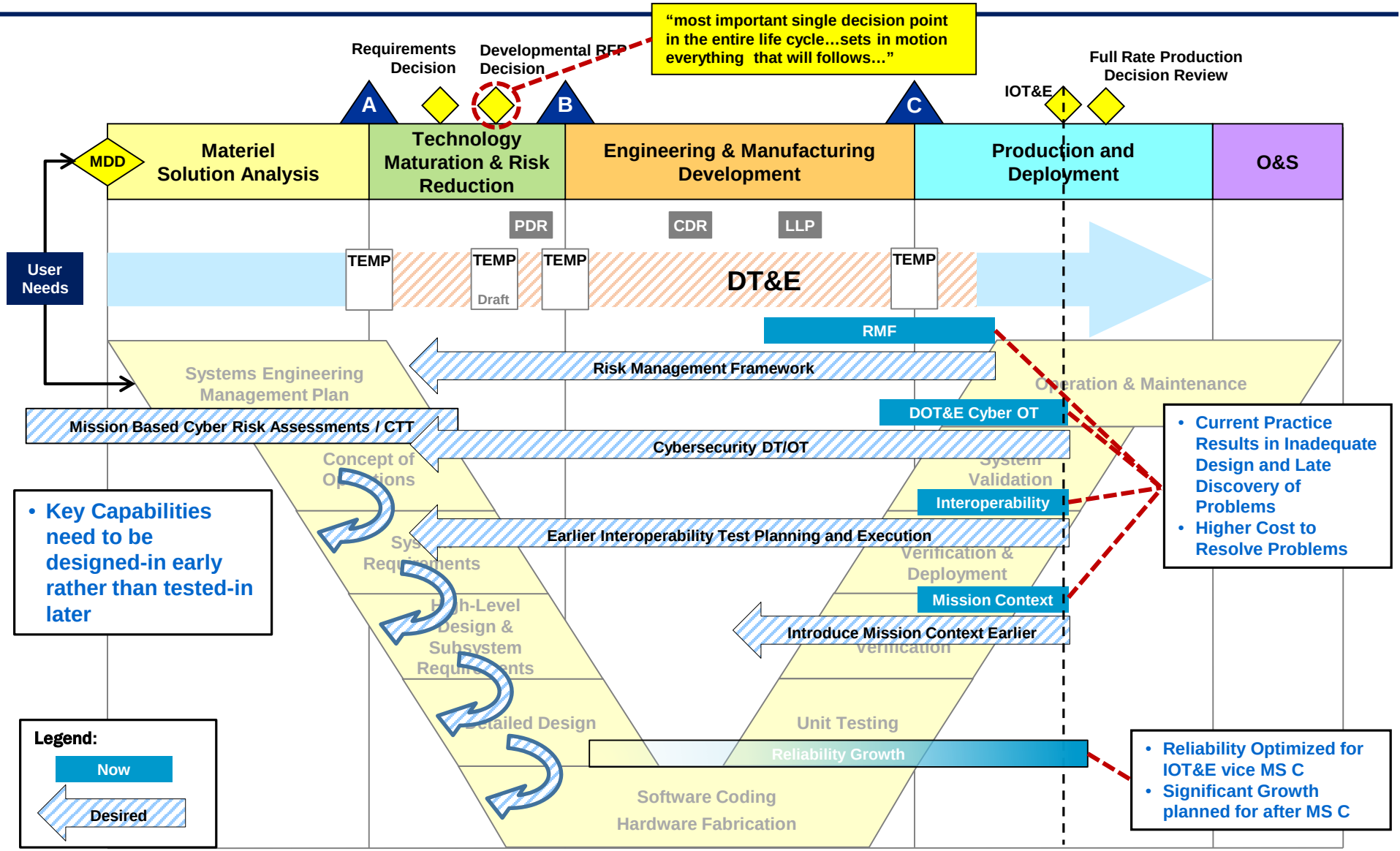
Dr. Steven J Hutchison, "Whatever happened to Good Old-Fashioned DT&E?" *The ITEA Journal*, March 2014, Volume 35, Number 1, pages 16-26.

What Delays Program Execution?

