Program Success Through SE Discipline in Technology Maturity

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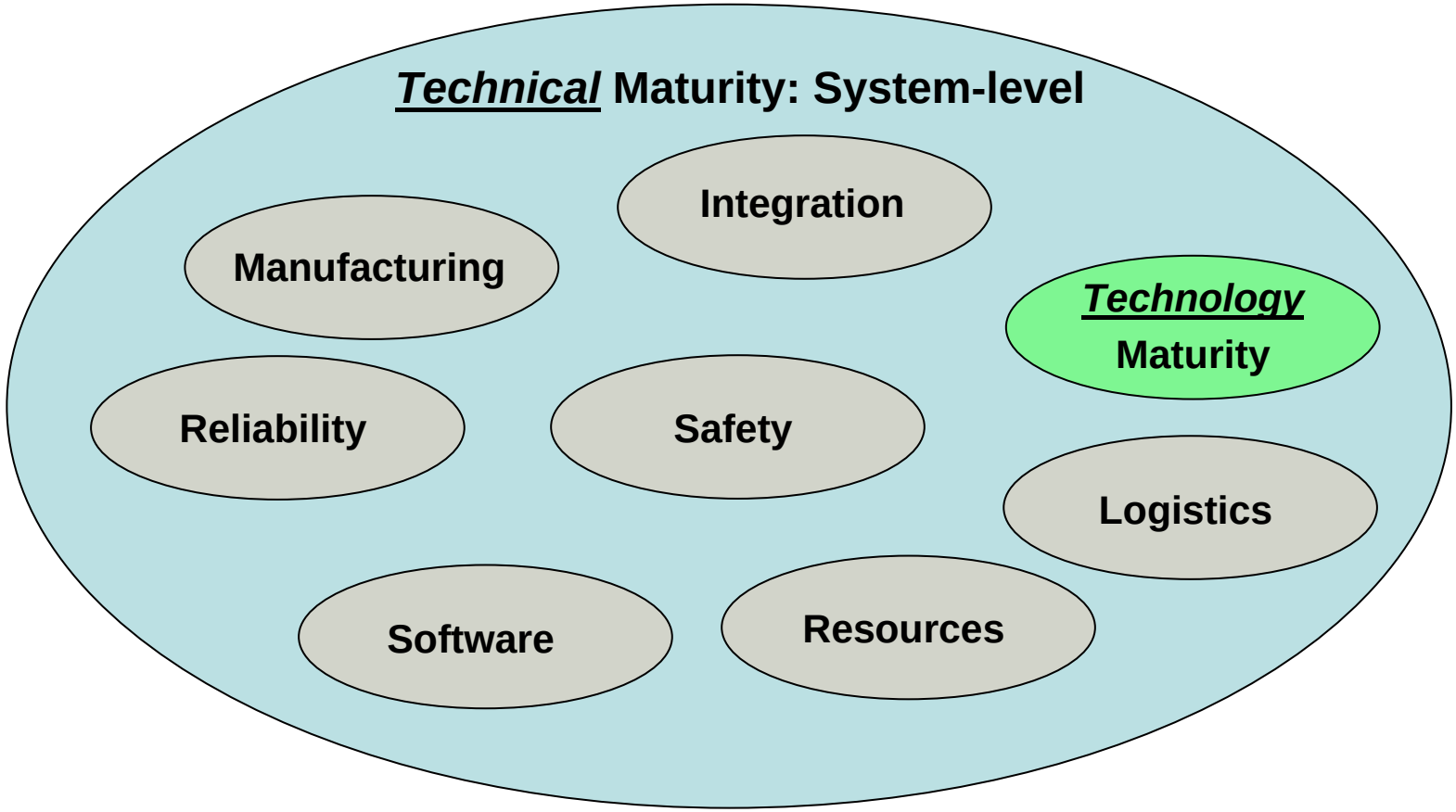
Purpose of Breakout Session

- How can we increase the rigor of Technology Maturity in acquisition program Systems Engineering and T&E processes?

Scope of Today's Discussion



Outline

- Technology Maturity Background
- AT&L Technology Maturity Initiative
- Next Steps
  - Transition of Emphasis

Background

- Findings from multiple studies attribute some program troubles to lack of technology maturity (TM)
  - GAO
  - QDR
  - DAPA
  - SSE/AS Program Support Reviews
- "Programs that started development with **immature** technologies experienced an average acquisition unit cost increase of nearly **21 percent"** (GAO Report)
- FY06, PL 109-163, Section 801 requires USD(AT&L) certification, before Milestone B, that *"the technology in the program has been demonstrated in a relevant environment"*
  - Above wording equates to Technology Readiness Level (TRL) 6

Example PSR TM Findings

- PM chose “a software architecture that depends upon COTS middleware that does not yet exist “
  - Although an alternative has been identified, no effort has been expended to pursue this solution
- “Technology maturity growth of critical Engineering Development Models lagging the plan”
  - PSR Recommendation: Initiate development of off-ramps to maximize operational performance
- “Technology Readiness Level (TRL) 6 of major subsystem at Milestone B is unlikely to be achieved; planned testing will not support accurate assessment of true maturity”
- “TRA conducted too late to influence decision process”
- “TRA conducted too late to support LRIP decision”
- “Technology Development Strategy (TDS) document is not a strategy, but a statement of Needs and Requirements”

