The New Technology Readiness Assessment (TRAs) Process

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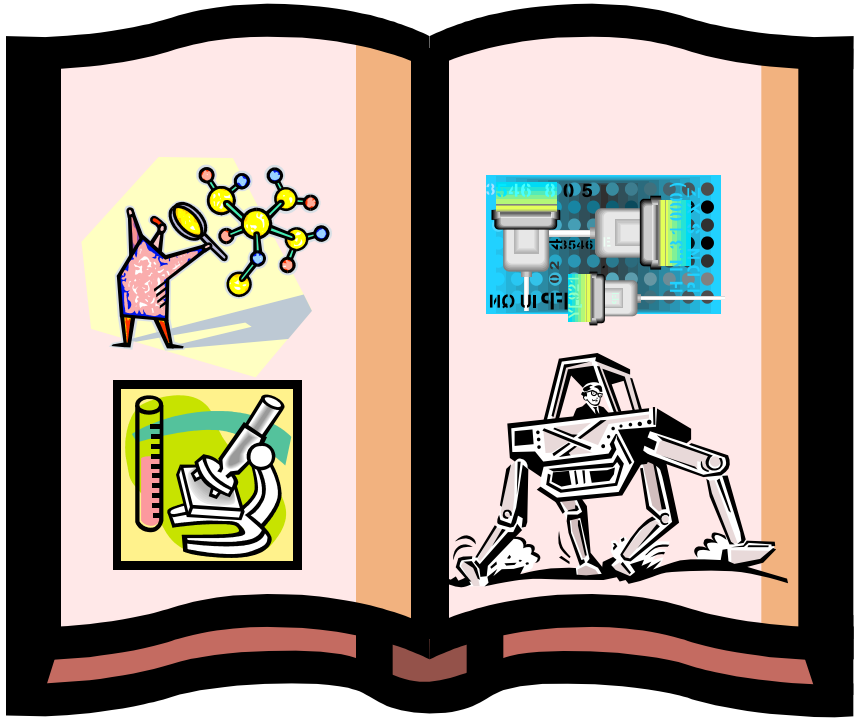
Outline

- **TRA Background**
- **TRA Importance**
- **Policy and Statutory Changes Since 2005 Deskbook**
- **Principal TRA Process Changes Reflected in 2009 Deskbook**

What is a TRA?

- **Systematic, metrics-based process that assesses the maturity of Critical Technology Elements (CTEs)**
  - **Uses Technology Readiness Levels (TRLs) as the metric**
- **Regulatory information requirement for *all* acquisition programs at MSs B and C**
  - **Submitted to DRD for ACAT ID and IAM programs, including space programs**



≠ Not a risk assessment

≠ Not a design review

≠ Does not address system integration

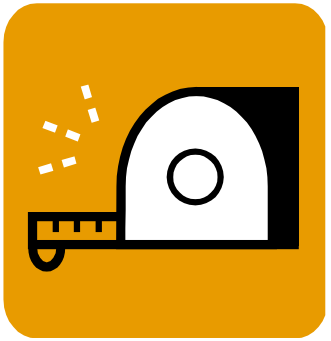
Critical Technology Element (CTE) Defined

A technology element is "critical" if the system being acquired depends on this technology element to meet operational requirements (within acceptable cost and schedule limits) *and if the technology element or its application* is either new or novel or in an area that poses major technological risk during detailed design or demonstration.

