
Integrated Testing: We Can Do It

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NDIA 2008/2009 DT&E Committee Focus

- **National Defense Industrial Association (NDIA) Effort**
 - Systems Engineering Division planning for 2008/2009
 - Developmental Test and Evaluation (DT&E) Committee priority
- **White Paper Recommendation as Follow-on Focus:**

“DT and OT need to be integrated whenever possible to improve overall T&E efficiency. The utility and applicability of DT results are reduced due to lack of operational relevance.”
- **SE Point Paper Recommendation for 2008:**

“Starting with the recommendation from the 2007-08 white paper, develop more detail on methods and practices for Integrated Test.”
- **Integrated Testing Definition (April 2008 Memo):**

“Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities.”

Integrated CT/DT/OT Focus: Methods and Practices

Committee Approach

- **Identify Existing Methods and Practices:**
 - Existing policies and instantiations in Service policies
 - Existing charters, roles and positions, collaborative planning efforts
 - Examples of successful integrated CT/DT/OT activities
- **Investigate Barriers to Integrated CT/DT/OT**
 - Data, resources, planning
 - Cultural constraints
- **Identify Approaches Within Current Policies**
 - Additional methods and practices in view of April 2008 integrated test definition
 - Interactions that can be improved between stakeholders
 - Integrated test strategy as part of overall test planning

Barrier to Integrated Testing are Cultural

Why Integrated Testing?

5000.02

a. The fundamental purpose of T&E is to provide knowledge to assist in managing the risks involved in developing, producing, operating, and sustaining systems and capabilities. T&E measures progress in both system and capability development. T&E provides knowledge of system capabilities and limitations to the acquisition community for use in improving the system performance, and the user community for optimizing system use in operations. T&E expertise must be brought to bear at the beginning of the system life cycle to provide earlier learning about the strengths and weaknesses of the system under development. The goal is early identification of technical, operational, and system deficiencies, so that appropriate and timely corrective actions can be developed prior to fielding the system.

Dr. Charles E. McQueary
Director of Operational Test and Evaluation
Defense AT&L: January-February 2008

I strongly believe that OT&E should be a process of confirmation and not one of discovery. Unfortunately, OT&E is too often the place where performance shortcomings and new failure modes are discovered. When problems are discovered late in the acquisition process, the cost to fix these problems is much higher than if they were discovered earlier. In addition, the time lost when problems are found at this stage can be substantial—and when our forces need a new capability, the latter penalty may be even more substantial than increased cost.

Navy OT&E Framework Integrated Test Methodology

Robust testing minimizes “surprises” when the product is sent to the war fighter and ensures the specified capabilities are evaluated in the operational environment. Risk is reduced by bringing all testing agents together early in the process to ensure capabilities are tied to mission, mission oriented testing is conducted, system anomalies/deficiencies are identified early in the process, and

Need early identification of problems

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Robust testing minimizes “surprises” when the product is sent to the war fighter

Need early identification of problems

Why Integrated Testing?

DSB Task Force on DT&E May 2008 Report

FINDINGS

The changes in the last 15 years, when aggregated, have had a significant negative impact on DoD's ability to successfully execute increasingly complex acquisition programs. Major contributors include massive workforce reductions in acquisition and test personnel, a lack of up-to-date process guidance in some acquisition organizations, acquisition process changes, as well as the high retirement rate of the most experienced technical and managerial personnel in government and industry without an adequate replacement pipeline.

- Major personnel reductions have strained the pool of experienced government test personnel

The attacks of September 11, 2001, ushered in a new era of warfighting with the Global War on Terrorism. Significant priority was given to finding more efficient ways to deliver new capabilities to the Combatant Commanders for use against quickly adapting threats. Rigorous T&E before deployment was sometimes sacrificed to meet schedule demands.

Navy OT&E Framework Integrated Test Methodology

all data are shared. Cost is reduced by the sharing of resources, elimination of duplicative testing, and the early identification and correction of deficiencies. Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets. None of these objectives can be achieved without the cooperation of all parties and commitment to a “team” approach between the program office, OT, DT, and contractor personnel involved.