- **In 2017, IDA updated their study *"Reasons Behind Program Delays"***
  - Reviewed 134 programs that experienced a delay of at least 6 months in the FRP decision (or similar milestone) and had a FRP decision after 2000
  - Most delays were under 6 years and the longest was 17
  - Typically, multiple reasons drive a delay, and the number of reasons cited correlates with the length (more reasons = longer delay)
  - Data indicated that success-oriented schedules are a significant problem
  - The most commonly cited reason for a ***delay was a system performance problem identified during test that the PM addressed before moving forward***
  - The ***least commonly cited reason is a problem conducting the test*** and programs generally don't schedule enough time to fix the problems they find during test

Systems Engineering, Test, & Acquisition

The Problem



D,DT&E "Shift Left" Initiative

- **DT&E introduced "Shift Left" in FY 2012 ensure to development problems do not become Warfighter or production problems**
  - Focus critical DT&E activities earlier in the acquisition life cycle. Find and fix problems early
  - Three Initial Focus Area – Cybersecurity, Interoperability, and Mission Context
  - Additional focus on Reliability and overall System Performance
- **"Shift Left" is about getting the right information earlier to make better decisions:**
  - Technical Maturity (e.g., PDR/CDR)
  - Programmatic (e.g., LLP)
  - Acquisition (e.g., MS C)
- **Can we Shift Further Left" and increase collaboration between the developmental test and operational test communities?**
  - Requirements / Architecture
  - Make Better use of integrated testing

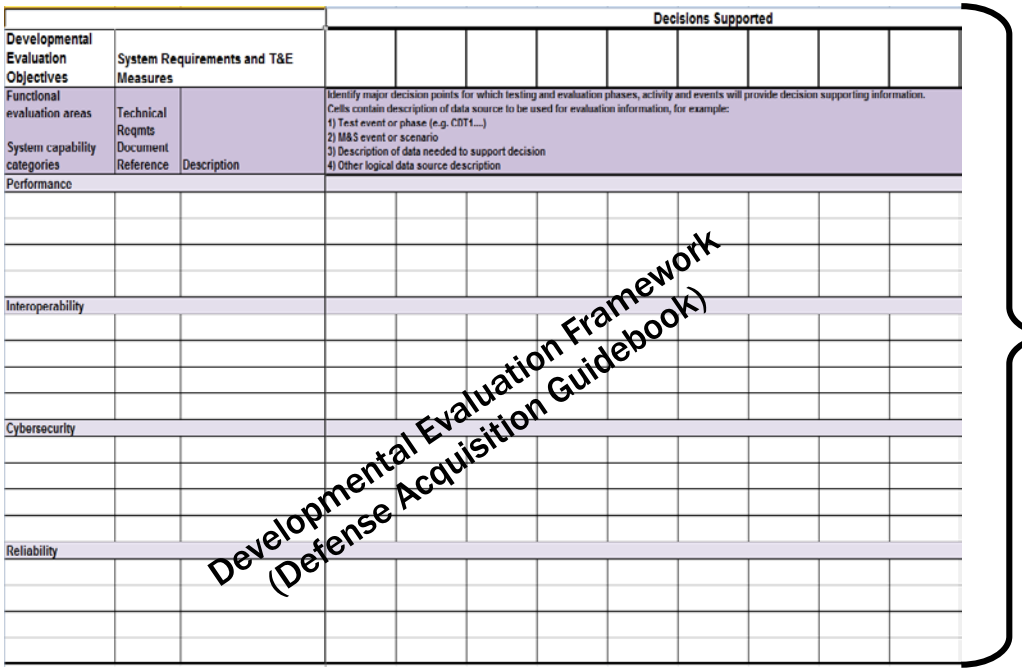
Ensure the design is stable and will not be subject to significant design changes after the production decision

Why "Shift Left"?

- **Between FY 1997 and FY 2013, only 75 of 135 programs (56%) met their reliability threshold requirements at IOT&E**
- **Fielded systems continue to experience Interoperability issues and Cybersecurity vulnerabilities**
- **Too many acquisition programs optimize test strategies to deliver data/performance at IOT&E after the production decision**
  - Success is measured too late – after the production decision where development is virtually complete
  - Too late to make significant changes without high cost
- **Too many acquisition programs conduct extensive and critical DT&E activities after the production decision**
  - Cybersecurity / Interoperability testing often deferred until IOT&E.
  - Reliability Growth Plans focus on meeting goals at IOT&E or beyond.
  - Limited Mission Context and lack of realistic threat environment