CTEs may be hardware or software at the subsystem or component level

TRL Overview

- **Measures technology maturity**
- **Indicates what has been accomplished in the development of a technology**
  - **Theory, laboratory, field**
  - **Relevant environment, operational environment**
  - **Subscale, full scale**
  - **Breadboard, brassboard, prototype**
  - **Reduced performance, full performance**



- **Does not indicate that the technology is right for the job or that application of the technology will result in successful development of the system – or how hard the application might prove.**

Hardware TRLs

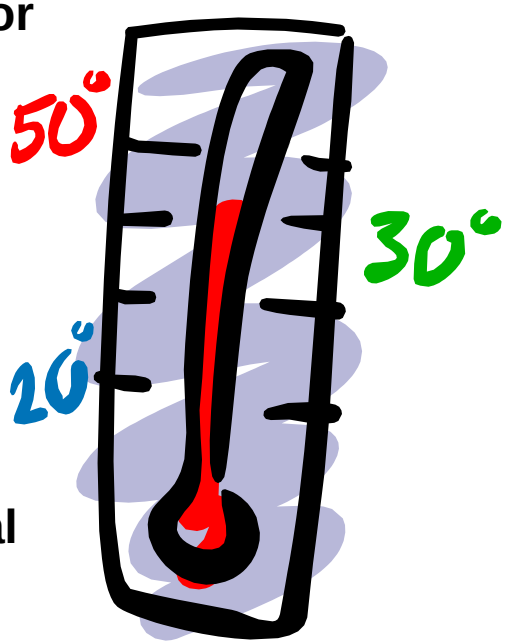
Increasing maturity

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

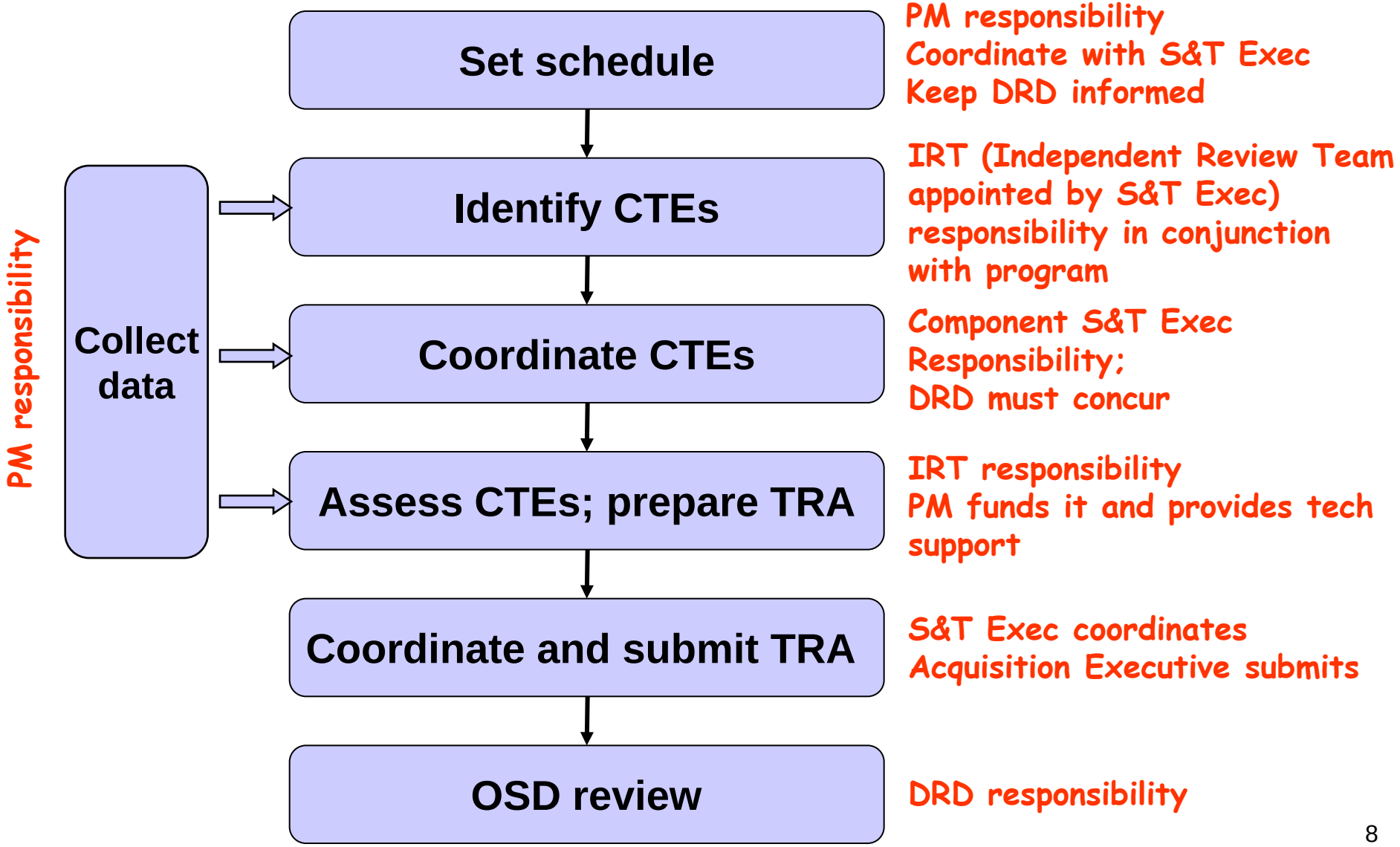
Software TRLs

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, i.e. software prototype development 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 mission qualified through test and demonstration in an operational environment
9. Actual system proven through successful mission proven operational capabilities



Process Overview



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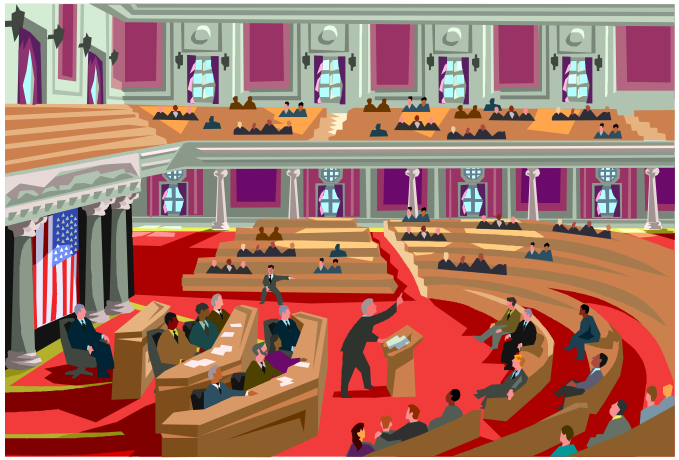
Why is a Milestone B TRA Important? (1 of 3)

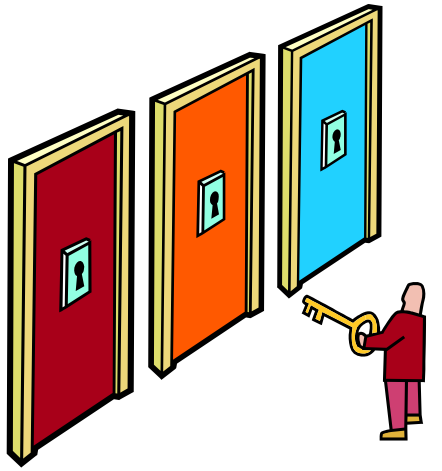
- **The Milestone Decision Authority (MDA) uses the information to support a decision to initiate a program**
  - **Trying to apply immature technologies has led to technical, schedule, and cost problems during systems acquisition**
  - **TRA established as a control to ensure that critical technologies are mature, based on what has been accomplished**



- **Congressional interest**
  - **MDA must certify to Congress that the technology in programs has been demonstrated in a relevant environment at program initiation**
  - **MDA must justify any waivers for national security to Congress**

Why is a Milestone B TRA Important? (2 of 3)

- **The PM uses the expertise of the assessment team and the rigor and discipline of the process to allow for:**
  - **Early, in depth review of the conceptual product baseline**
  - **Periodic in-depth reviews of maturation events documented as verification criteria in an associated CTE maturation plan**
  - **Highlighting *(and in some cases discovering)* critical technologies and other potential technology risk areas that require management attention (and possibly additional resources)**
- **The PM, PEO, and CAE use the results of the assessment to:**
  - **Optimize the acquisition strategy and thereby increase the probability of a successful outcome**
  - **Determine capabilities to be developed in the next increment**
  - **Focus technology investment**