Need integrated testing to meet cost/schedule demands

Why Integrated Testing?

DSB Task Force on DT&E May 2008 Report FINDINGS

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***Negative impact on ability to successfully execute complex programs:
Massive workforce reductions in acquisition and test personnel***

Rigorous T&E ... sacrificed to meet schedule demands

Cost is reduced by sharing of resources, elimination of duplicative testing

and the early identification and correction of deficiencies. Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets. Objectives can be achieved without the cost of a sequential approach between the program office, O&A, and test organizations.

Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets

Need integrated testing to meet cost/schedule demands

Paper at NDIA Test & Evaluation Conference

NDIA Test and Evaluation Conference
Paper #7847



Walking the Line with Title 10: Implementation Strategies for Integrated Testing

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NDIA T&E Conference March 2009

Implementation Framework



Attributes of Integrated Testing

- **If you find the contractor data augmenting the OT&E data,**
you might be doing integrated testing
- **If the DT&E and OT&E personnel recognize each other in the airport,**
you might be doing integrated testing
- **If the OT&E personnel influences DT&E scenarios,**
you might be doing integrated testing
- **If the DT&E system is operated by end users,**
you might be doing integrated testing
- **If the CT, DT, and OT teams are sharing data in a common format,**
you might be doing integrated testing
- **If the OT&E confirms DT&E results,**
you might be doing integrated testing

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Positive Impact on Discussion

- Integrated Testing is not a new concept
- Title 10 is not a real barrier
- Policies now sufficient
- Need to institutionalize best practices

Integrated Test Definitions: DoD

DAG Chapter 9

9.3.3. Combined DT&E and OT&E

Whenever feasible, DT&E and OT&E events should be combined, if that supports technical and operational test objectives to gain the optimum amount of testing benefit for reasonable cost and time. The user community should be involved early in test planning to ensure the statement of desired capabilities is interpreted correctly and tested realistically. Certain events can be organized to provide information useful to developmental and operational evaluators and lend themselves to the combined DT and OT approach. The concept is to conduct a single, combined test program that produces credible qualitative and quantitative information that can be used to address developmental and operational issues. Examples of this approach include combined DT and OT events, or piggybacking an operational assessment onto a developmental test. Likewise, developmental testing data requirements can be accommodated by an operational test. This approach can reduce the time and expense of conducting dedicated OT events that replicate DT events, or vice versa, yet still provide adequate technical risk reduction. The developmental and operational testers can develop a test management structure to share control of the combined events. Combined DT and OT events and test data requirements must be identified early to prevent unnecessary duplication of effort and to control costs. It is important that neither the DT&E nor OT&E objectives are compromised in designing combined events. For further explanation of this combined strategy, refer to the [DAU Test and Evaluation Management Guide](#).

OSD McQueary/Young Memo 22 Dec 2007

- Developmental and operational test activities shall be integrated and seamless throughout the system life cycle. As technology, software, and threats change, follow-on T&E should be used to assess current mission performance and inform operational users' during the development of new capability requirements.

OSD McQueary/Finley Memo 25 Apr 2008

Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities.

Integrated Test Definitions: DoD

Developmental and operational test activities shall be integrated and seamless

DAG Chapter 9.3.3.

9.3.3. Combined DT&E and OT&E

Whenever feasible, DT&E and OT&E events should be combined, if that supports technical and operational test objectives to gain the optimum amount of testing benefit for reasonable cost and time. The user community should be involved early in test planning to ensure the statement of desired capabilities is interpreted correctly and organized to provide information useful to developers themselves to the combined DT and OT approach. A combined test program that produces credible qualitative information can be used to address developmental and operational test objectives. This approach can reduce the time and cost of combined DT and OT events, or piggybacking an operational test. Likewise, developmental testing data requirements can be used to address operational test. This approach can reduce the time and cost of combined DT and OT events that replicate DT events, or vice versa, yet still provide the necessary test data.