Developmental Evaluation Framework

- **Use a Developmental Evaluation Framework to structure the test program**
  - Shows the correlation/mapping between test events, key resources, and the decision supported – roadmap to obtain developmental test data
  - Highlights the evaluation strategy and critical data needs to support key engineering and acquisition decisions
  - Ensures alignment between the test strategy and acquisition strategy



- **The Framework Identifies key data that contributes to assessing progress on:**
  - Key Performance Parameters
  - Critical Technical Parameters
  - Key System Attributes
  - Interoperability requirements
  - Cybersecurity requirements
  - Reliability growth
  - Maintainability attributes
  - Developmental test objectives
  - Others as needed

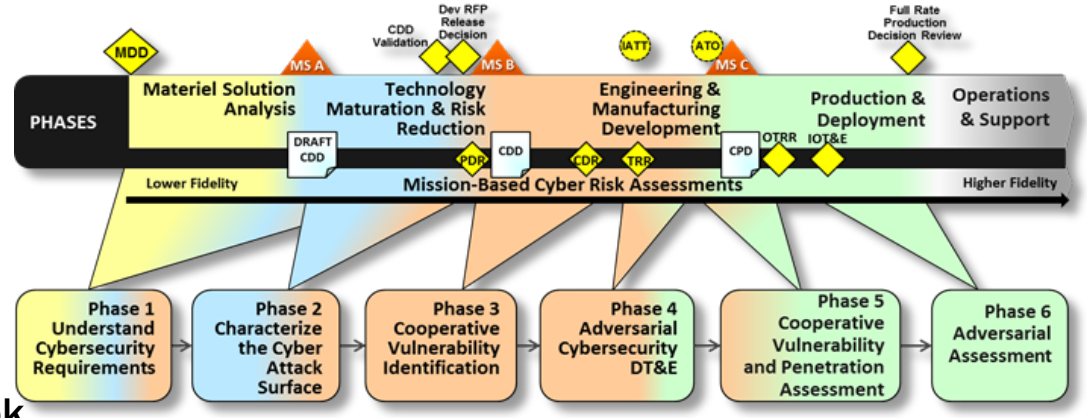
Scientific Test and Analysis Techniques (STAT) Center of Excellence (COE)

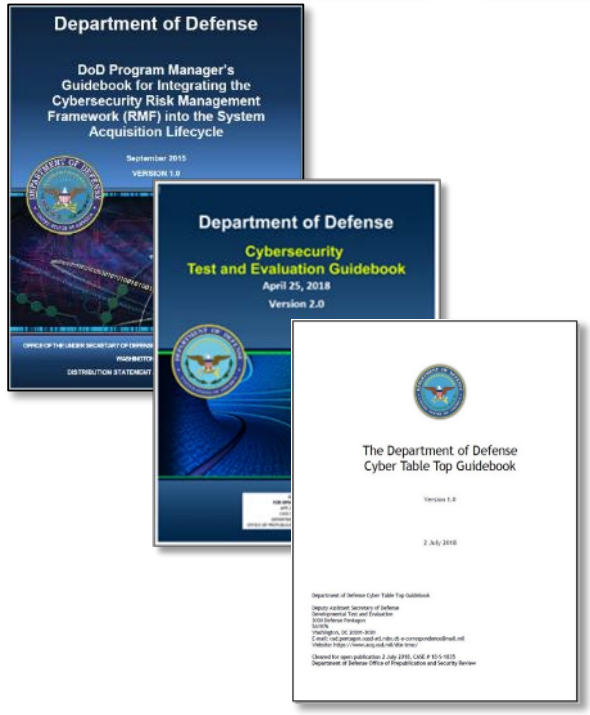
- **Established and funded by DASD(DT&E) in 2012 to provide Independent PhD level technical STAT skills**
  - Plan to increase T&E efficiency & effectiveness
  - COE supports DOD major acquisition programs
- **Mission: Provide independent advice and assistance to designated acquisition programs in the application of scientific test and analysis techniques in the development of test & evaluation strategies and plans**
- **Functions**
  - Supports acquisition programs to increase T&E efficiency & effectiveness
  - Provide technical assistance to the DASD(DT&E) staff, as requested
  - Capture STAT best practices for wider dissemination across acquisition community
  - Develop case studies that exemplify appropriate use of STAT in achieving more rigorous T&E
  - Identify STAT research needs and communicate them to the academic community
  - Provide training at the point of need to ensure program led rigor in testing
- **FY19 Program Engagement**
  - Over 240 engagements resulting in direct impact on 51 ACAT I programs.