Why is a Milestone B TRA Important? (3 of 3)

- **For Information Technology (IT) systems, which rely heavily on off-the-shelf components, TRAs have increased management's focus on finding CTEs that relate specifically to IT issues (e.g., interfaces, throughput, scalability, external dependencies, integration, and information assurance)**
  - **Since many IT systems have experienced problems in these areas, the TRA has proven useful in understanding potential problems earlier in the process, when solution options are easier to adopt and less costly to implement**

Why is a Milestone C TRA Important? (1 of 2)

- **Reflects the resolution of any technology deficiencies that arose during EMD**
- **Serves as a check that all CTEs are maturing as planned especially any new CTEs identified in EMD**
- **Documents successful developmental test and evaluation (DT&E)**
- **Avoids technology driven OT problems: OT should focus on “effective and suitable”**
- **Confirms expansion of performance envelope to “operational” environment – generally a broader environment than can be tested in OT**

Why is a Milestone C TRA Important? (2 of 2)

- **For MAIS programs, or software intensive systems with no production components**
  - **Examines plans for maintenance and upgrades to ensure that no new CTEs are involved**
  - **Determines whether algorithms will transfer successfully when host platforms are moved and full-scale applications are initiated in a real operational environment**
  - **Identifies where new Milestone Bs are needed for future releases to initiate efforts to improve performance and determines the architectural changes necessary to support these future releases**
  - **Checks technology component of information assurance before deployment**
  - **Ensures that the operational environment for systems to deploy has included duress**

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Technology Maturation Policy Leading to Milestone A

"…the lead DoD Component(s) shall prepare an AoA study plan to assess preliminary materiel solutions, *identify key technologies*, and …"

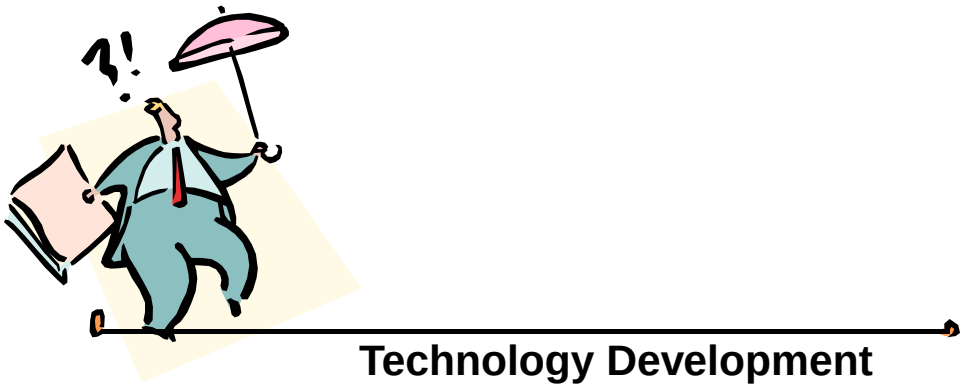
"… The purpose of the AoA is to assess the potential materiel solutions to satisfy the capability need documented in the approved ICD. The AoA *shall assess the critical technology elements (CTEs) associated with each proposed materiel solution, including technology maturity*, integration risk, manufacturing feasibility, *and, where necessary, technology maturation and demonstration needs* …"

(DoDI 5000.02, Encl 2, para 4.c.(5 & 6))

Technology Maturation Policy Leading to Milestone B is Unambiguous (1 of 3)

"PMs shall reduce technology risk, demonstrate technologies in a relevant environment, and identify technology alternatives, prior to program initiation" (DoDD 5000.01, Encl 2, para E1.1.14)

The TRA complements, but does not diminish, the PM's responsibility to pursue risk reduction efforts prior to program initiation at Milestone B

