

DoD Technology Readiness Assessment (TRA) Policy



Jack Taylor

**Associate Director for Ground and Sea Vehicles
ODUSD(S&T) / Weapons Systems**

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE SEP 2007		2. REPORT TYPE		3. DATES COVERED 00-00-2007 to 00-00-2007	
4. TITLE AND SUBTITLE DoD Technology Readiness Assessment (TRA) Policy				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Ofc Deputy Under Secretary of Defense, Science & Technology/Weapons Systems, 1777 N. Kent St, Rosslyn, VA, 22209				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM002182. Presented at the AFRL Technology Maturity Conference held in Virginia Beach, VA on 11-13 September 2007.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 17	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

How TRAs Got Started

- “Identify each case in which a major defense acquisition program entered system development and demonstration ... into which key technology has been incorporated that does not meet the technology maturity requirement ... and provide a justification for why such key technology was incorporated and identify any determination of technological maturity with which the Deputy Under Secretary of Defense for Science and Technology did not concur and explain how the issue has been resolved.” *National Defense Authorization Act for Fiscal Year 2002*
- “The management and mitigation of technology risk, which allows less costly and less time-consuming systems development, is a crucial part of overall program management and is especially relevant to meeting cost and schedule goals. Objective assessment of technology maturity and risk shall be a routine aspect of DoD acquisition.” *DoDI 5000.2, paragraph 3.7.2.2*

What is a TRA?

- **Systematic, metrics-based process that assesses the maturity of Critical Technology Elements (CTEs). A CTE is a technology that is both:**
 - 1) Essential for (threshold) system performance, and
 - 2) New or novel, or used in a new or novel way
- **Uses Technology Readiness Levels (TRLs) as the metric**
- **Required for all MDAP & MAIS**

A TRA:

- **Is not a risk assessment**
- **Is not a design review**
- **Does not address system integration**

Technology Readiness Levels (TRLs) for Hardware



Increasing maturity

1. Basic principles observed and reported
2. Technology concept and/or application formulated
3. Analytical and experimental critical function and/or characteristic proof of concept
4. Component and/or breadboard validation in a laboratory environment
5. Component and/or breadboard validation in a relevant environment
6. System/subsystem model or prototype demonstration in a relevant environment
7. System prototype demonstration in an operational environment
8. Actual system completed and qualified through test and demonstration
9. Actual system proven through successful mission operations

TRLs for Software



Increasing maturity

1. Basic principles observed and reported
2. Technology concept and/or application formulated
3. Analytical and experimental critical function and/or characteristic proof of concept
4. Module and/or subsystem validation in a laboratory environment
5. Module and/or subsystem validation in a relevant environment
6. Module and/or subsystem validation in a relevant end-to-end environment
7. System prototype demonstration in an operational high fidelity environment
8. Actual system completed and qualified through test and demonstration in an operational environment
9. Actual system proven through successful mission-proven operational capabilities

What is a Critical Technology Element (CTE)

A technology element is “critical” if the system being acquired depends on this technology element to meet operational requirements with acceptable development cost and schedule and with acceptable production and operation costs *and* if the technology element or its application is either new or novel.

An element that is new or novel or being used in a new or novel way is critical if it is necessary to achieve the successful development of a system, its acquisition, or its (threshold) operational utility.

CTEs may be related to hardware, software, manufacturing, or life cycle at the subsystem or component level

What is Relevant Environment

A relevant environment for the demonstration of a technology is a set of test conditions that provide confidence that skillful application of that technology to an item (component, subsystem, or system) will support the required (threshold) functionality of that item across the full spectrum of required operational employments.

Examples of Relevant Environment

- **Physical Environment** - Mechanical Components, Processors, Servers and Electronics; Kinematic Environment; Thermal and Heat Transfer Environment; Electrical and Electromagnetic Environment; Climatic Environment; User and Use Environment
- **Logical Environment** - Software (Algorithm) Interfaces; Security Interfaces
- **Data Environment** - Data Formats and Data Bases; Anticipated Data Rates, Data Delay and Data Throughput; and Data Packaging and Framing
- **Security Environment** - Connection to firewalls; Security Appliqués; Rates and Methods of Attack

TRL 6 Hardware

Minimum Maturity at Milestone B

- **Definition:** System/subsystem model or prototype demonstration in a relevant environment.
- **Description:** Representative model or prototype system is tested in a relevant environment. A major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated, such as a tri-mode seeker for a missile in a “stimulated” environment.



- **Supporting Information:** Results from laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. How did the test environment differ from the operational environment? Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?

TRL 7 Hardware

Minimum Maturity at Milestone C

- **Definition:** System prototype demonstration in an operational environment.
- **Description:** Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g., in an aircraft, in a vehicle, or in space). Example: testing the prototype system (radar) in a test-bed aircraft.
- **Supporting Information:** Results from testing a prototype system in an operational environment. Who performed the tests? How did the test compare with expectations? What problems, if any, were encountered? What are/were the plans, options, or actions to resolve problems before moving to the next level?