Using Scientific Test and Evaluations Techniques to ensure testing produces valuable data that informs better decisions and increases the information gained in testing to support knowledge-based decisions

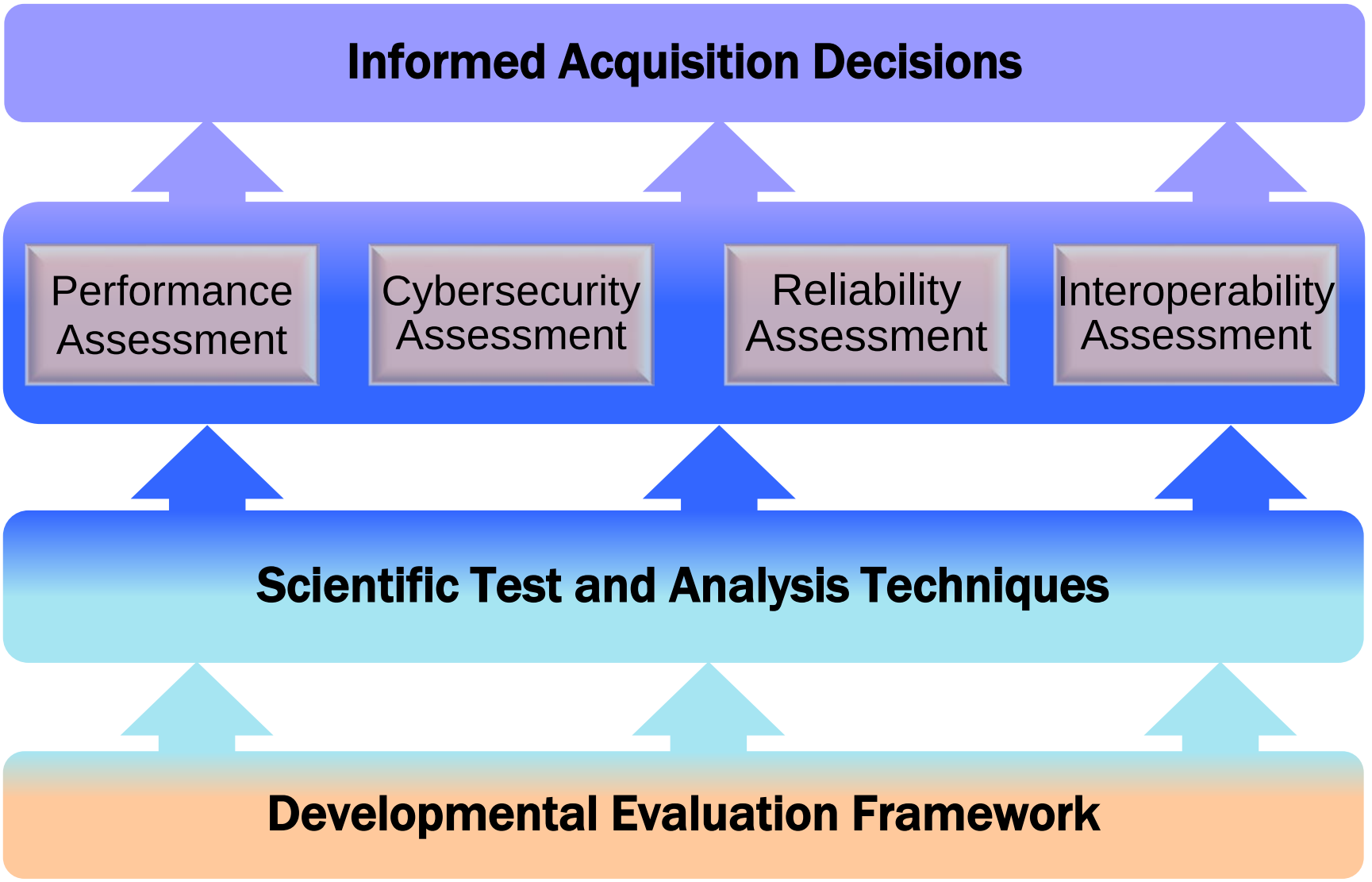
Progress in Cybersecurity T&E Requirements, Policy, and Guidance