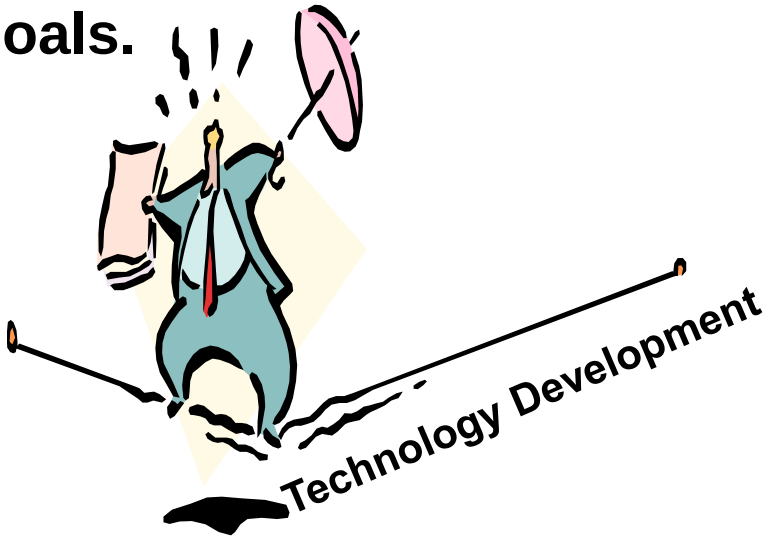


Technology Maturation Policy Leading to Milestone B is Unambiguous (2 of 3)

"The project shall exit the Technology Development Phase when an affordable program or increment of militarily useful capability has been identified; the technology and manufacturing processes for that program or increment have been assessed and demonstrated in a relevant environment; manufacturing risks have been identified; a system or increment can be developed for production within a short timeframe (normally less than 5 years for weapon systems); or, when the MDA decides to terminate the effort … A Milestone B decision follows the completion of Technology Development."
(DoDI 5000.02, Encl 2, para 5.d.(7))

Technology Maturation Policy Leading to Milestone B is Unambiguous (3 of 3)

"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. Technology developed in S&T or procured from industry or other sources shall have been demonstrated in a relevant environment or, preferably, in an operational environment to be considered mature enough to use for product development (see the "Technology Readiness Assessment (TRA) Deskbook" (Reference(n)). Technology readiness assessments, and where necessary, independent assessments, shall be conducted.

If technology is not mature, the DoD Component shall use alternative technology that is mature and that can meet the user's needs." (DoDI 5000.02, Encl 2, para 5.d.(4))

Prototyping and Competition Policy Provides Technology Maturation Safeguards

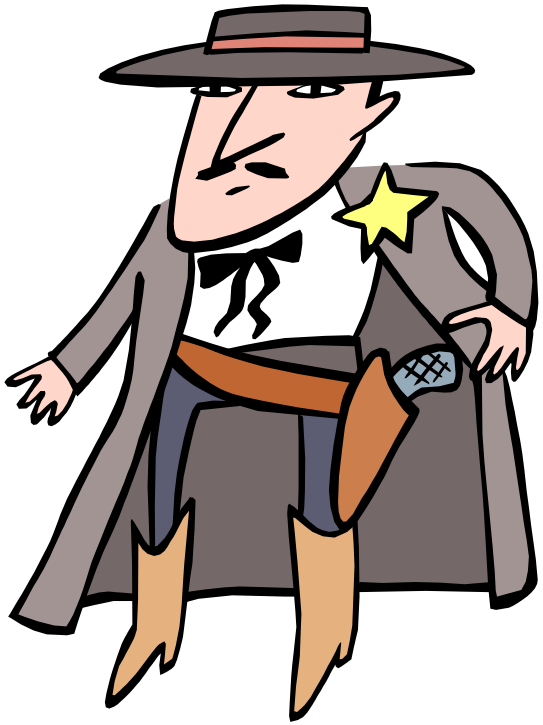
"Evolutionary acquisition requires . . . Technology development preceding initiation of an increment shall continue until the required level of maturity is achieved, prototypes of the system or key system elements are produced, and a preliminary design is completed. . . ."
DoDI 5000.02, Encl 2, para 2.b