The developmental and operational testers can develop a test management structure to share control of the combined events. Combined DT and OT events and test data requirements must be identified early to prevent unnecessary duplication of effort and to control costs. It is important that neither the DT&E nor OT&E objectives are compromised in designing combined events. For further explanation of this combined strategy, refer to the [DAU Test and Evaluation Management](#)

Conduct a single combined test program that produces credible qualitative and quantitative information that can be used to address developmental and operational issues

Collaborative planning and collaborative execution

... 25 Apr 2008
collaborative planning and collaborative execution: ... to provide shared data in support of independent ... and reporting by all stakeholders particularly the ... developmental (both contractor and government) and operational test and evaluation communities.

... ec 2007
 ... activities shall be integrated and seamless ... echnology, software, and threats change, ... ss current mission performance and inform ... development of new capability requirements.

Integrated Test Definitions: Services

Army DA PAM 73-1 • 30 May 2003

Integrated testing and evaluation

A T&E strategy that reduces the multiple and redundant products and processes, and encompasses the development of a single integrated system evaluation plan and a single integrated test/simulation strategy, leading to a single system evaluation report for the customer. The process also increases the use of contractor data for evaluation and expands the use of M&S with the goal of reducing T&E costs. Integrated T&E strategies may include combined DT/OT events where appropriate.

Integrated DT/OT

Integrated DT/OT, a special case of a Combined DT/OT, is a single phased event that generates data to address developmental and operational issues simultaneously under operational conditions. The execution strategy for this event is based on the requirements of the program.

Navy OT&E Framework Integrated Test Methodology

IT is a cooperative approach to T&E where CT, DT, and OT entities work to blend or integrate the T&E requirements throughout the defense acquisition process.

Integration of CT, DT, and OT does not involve the analysis and reporting aspects of T&E, which remain solely under the purview of the respective CT, DT, or OT organization.

Air Force AFI99-103 26 FEBRUARY 2008

Integrated Testing—The harmonization of all types of tests and evaluations that are planned and integrated as early as possible into an efficient continuum, efficiently phased and resourced over time, and reported collaboratively in order to achieve greater test efficiency, reduced cost, and schedule savings without compromising the objectives and needs of the participating test organizations.

Integrated Test Team (ITT)—A cross-functional team of empowered representatives from multiple disciplines and organizations and co-chaired by operational testers and the program manager. The ITT is responsible for developing the T&E strategy and TEMP, assisting the acquisition community with T&E matters, and guiding the development of test plans that are integrated. Note: The ITT is the Air Force equivalent to the T&E Working Integrated Product Team (T&E WIPT) described in the Defense Acquisition Guidebook.

Integrated Test Definitions: Services

Army DA PAM 73-1 • 30 May 2003

Integrated Test Strategy Single integrated test strategy

A T&E strategy that integrates the development of a single integrated system evaluation plan and a single integrated test/simulation strategy, leading to a single system evaluation report for the customer. The process also increases the use of contractor data for evaluation and expands the use of M&S with the goal of reducing T&E costs. Integrated T&E strategy includes the use of DT/OT where appropriate.

Generates data to address developmental and operational issues simultaneously under operational conditions

Integrated DT/OT

Integrated DT/OT, a special case of a Combined Test Strategy, is based on the requirements of the program.

Navy OT&E Framework Integrated Test Methodology

IT is a cooperative approach to T&E where CT, DT, and OT entities or integrate the T&E requirements throughout the defense acquisition process. Integration of CT, DT, and OT does not involve the analysis and integration of T&E, which remain solely under the purview of the respective organization.

CT, DT, and OT entities work to blend or integrate the T&E requirements

Air Force AFI99-103 26 FEBRUARY 2008

Integrated Testing—The harmonization of all types of tests integrated as early as possible into an efficient continuum

Harmonization of all types of tests

reported collaboratively in order to achieve greater test efficiency, reduced cost, and schedule savings without compromise.

