Erasing the Line with Title 10: Best Practices in Integrated Testing

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NDIA Systems Engineering Division DT&E Committee Focus Topic #1

Progress During 2009:

NDIA Test and Evaluation Conference
Paper #7847

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

NDIA T&E Conferer

NDIA Systems Engineering Conference
Paper #8848

Integrated Testing: We Can Do It

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NDIA SE Conference Oct 2009

NDIA Systems Engineering Conference
Paper #8818

Integrated Testing: Tutorial

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NDIA SE Conference Oct 2009

2009 ITEA Journal

Integrating Test a

ITEA Journal 2009; 30: 375–380
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Integrated Testing: A Necessity, Not Just an Option

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Department of Defense policy states that developmental and operational test activities need to be integrated whenever possible to improve overall test and evaluation efficiency with increased emphasis on operational relevance. The National Defense Industrial Association Systems Engineering Division Developmental Test and Evaluation Committee has been evaluating existing integrated testing policies, methods, and practices to identify an implementation framework with best practices for sharing data, involving developmental test and operational test stakeholders in integrated test planning, and collaboratively executing an integrated test program. Barriers to integrated testing were identified looking at the cultural constraints placed on planning, people, and data. While the definitions and mandates are recent, the practice of integrated testing is not new. The framework described focuses on existing policy and captures best practices.

Key words: Collaborative planning; collaborative execution; shared data; DT&E; OT&E; Army; Navy; Air Force; contractor support; resource planning.

The motivation for integrated testing has long existed in the desire to identify system deficiencies early, meet schedule compression demands, and reduce costs. In the Secretary of Defense April 6, 2009, integrated testing e of the initiatives successfully eform acquisition and require- *1* provides the Integrating Test n of that memo. The purpose of T&E) is described as translating dledge to support management ith fielding system capabilities. the integrated test policy is to ementary relationship between erational testing throughout the al definition of integrated testing ce of the Secretary of Defense cosigned by the Director of d Evaluation and the Deputy fense for Acquisition and Tech- ion focused on the need for g and collaborative execution of wide shared data for independent Acquisition Guidebook (DAG) valuation) (DoD, 2009) has long an integrated test and evaluation strategy and amplifies this by describing the concept as a single test program to address issues from developmental test and evaluation (DT&E) and operational test and evaluation (OT&E).

The National Defense Industrial Association (NDIA) Systems Engineering Division DT&E Committee was charged with focusing on integrated testing in view of the OSD memorandum mandating the use of integrated testing (OSD 2007). The Committee used the preceding definition to develop an implementation framework from the key points in the definition:

- collaborative planning,
- collaborative execution,
- shared data.

While the formal definition is recent, the concept is not new. The Department of Defense (DoD) has written policies regarding combined activities relating to DT&E and OT&E since the early 1970s. In soliciting best practices for integrated testing, many examples emerge showing successful implementation before the Department issued the recent policies and definitions. The Army, Navy, and Air Force had already defined integrated testing in their respective test and evaluation policies. *Table 1* lists the integrated testing definitions identified in the DoD and Services policy and procedure documents.

Motivation for Integrated Testing

- **5000.02:**
  - The fundamental purpose of T&E is to provide knowledge
  - The goal of testing is the early identification of technical, operational, and system deficiencies
- **Defense AT&L Jan/Feb 2008:**
  - OT&E should be a process of confirmation and not one of discovery
  - When problems are discovered late in the acquisition process, the cost to fix these problems is much higher
- **Navy OT&E Framework IT Methodology:**
  - Robust testing minimizes “surprises” when the product is sent to the war fighter
  - Risk is reduced by bringing all testing agents together early in the process to ensure capabilities are tied to mission

Need Early Identification of Problems

Will Integrated Testing Save Cost and Schedule?

- **Need Integrated Testing to Fit into Existing T&E Box**
- **Already have challenging schedule for T&E**
  - Integrated testing provides a test continuum to find problems earlier when it is more cost effective to solve them
  - Helps to meet existing compressed schedule
- **Already have a tight budget for T&E**
  - Reducing cost by sharing resources and data
  - Helps to meet existing budget
- **The Defense Science Board Task Force (May 2008):**
  - Acquisition reform went too far
  - Government does not have the capacity to work current programs

Cost Avoidance and Schedule Containment

New Definition, Old Concept

- **Formal Definition April 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 CT/DT/OT Activities Since 1970s**
- **Policy Definitions Already Exist**

Army DA PAM 73-1	Integrated T&E strategies may include combined DT or OT events where appropriate. Integrated DT or OT, a special case of a combined DT and 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 and IT 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 AFI 99-103	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 Testing is NOT