"The TDS and associated funding shall provide for two or more competing teams producing prototypes of the system and/or key system elements prior to, or through, Milestone B. The prototypes shall be representative platforms reflecting the maturity of technologies and integrated system performance consistent with expected capability."
DoDI 5000.02, Encl 2, para 5.c.(9)

- **Promotes maturity via**
  - **More rigorous relevant environment demonstrations**
  - **More comprehensive evidence of maturity**
  - **Fewer technical problems in the final design**
  - **Using prototypes for accelerated life-cycle tests**
  - **Providing insight into production issues**

RFP Policy Provides Technology Maturation Safeguards

"Final RFPs for the EMD phase, or any succeeding acquisition phase, shall not be released, nor shall any action be taken that would commit the program to a particular contracting strategy, until the MDA has approved the Acquisition Strategy. The PM shall include language in the RFP advising offerors that (1) the government will not award a contract to an offeror whose proposal is based on CTEs that have not been demonstrated in a relevant environment and (2) that offerors will be required to specify the technology readiness level of the CTEs on which their proposal is based and to provide reports documenting how those CTEs have been demonstrated in a relevant environment" (DoDI 5000.02, Encl 2, para. 6.c.(4)).



Open Dialogue and Feedback on AT&L Policy (AT&L memo 24 Aug 2007)

- **Policy**
  - **"Structure all planned competitions with one or more feedback and dialogue points prior to receipt of final proposals"**
  - **"All ongoing competitions should be reviewed with a bias toward incorporating feedback and dialogue sessions before receipt of final proposals"**

- **Results of the Dialogue**
  - **A high quality well understood proposal**
  - **Allows the acquisition team to well explain, and for industry to understand, the fundamental factors which determine the outcome of the competition**
  - ***Provides multiple inputs for the government to define the required relevant environment for candidate CTEs, and to clarify criteria with contractors***

• • • The Policy is Reflected as a Statutory Requirement for Certification

Title 10 US Code 2366b:

Major defense acquisition programs: certification required before Milestone B or Key Decision Point B approval:

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 • • •

the technology in the program has been demonstrated in a relevant environment as determined by the Milestone Decision Authority on the basis of an independent review and assessment by the Director of Defense Research and Engineering;

Certification submitted with the first Selected Acquisition Report for the program

• • • and for Milestone B Certification Changes

(1) The program manager for a MDAP that has received certification under subsection (a) shall immediately notify the milestone decision authority (MDA) of any changes to the program that –

(A) alter the substantive basis for the certification of the MDA relating to any of the components of such certification

(B) Otherwise cause the program to deviate significantly from the material provided to the milestone decision authority in support of such certification

(2) Upon receipt of information under para 1, the MDA may withdraw the certification concerned or rescind MS B approval (or KDP B approval in the case of a space program) if the MDA determines that such certification or approval is no longer valid

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DoD Practices to Support the Statutory Requirements (1 of 2)

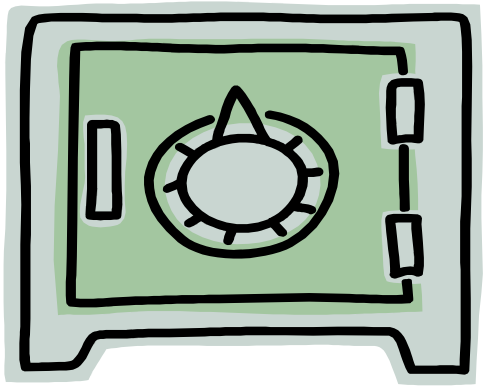
- **Early evaluations of technology maturity (prior to Milestone A)**
  - **To provide a basis for modifying the requirements if technological risks are too high**
  - **To support the development of TMPs that show how all likely CTEs will be demonstrated in a relevant environment before preliminary design begins at the full system level**
  - **To refine the TDS**
  - **To inform the test and evaluation (T&E) community about technology maturity needs**
  - **To ensure that all potential CTEs are included in the program's risk management database and plan**
  - **To articulate external dependencies on technology base projects and define specific technologies, technology demonstration events, and exit criteria for the technology to transition into the acquisition program**