Integrated as early as possible into an efficient continuum

Integrated Test Team (ITT)—A cross-functional team of empowered representatives from multiple disciplines and organizations and co-chaired by operational testers and the program manager. The ITT is

Development of test plans that are integrated

responsible for developing the T&E test plans, and guiding the development of test plans.

equivalent to the T&E Working Integrated Product Team (T&E WIPT) described in the Defense Acquisition Guidebook.

What Does Title 10 Say?

(d) Impartiality of Contractor Testing Personnel.— In the case of a major defense acquisition program (as defined in subsection (a)(2)), no person employed by the contractor for the system being tested may be involved in the conduct of the operational test and evaluation required under subsection (a). The limitation in the preceding sentence does not apply to the extent that the Secretary of Defense plans for persons employed by that contractor to be involved in the operation, maintenance, and support of the system being tested when the system is deployed in combat.

(e) Impartial Contracted Advisory and Assistance Services.—

(1) The Director may not contract with any person for advisory and assistance services with regard to the test and evaluation of a system if that person participated in (or is participating in) the development, production, or testing of such system for a military department or Defense Agency (or for another contractor of the Department of Defense).

(2) The Director may waive the limitation under paragraph (1) in any case if the Director determines in writing that sufficient steps have been taken to ensure the impartiality of the contractor in providing the services. The Inspector General of the Department of Defense shall review each such waiver and shall include in the Inspector General's semi-annual report an assessment of those waivers made since the last such report.

(3) (A) A contractor that has participated in (or is participating in) the development, production, or testing of a system for a military department or Defense Agency (or for another contractor of the Department of Defense) may not be involved (in any way) in the establishment of criteria for data collection, performance assessment, or evaluation activities for the operational test and evaluation.

(B) The limitation in subparagraph (A) does not apply to a contractor that is involved in such development, production, or testing solely in testing

10 USC 2332

NB: This unofficial compilation of the U.S. Code is current as of Jan. 3, 2009.

conduct of
OT&E

establishing
criteria for OT&E

OT&E
evaluation

Contractor cannot be involved in:

- OT&E conduct
- Establishing OT&E criteria
- OT&E evaluation

Title 10 Allows Support to OT&E

DAG Chapter 9

Integrating T&E consists of many aspects, all designed to optimize test scope and minimize cost. For example, separate contractor developmental testing might be combined with governmental developmental test and evaluation, with control being exercised by a combined test organization. Live testing might be integrated with verified, validated, and accredited

Army DA PAM 73-1 • 30 May 2003

c. Discussions with system contractor personnel may be necessary to ensure full technical understanding of test incidents observed during the IOT&E or related activities. All discussions will be held separately from any scoring or assessment activities. The MATDEV should maintain written record of the nature of these contractor and Government discussions.

Navv OT&E Framework Integrated Test Methodology

“Integrated testing” blends or combines contractor, developmental, and OT to form a cohesive testing continuum. This integration cannot occur unless the participants (CT, DT, and OT) have determined their entering requirements for adequate testing of the system under evaluation. IT does not remove or combine any of OPTEVFOR’s current or future requirements for reporting based on a separate (OPTEVFOR) analysis of the shared test information produced by the IT effort.

Air Force AFI99-103 26 FEBRUARY 2008

5.6.2. System Contractor Support to Operational Testing. System contractors may be beneficial in providing logistic support and training, test failure analyses, test data, and unique software and instrumentation support that could increase the value of operational test data. Explanations of how this con-

Title 10:
Contractor cannot be involved in:

- OT&E conduct
- Establishing OT&E criteria
- OT&E evaluation

Contractor **CAN** provide:

- **Technical understanding of test incidents**
- **Logistic support and training**
- **Support to test failure analysis**
- **Unique software and instrumentation support**

Title 10 Allows Sharing of Data

Army DA PAM 73-1 • 30 May 2003

- a. The T&E WIPT goals are to develop a mutually agreeable T&E program that will provide the necessary data for evaluations. T&E WIPTs provide support for the development, staffing, coordination, and approval of all required T&E
- (6) Support the CE process by accomplishing early, more detailed, and continuing T&E documentation, planning, integration, and promote the sharing of data.