- **Policy**
  - Aug 2017: DoDI 5000.02, Encl 14
- **Requirements**
  - Jan 2017: JROCM 009-17
- **Guidance**
  - Sep 2015: DoD PM's Cybersecurity Guidebook
  - Jan 2017: Cyber Survivability Implementation Guide
  - Feb 2017: Defense Acquisition Guidebook Update
  - Apr 2018: DoD Cybersecurity T&E Guidebook
  - Jul 2018: DoD Cyber Table Top Guidebook
- **Training**
  - Defense Acquisition University
  - Cyber Tabletop Exercises
  - Cross-Service Working Groups
- **Investments**



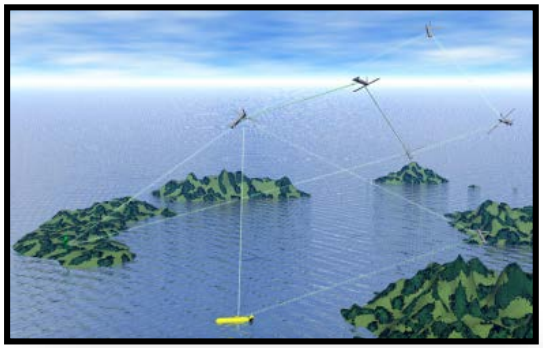


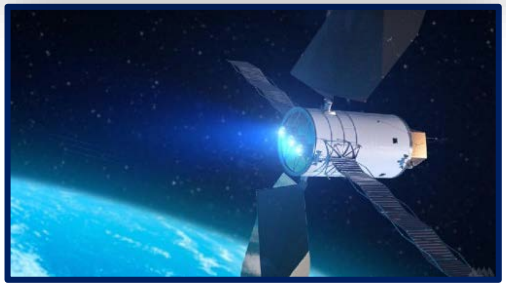
DT&E Knowledge Flow



Advancing the DT&E 'State of Practice'

- **Evolve "the state of practice" of DT&E to keep pace with emerging technology and improve test efficiency to field systems faster**
  - Increase the efficiency and effectiveness of T&E across the DT&E, OT&E and Test Resources communities
  - Increase the use of Statistical Test Design to improve test efficiency
  - Shift critical DT and OT testing left in the development cycle – leverage integrated testing and mission based T&E
  - Ensure DT&E policy, guidance, techniques, infrastructure keep pace and support testing of emerging capabilities and technologies (e.g., hypersonics, artificial intelligence)
  - Develop and document a DT&E approach for software testing that informs DT&E assessments

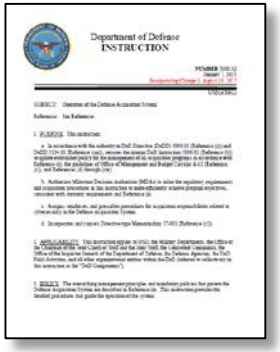




Back-up

Cybersecurity Policy Overview

- **DoDI 5000.02, Operation of the Defense Acquisition System, August 10, 2017, incorporating Change 3 – Enclosure 14**
- **DoDI 5000.75, Business Systems Requirements And Acquisition, February 2, 2017**
- **"Procedures for Operational Test and Evaluation of Cybersecurity in Acquisition Programs," DOT&E Memo, April 3, 2018**
- **DoDI 8500.01, Cybersecurity, March 14, 2014**
- **DoDI 8510.01, Risk Management Framework (RMF), July 28, 2017, with Change 2**
- **JROCM 009-17, "System Survivability KPP Update to ensure Joint Force Mission Assurance"**
  - Cyber Survivability Endorsement Implementation Guide (CSEIG), v1.01a