DoD Practices to Support the Statutory Requirements (2 of 2)

- **USD(AT&L) practice**
  - **Programs will not be initiated at MS B with immature technologies**
  - **The same standards apply to all acquisition programs**

- **As directed by 10 USC 2366b, DDR&E will provide technical advice based upon an independent review and assessment to the MDA in support of certification**
  - **For MDAPs, MAIS, and space systems the approved TRA process, as found in the DoD TRA Deskbook, and report will be the basis of that advice**
  - **DDR&E approved TRA process takes precedence over other guidance in situations where conflict would arise, pending future modification**

TRA Processes Designed to Support This Technical Advice (1 of 2)



- **Safeguards in place to provide the DDR&E with the confidence necessary to assure the MDA that certification can be made**
  - **To make the TRA support the certification, it must draw upon the best technical information available**
    - **As such, a generic TRA not based on the planned technical solution is not acceptable**
    - **The TRA must be based on the technologies in the system**
  - **The identification and assessment of CTEs must be performed by subject matter experts**
    - **These experts must be independent of the program (DDR&E concurrence required)**
    - **DDR&E has final say on CTE list**

TRA Processes Designed to Support This Technical Advice (2 of 2)

- **Assurance that technologies have been demonstrated in a relevant environment by the winning EMD Phase contractor**
  - **To initiate programs with mature technologies, the source selection process should include a focus on technical maturity**
  - **TRAs must be performed on all the competitors in a source selection**
- **ADM language establishing conditions for CTE insertion after Milestone B**
  - **To initiate programs with mature technologies, immature CTEs may be pursued in a parallel development effort, if approved maturation plans submitted with the TRA— *on ramp vice off ramp for preferred approaches with undemonstrated technologies***

Basis of Technology Maturity Assessments Throughout Acquisition

	Milestone A	Milestone B	Milestone C
Basis of CTE Identification	Early evaluation of technology maturity	Current level of design and CDD requirements	Planned LRIP article (or limited deploy-ment version of an IT system), prior TRAs, and final design
CTE Identification Status	Potential CTEs	CTEs – actual technologies in a preliminary design	CTEs of planned LRIP articles (or limited deployment version of an IT system)
Assessment Method	Evaluated in early evaluations of technology maturity and TMPs	Assessed in Mile-stone B TRA	Assessed in Milestone C TRA
Documentation	Informal submission to DRD and corresponding updates to TDS appendix	Milestone B TRA	Milestone C TRA

References and Resources

- **Defense Acquisition Resource Center http://akss.dau.mil/darc/darc.html**
  - **DoD Directive 5000.01 (DoDD 5000.01), *The Defense Acquisition System*, dated Dec 2, 2008**
  - **DoD Instruction 5000.02 (DoDI 5000.02), *Operation of the Defense Acquisition System*, dated Dec 2, 2008**
  - ***Defense Acquisition Guidebook***
- ***DAU Continuous Learning Module CLE021***
  - **https://learn.dau.mil/html/clc/Clc.jsp to browse it**
- ***TRA Deskbook***
  - **http://www.dod.mil/ddre/doc/DoD_TRA_July_2009_Read_Version.pdf**
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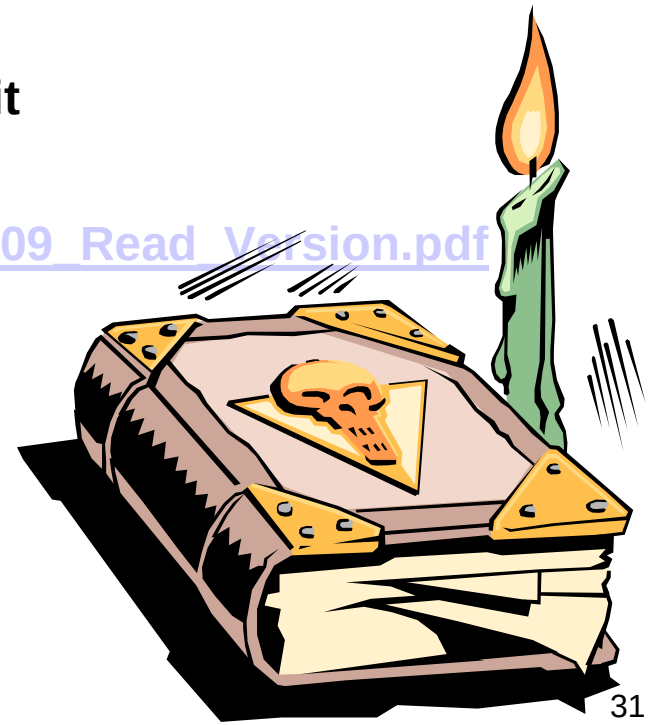