T&E Management Guide 4.8 CONTRACTOR TESTING

The Deputy for T&E is responsible for ensuring that contractor-conducted tests are monitored by the government. The Deputy for T&E must also be given access to all contractor internal data, test results, and test reports related to the acquisition program. Usually, the contract requires that government representatives be informed ahead of time of any (significant or otherwise) testing the contractor conducts so the government can arrange to witness certain testing or receive results of the tests. Further, the contractor's internal data should be available as a contract provision. The Deputy for T&E must ensure that government test personnel (DT&E/OT&E) have access to contractor test results. It would be desirable to have all testers observe some contractor tests to help develop confidence in the results and identify areas of risk.

OSD McQueary/Young Memo 22 Dec 2007

- To maximize the efficiency of the T&E process and more effectively integrate developmental and operational T&E, evaluations shall take into account all available and relevant data and information from contractor and government sources.

Navy OT&E Framework Integrated Test Methodology

- Fourth, OT uses the shared data from the IT period to “answer” or achieve resolution on as many measures of effectiveness (MOE) and measures of suitability (MOS) as possible. The goal being to have sufficient data/test information at the end of the IT phase to resolve most COIs, pending successful completion of the final independent OT phase.

The product of the IT integration effort should be an IT database, similar in structure and content to the OT&E Framework database (step **nine**), but merged with DT and CT requirements.

Air Force AFI99-103 26 FEBRUARY 2008

Operational testers may use data from sources such as DT&E, integrated testing, and OAs to augment or reduce the scope of dedicated operational testing if the data can be verified as accurate and applicable.

5.5.2. Contractor T&E Data. Test teams and TIPTs should use as much contractor T&E data as possible if its accuracy can be verified. Contractor T&E data should be visible in the common T&E database.

AFMAN63-119 20 JUNE 2008

A12.1.2. DT&E and OT&E plans and concepts are structured so that OT&E can capture and use DT&E data to reduce OT&E requirements. (ITT) (See A14, A15, A23, A27)

T&E Strategies

5000.02

b. The PM, in concert with the user and the T&E community, shall coordinate DT&E, OT&E, LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development. The T&E strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulations, evaluate technical performance and system maturity, and determine whether systems are operationally effective, suitable, and survivable against the threat detailed in the STAR or STA. The T&E strategy shall also address development and assessment of the weapons support equipment during the EMD Phase, and into production, to ensure satisfactory test system measurement performance, calibration traceability and support, required diagnostics, and safety. Adequate time and resources shall be planned to support pre-test predictions and post-test reconciliation of models and test results, for all major test events. The PM, in concert with the user and the T&E community, shall provide safety releases (to include formal Environment, Safety, and Occupational Health (ESOH) risk acceptance in accordance with Section 6 of Enclosure 12) to the developmental and operational testers prior to any test using personnel.

Test and Evaluation Strategy:

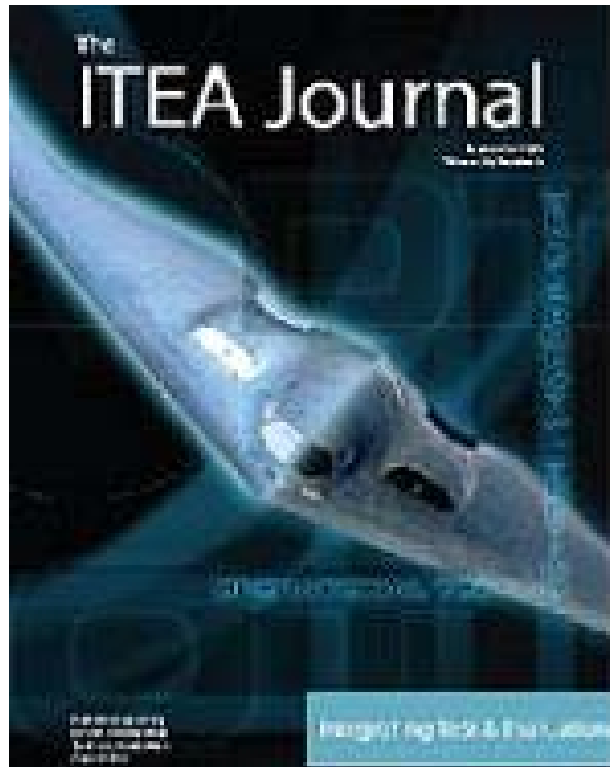
- Knowledge to manage risks
- Empirical data to validate models and simulations
- Evaluate technical performance
- Evaluate system maturity
- Determine operational
 - Effectiveness
 - Suitability
 - Survivability