- Mandatory combination of Developmental Test and Operational Test events
- Operational Testing conducted during DT event
- Development Testing postponed to an OT event
- DT personnel conducting OT
- Eliminating the need for DT
- Eliminating the need for OT

Integrated Testing Brings Together DT and OT Strategies

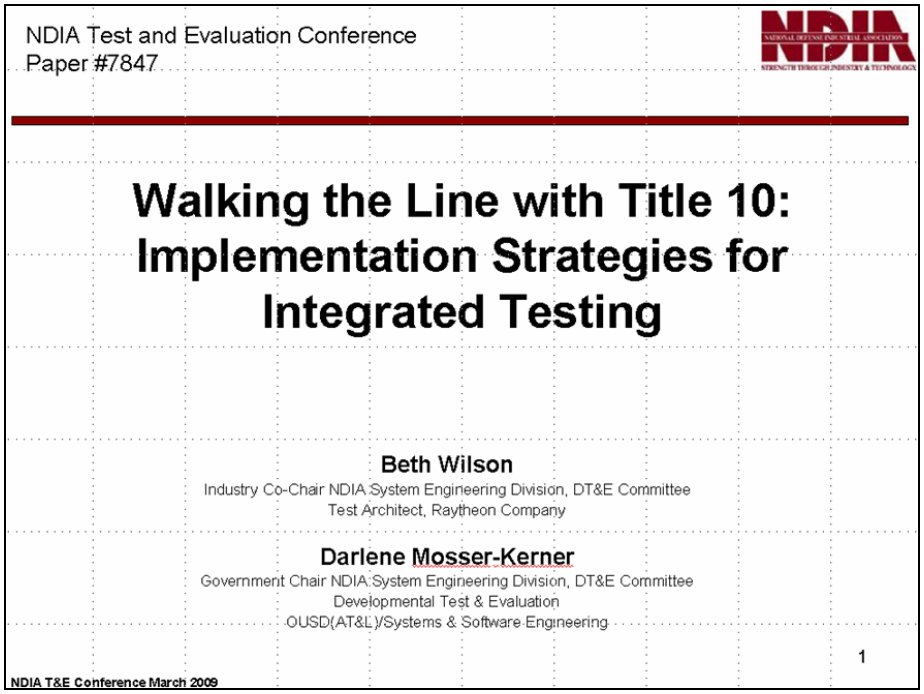
Challenges with Integrated Testing

- **Direction Perceived by Some to be Conflicting**
  - Operational evaluators … statutory roles
  - Can OT really use DT data?
  - Does reference to statutory roles mean that OT is still independent from DT?

- **Interpretations of Integrated Testing Confusing**
  - Does combined testing mean OT is added to DT?
  - Does shared data mean that OT can evaluate system performance during DT?

Barriers Are Largely Cultural

Paper at 2009 NDIA Test & Evaluation Conference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Walking the Line with Title 10: Implementation Strategies for Integrated Testing

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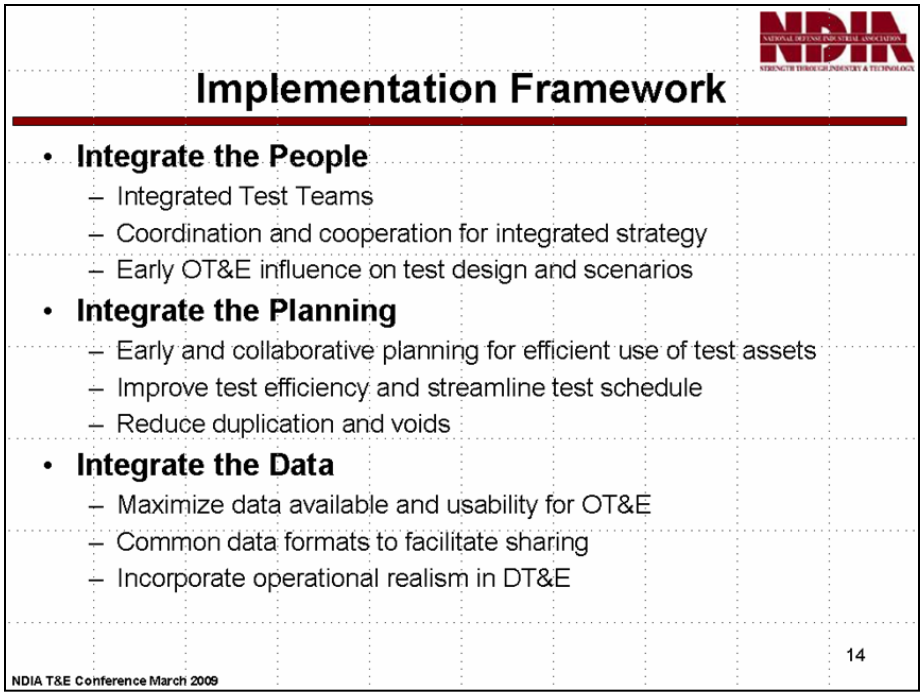
NDIA T&E Conference March 2009