BACKUP

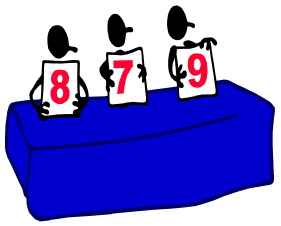
PM Roles and Responsibilities

- Plans and funds the program's risk reduction activities to ensure that CTEs reach the appropriate maturity levels
- Informs the Component S&T Executive of the need to conduct a TRA
- Funds the TRA evaluation for his program
- Designates a responsible individual in the program office to organize all TRA activities
- Prepares a draft TRA schedule and incorporates the approved version in the program's IMP and IMS
- Suggests to the Component S&T Executive the subject matter expertise needed to perform the TRA
- Familiarizes the IRT with the program
- Identifies possible CTEs for consideration by the IRT
- Provides evidence of CTE maturity to the IRT for its assessment, including contractor data
- Provides technical expertise to the IRT as needed
- Drafts the section of the TRA report containing a brief description of the program (program/system overview, objectives, and descriptions)

Component S&T Executive Roles and Responsibilities

- Directs the conduct of the TRA
- Coordinates on the TRA schedule
- Nominates SMEs to be on the IRT
- Provides the DRD with the credentials of all prospective IRT members and with sufficient information to confirm their independence from the program
- Trains IRT members on the TRA process
- Reviews the TRA report and prepares the TRA report cover memorandum, which may include additional technical information deemed appropriate to support or disagree with IRT findings
- Sends the completed TRA to the CAE for official transmittal to the DRD and furnishes an advance copy to the DRD
- Maintains continuity in the IRT membership for all TRAs conducted over the life of a program, to the maximum extent possible

IRT Roles and Responsibilities



- **Keeps the Component S&T Executive and the DRD informed on progress throughout the entire TRA process**
- **Develops a list of CTE candidates in conjunction with the program**
- **Assesses the TRLs for all CTEs**
- **Prepares (or oversees the preparation of) elements of the TRA report including (1) the IRT credentials and (2) IRT deliberations, findings, conclusions, and supporting evidence.**
  - **The assessment process should not be constrained to a validation of a "program-developed" position on the TRL**

DRD Roles and Responsibilities

- **Concurs with the TRA schedule**
- **Concurs with the composition of the IRT**
- **Reviews the candidate CTE list and identifies any changes necessary to form the final CTE list. Additions to the list can include any special interest technologies that warrant the rigor of the formal TRA process**
- **Exercises oversight by monitoring and evaluating the TRA process and reviewing the TRA. On the basis of that review, a TRA revision may be requested or the DRD may conduct its own Independent Technical Assessment (ITA).**
- **Sends the results of its TRA review to the appropriate OIPT and/or the DAB**
- **Provides the DDR&E recommendations concerning certification**
- **Recommends technology maturity language for an ADM, noting, in particular, conditions under which new technology can be inserted into the program**