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Integrated Testing: A Necessity, Not Just an Option



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Joe Terlizese	SESO	X	X	X	X	X	X		
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Article Outline

- Definitions of Integrated Testing
- Barriers to Integrated Testing
- Implementation Framework for Effective Integrated Testing:
 - Collaborative Planning
 - Collaborative Execution
 - Shared Data
- Summary

Implementation Framework

- **Integrate the Planning**
 - Early and collaborative planning for efficient use of test assets
 - Improve test efficiency and streamline test schedule
 - Reduce duplication and voids
- **Integrate the People**
 - Integrated Test Teams
 - Coordination and cooperation for integrated strategy
 - Early OT&E influence on test design and scenarios
- **Integrate the Data**
 - Maximize data available and usability for OT&E
 - Common data formats to facilitate sharing
 - Incorporate operational realism in DT&E

Path Forward

Continuing Effort Output Products

- **Continuing Effort Theme**
 - Policy is okay as is (no additional changes recommended)
 - Some teams are already doing this well
 - Continue to work cultural barriers with information
- **Integrated Testing Tutorial**
 - Presented at NDIA Systems Engineering Conference
 - Basis for potential Defense Acquisition University online learning module
- **Potential Topic for ICOTE (Industry Consortium on OT&E)**
- **Promote Framework on Integrated Testing**
 - Paper presented at NDIA Test & Evaluation Conference (Mar 2009)
“Walking the Line with Title 10”
 - Abstract planned for NDIA Test & Evaluation Conference (2010)

Attributes of Integrated Testing

- **If you find the contractor data augmenting the OT&E data,**
you might be doing integrated testing
- **If the DT&E and OT&E personnel recognize each other in the airport,**
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- **If the OT&E personnel influences DT&E scenarios,**
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- **If the DT&E system is operated by end users,**
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you might be doing integrated testing
- **If the OT&E confirms DT&E results,**
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Summary

- **Integrated Testing is Needed**
 - Facilitate early identification and correction of system deficiencies
 - Make OT&E a process of confirmation instead of discovery
 - Minimize “surprises” when the product is sent to the war fighter
 - Reduce cost and schedule with shared resources and reduced duplication
- **Title 10**
 - Prohibits contractor involvement in OT&E conduct, criteria establishment, or evaluation
 - Allows contractor to provide technical understanding and support
 - Allows for collaborative planning and execution of an integrated test program to provide shared data to support independent analysis
- **Integrated Test Implementation Framework Involves Integrating**
 - **People:** Integrated test teams to introduce operational realism earlier
 - **Planning:** Early and collaborative efforts to streamline test program
 - **Data:** Sharing of data to address developmental and operational issues

Author

- **Dr. Beth Wilson** is a Principal Engineering Fellow who earned her PhD in Electrical Engineering from the University of Rhode Island. Since joining Raytheon in 1983, she has worked as a design engineer, program manager, research scientist, functional manager, and test director on sonar, satellite, and radar programs. She is currently the staff lead for the Systems Validation Test and Analysis Directorate. Previous assignments have included Test Architect for Dual Band Radar, a character-building deployment to Shemya, Alaska as the Test Director for the Cobra Dane Upgrade, a 2-year integration effort for the Relocatable Over the Horizon Radar (ROTHR) in Virginia, and being an exchange scientist to Australia. She is the Industry Co-Chair for the NDIA Systems Engineering Division Developmental Test and Evaluation Committee and the Industry Lead for the Integrated DT/OT focus area.