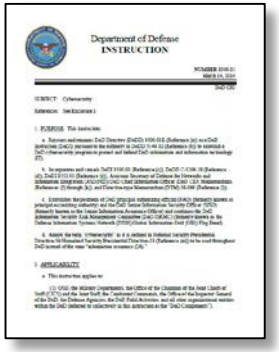

Department of Defense INSTRUCTION

DoDI 5000.02

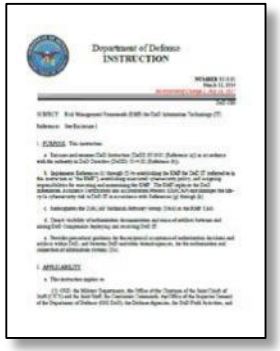

DOD INSTRUCTION 5000.75
BUSINESS SYSTEMS REQUIREMENTS AND ACQUISITION

DoDI 5000.75

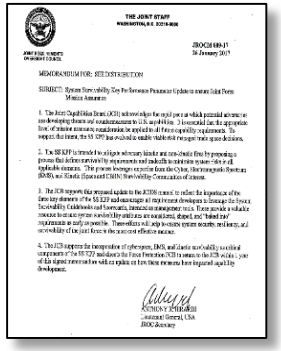
Procedures for Operational T&E


Department of Defense INSTRUCTION

DoDI 8500.01


Department of Defense INSTRUCTION

DoDI 8510.01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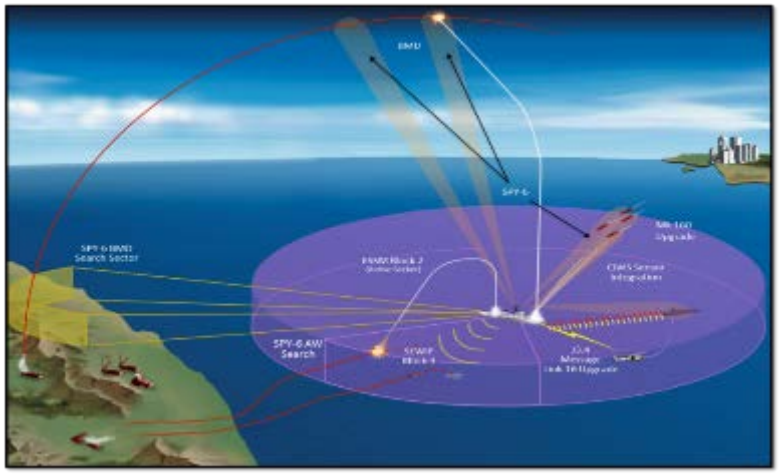
JROCM 009-17

Progress in DEF and STAT
AEGIS Probability of Raid Annihilation (P_{ra})



DOE Infusion into DT&E Strategy

A sequential *Design of Experiments* was implemented in ACB 12 testing that effectively reduced the test space for the more complicated ACB 16 build that had 4 hardware configurations and 3 software deliveries.

P_{ra} Requirement

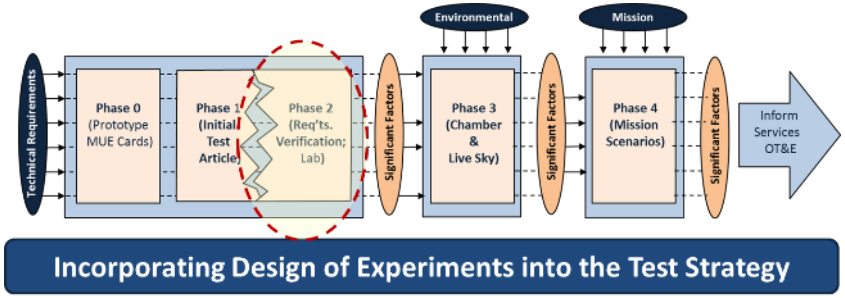
- The Aegis Combat System P_{ra} requirement that requires testing with multiple targets with multiple missiles per scenario
- This requirement was first applied to ACB 12 which had 1 hardware configuration and 2 software deliveries

Return on Investment

The STAT strategy reduced the total number of missiles required for DT&E by 96 at a cost of at least $1.1M per missile—a $105.6M in savings.

Progress in DEF and STAT
Military GPS User Equipment (MGUE) Program

DOE Infusion into DT&E Strategy



Incorporating Design of Experiments into the Test Strategy

Developmental Evaluation Framework

Response variables for DOE-based test designs

Developmental Evaluation Objecti

- Perform TRD requirements verification
- Provide progress reports via CTPs and TPMs
- Support CDD platform integration activities
- Support PEO certification and readiness for OT through the 63-119 process
- Inform milestone, production, and fielding decisions