Implementation Framework

- **Integrate the People**
  - Integrated Test Teams
  - Coordination and cooperation for integrated strategy
  - Early OT&E influence on test design and scenarios
- **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 Data**
  - Maximize data available and usability for OT&E
  - Common data formats to facilitate sharing
  - Incorporate operational realism in DT&E

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NDIA T&E Conference March 2009

Summary of Themes:

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

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
such development, production, or testing solely in testing

10 USC 23

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

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 (Test & Evaluation)	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.
Army DA PAM 73-1	**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.
Navy OT&E Framework and IT 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 AFI 99-103	**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.

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

DoD Policy DoDI 5000.02 Enclosure 6	Evaluations shall take into account all available and relevant data and information from contractor and government sources.
Army DA PAM 73-1	The T&E WIPT goals are to develop a mutually agreeable T&E program that will provide the necessary data for evaluations. Support the CE process by accomplishing early, more detailed, and continuing T&E documentation, planning, integration, and promote the sharing of data..
Navy OT&E Framework and IT Methodology	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 or test information at the end of the IT phase to resolve most COIs, pending successful completion of the final independent OT phase.
Air Force AFI 99-103	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. 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.

OSD Memo 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.

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

By conducting concept of operations experiments with mock-ups of the operational layout, the developmental and operational community implemented real platform mission threads using preliminary displays. By conducting this integrated exercise during the initial requirement development program phase, the user community directly effected key system design requirements through a discussion of performance parameters. The result was a product baseline that better met customer expectations with fewer surprises in performance characteristics.

An OT&E and DT&E community review of the program contractor test plan prior to submittal for approval allowed examined planned ground, simulation, and flight tests to ensure that a realistic approach was being taken. The integrated test program planners and community worked with the integrated test team to ensure that an integrated operational environment was applied to the entire system test program. This ensured that realistic test scenarios were developed throughout the contractor's and integrated test team's program. It also improved communication and set expectations across the test program.

Implementation Framework

- **Integrate the Planning**
- **Integrate the People**
  - Integrated Test Teams
  - Coordination and cooperation for integrated strategy
  - Early OT&E influence on test design and scenarios

Early participation of test personnel yields exceptional benefits as was seen when end-users acted as test operators during contractor testing, DT preparation, dry runs, and conduct. The operator interacted with the system in the way it would be used when fielded. By having the operator use the system, the development team identified display issues early and made corrections during DT.

When testing a new capability for an added mission, the OTA observed the DT preparation effort. When the opportunity presented itself, the OTA executed one of their planned tests and noted a difference in behavior. The DT team was able to explain that this was an artifact of the upgraded performance that provided a graceful degradation feature. This eliminated the chance of the OTA noting this as a deficiency and requiring a subsequent investigation.

Implementation Framework

- **Integrate the Planning**
- **Integrate the People**
- **Integrate the Data**
  - Maximize data available and usability for OT&E
  - Common data formats to facilitate sharing
  - Incorporate operational realism in DT&E

DT events with scripted firings were supplemented by OT firings introducing ‘‘tactical surprise.’’ Using more operationally realistic procedures for the DT firings allowed the OTA to include these data to increase the sample size to support operational effectiveness confidence computations. The strategy saved the program significant cost in reduced test assets. The cooperation also reduced time on the test range.

Where possible, the DT team used common data reduction tools so that the OTA had access to the DT data in the formats desired for OT&E. In addition, the OT&E data reduction tools were used during DT&E preparation. This allowed the DT&E team to detect a problem early where data formats not used by the DT&E team had been degraded and would have caused problems for OT&E. The problem was corrected before the DT event.

Path Forward
Resulting 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**
  - **Piloted at 2009 NDIA Systems Engineering Conference**
  - **Basis for potential Defense Acquisition University online learning module**

- **Systems Engineering Division Committees**
  - Mission Analysis (gap analysis for operational relevance)
  - System of Systems (map SoS T&E challenges to Integrated Test 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

Summary

- **Integrated Testing is Needed**
- **Integrated Testing is Already Being Done Well by Some Teams**
- **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

Title 10: Walking the Line → Erasing the Line

Authors

- **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. 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.

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