Example: Establishing the Relevant Environment

- Advanced Seacraft
 - Two Contractors, both using existing hull forms
 - One is a Commercial Ferry, in use; This hull uses an Al alloy, in lieu of steel
- What constitutes the “environment”?
 - Does commercial ferry use qualify as Operational Environment? (TRL 7), or Relevant environment (TRL 6)?
 - Must know the technical drivers of performance, Loading, Speed, Sea State

Example: Advanced Field Artillery System - High rate of Fire 155mm SPH

High rate of fire implied need for autoloader; Auto loader impossible with bagged propellant

Approaches

- Liquid Propellant: HAN-TEAN mixture was a **new or novel** chemical mixture to use as propellant
- Solid Propellant (originally “Unicharge”): Conventional energetic compounds, bonded into “toilet paper roll” sized packets that could be auto-loaded: Not new or novel, but **application is new or novel**

The TRA Process, 2003-2005

- **Technology Readiness Assessments conducted just prior to Milestone B**
 - Critical Technology Elements selected by Program Manager and Contractor
 - Component S&T and DUSD(S&T) can add technologies to the list
 - Assessments conducted by an independent panel of experts
- **OSD Policy states that Technologies should be “demonstrated in a relevant environment” (“TRL 6”)**
 - Establishing the criteria for “relevant environment” is difficult and subtle
 - Historically, most MDAP and MAIS enter Milestone B with one or more immature technologies
- **Component S&T Organization prepares the TRA and forwards (normally through Acquisition Executive) to DUSD(S&T)**
- **DUSD(S&T) concurs, concurs with reservation, or does not concur**
 - Immature technologies are addressed in various ways
 - Requirement for a Technology Maturation Plan
 - Often an Update to the TRA is required

TRAs explain the maturity of the technologies and are input to the decision at Milestone B

Title 10 Requirement for Certification by AT&L

NDA 2006, 10 USC §2366a

Certification required before Milestone B or Key Decision Point B approval:

- (a) **CERTIFICATION.** A major defense acquisition program may not receive Milestone B approval, or Key Decision Point B approval in the case of a space program, until the milestone decision authority certifies that –
- (2) the technology in the program has been demonstrated in a relevant environment;
 - • •
 - (10) the program complies with all relevant policies, regulations and directives of the Department of Defense



THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

MAY 02 2006

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Implementation of Section 2366a of Title 10, United States Code

Section 2366a of title 10, United States Code, as enacted by section 801 of the National Defense Authorization Act for Fiscal Year 2006 (Pub. L. No. 109-163), requires the Milestone Decision Authority (MDA) for a Major Defense Acquisition Program (MDAP) to make certain certifications prior to Milestone B or Key Decision Point B approval.

To fulfill this requirement, the MDA, without the authority to delegate, shall sign a memorandum, subject "Program Certification," prior to signing the Acquisition Decision Memorandum (ADM). This certification memorandum shall be prepared "for the record," and shall include the statements in the attachment, without modification. If the program is initiated at a later decision point, e.g., Milestone C, a similar memorandum shall be prepared, as a matter of policy, consistent with the intent of the statute. The certification memorandum shall be submitted to the congressional defense committees, as defined at 10 U.S.C. 101 (16), with the first Selected Acquisition Report for the program after completion of the certification.

The MDA may waive one or more of components (1) through (6) of the required certification (specifically, one or more of paragraphs (1) through (6) in the attachment) for an MDAP if the MDA determines that, but for such a waiver, the Department would be unable to meet critical national security objectives. The MDA shall submit the waiver, the determination, and reasons for the determination, in writing, to the congressional defense committees within 30 days of authorizing the waiver. The MDA may not delegate this waiver authority.

In addition to the certification memorandum, the MDA will include the following statement in the ADM: "I have reviewed the program and have made the certifications required, or executed a waiver as authorized, by section 2366a of title 10, United States Code."

This policy shall apply to MDAPs approved by me and to MDAPs managed by Department of Defense Component Acquisition Executives or the Assistant Secretary of Defense for Networks and Information Integration. This requirement went into effect January 6, 2006, and shall be reflected in the next revision to Department of Defense Instruction 5000.2.

Attachment:
As stated

.....But Waivers Are Allowed

(c) WAIVER FOR NATIONAL SECURITY. The milestone decision authority may waive the applicability to a major defense acquisition program of one or more components (as specified in paragraph (1), (2), (3), (4), (5), (6), (7), (8), or (9) of subsection (a)) of the certification requirement if the milestone decision authority determines that, but for such a waiver, the Department would be unable to meet critical national security objectives.

Whenever the milestone decision authority makes such a determination and authorizes such a waiver, the waiver, the determination, and the reasons for the determination shall be submitted in writing to the congressional defense committees within 30 days after the waiver is authorized.

Potential Impacts of 10 USC §2366a

- In practice, since law enacted, no waivers have been granted.
- Critical Technology Elements need to be identified at earliest opportunity, and balanced against requirements & schedule.
- Importance of Test & Evaluation in pre SDD increased.
- Technology Maturation prior to MS B decision.
- Technology Development Strategies aggregating technology transitions into “blocks”.

Summary

- **The law requiring certification of “demonstration in a relevant environment” has implications for both technology developers as well as PMs**
- **Developers of new technology will need to think ahead to “relevant environments” and guide their measurement efforts with an eye to easing incorporation of their technology in system development.**
- **The TRA process has increased the interactions between S&T and Acquisition in DoD. A TRA Deskbook facilitates the process**