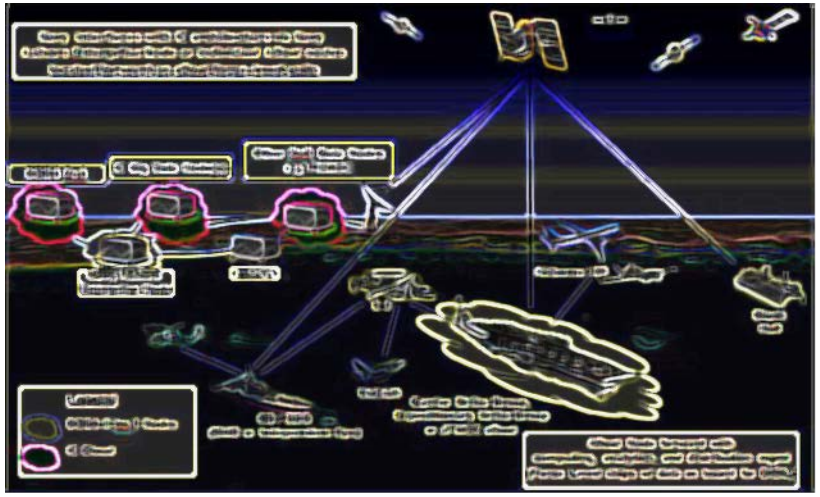
Table 3-15. MGUE Decision Support Questions

DSQ #1	Can GB-GRAM-M support legacy and modernized functions?
DSQ #2	Can GRAM-S/M support legacy and modernized functions?
DSQ #3	Can GB-GRAM-M be integrated into lead platforms?
DSQ #4	Can GRAM-S/M be integrated into lead platforms?
DSQ #5	Is MGUE secure?

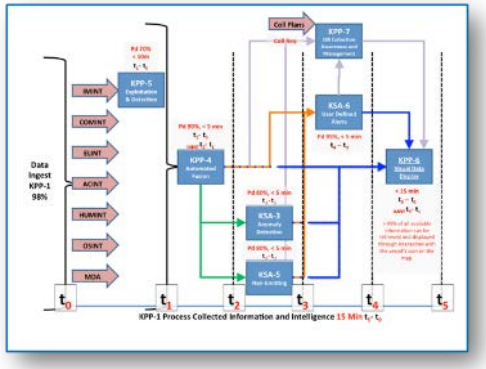
Return on Investment

- Test space augmentation - DOE-based test designs for 1648 requirements vice the original 122
- Test Efficiencies - Sixty percent (60%) reduction in test cycle time relative to the initial verification approach, which allowed supporting a Congressional Mandate for fielding MGUE

Progress in DEF and STAT
Distributed Common Ground System–Navy (DCGS-N)



DOE Infusion into DT&E Strategy



Ref: DCGS-N Increment 2 TEMP, TEIN 1818, Version 1.0, 1 Aug 2016

Developmental Evaluation Framework

DEO/Capabilities	Decision		DEF Decision Support Questions
Performance	MS-B / FCR-1 Build Decision	1	Is intrastructure scalable?
Targetting		2	Is system intra- and inter-operable?
Fusion (0-3)		3	Is system usable?
User Experience		4	Is system cyber secure?
Imagery Analytics		5	Is high-side fusion feasible?
Data Management		6	Is the volume of automatically exploitable data handled properly?
Federation/Task Management		7	Status of KPP satisfaction?
Hardware Infrastructure	FCR-1 Fielding Decision		DSQ 1-7
Software Infrastructure		8	Will C2S support enterprise node capability?
Build Intelligence Products		9	Is Inc2 analytics node as capable as Inc1 enterprise node?
Interoperability	FCR-2 Fielding Decision		DSQ 1-7
L0 Fusion/Ingest		10	Is Inc2 afloat capability at least as capable as Inc1 afloat?
Data Management		11	Meet all KPP minimum thresholds?
Net-Ready KPP	FDDR / FCR-3-5 Fielding Decision		DSQ 1-7
Collection Management		12	Status of new DRGB prioritized requirements?
Cross-Domain Solution		13	Status of previous discrepancies?
Cybersecurity			
System/SW assurance			
Risk Management Framework			
Vulnerability Assessment			
Reliability			
Infrastructure Reliability			

Source: VCRM categories (SEP)

Test events / Data sources (TBD)
TBD (evaluation info needs defined)

Requirements/Technical Measures
Core Team SME defined

Return on Investment

- Facilitated the definition of systems engineering requirements relationships between intelligence requirements
- **Combined DT&E/OT&E test designs that reduced test time by ~50%**
- **DOE test designs for M&S VV&A, the evaluation of lower level performance requirements, and design trade-offs**