Major contributors to poor program performance

AT&L Technology Maturity Initiative

Purpose

- To fully integrate Technology Maturity into the Systems Engineering and DT&E processes to:
  - Increase the rigor of SE
  - Plan for alternatives in the event of TM difficulty
  - Verify Technology Readiness Levels (TRL) during DT&E
  - Updates will complement proposed Risk-Based Source Selection, Time-Defined Acquisition, and Concept Decision (CD) processes

Scope

- Stay within existing acquisition review structure
- Use existing DDR&E Technology Readiness Assessment (TRA) methodology

Definition:

- TRL is a component- or subsystem-level, (vice system-level), metric

Technology Maturity Across System Lifecycle (as-is)

Decision	TRL (min)	
CD	1*	
MS A	4*	
MS B	6	← Statute, per Sec 801
MS C	8*	

* Guidance, not statute

Should Technology Maturity be tracked between Milestones? (Technical Reviews?)

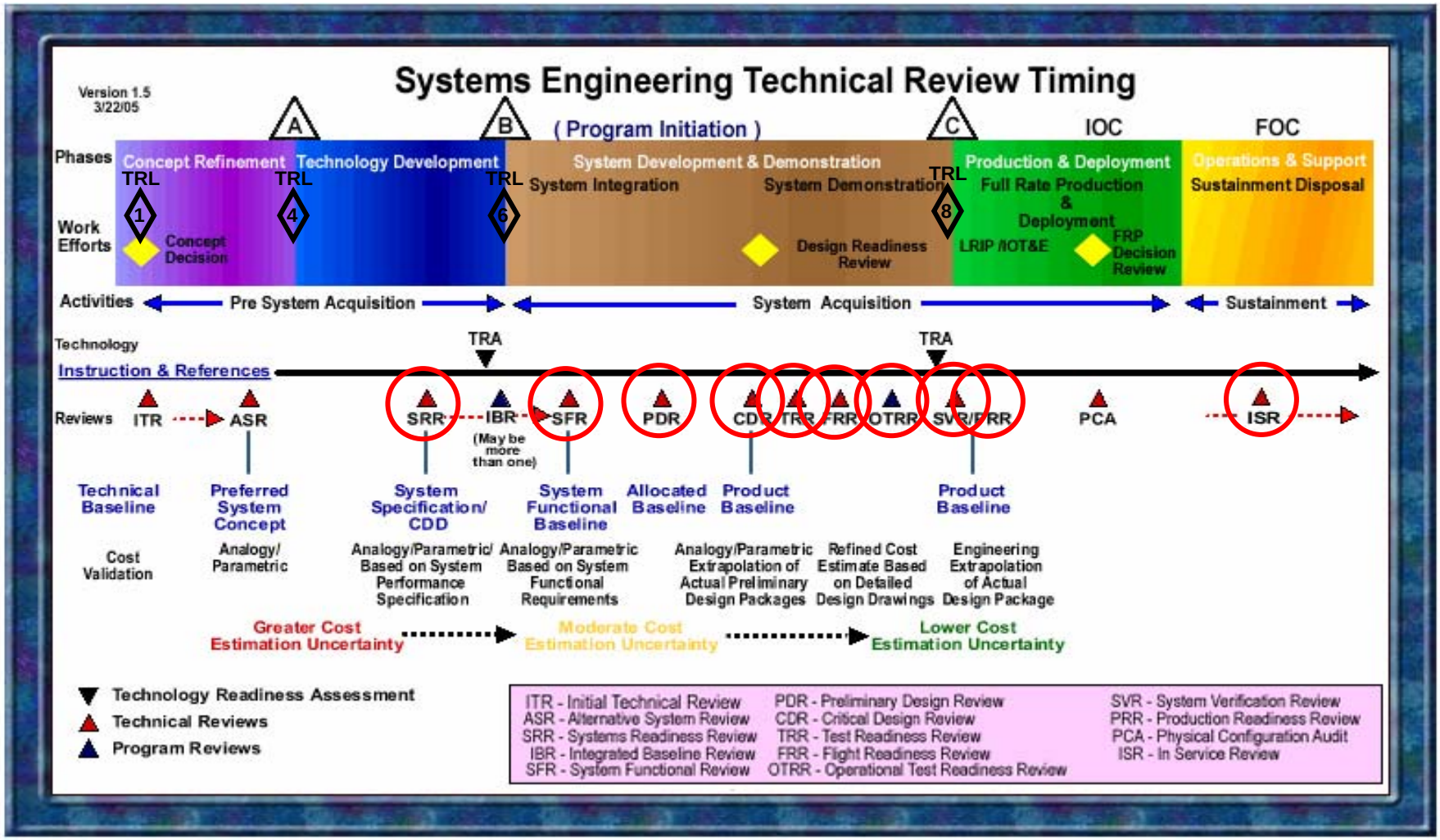
Compressed Schedules Must Start with Higher Technology Maturity

Technical Review Opportunities	Decision	TRL (min)	
Evaluation of Alternatives	EOA	4-5*	Compressed/ Merged
Initial Technical Review	CD	4-5*	
Systems Requirements Review	MS B	6 ←	Statute, per Sec 801
Systems Verification Review/ Production Readiness Review	MS C	8*	

* Guidance, not statute

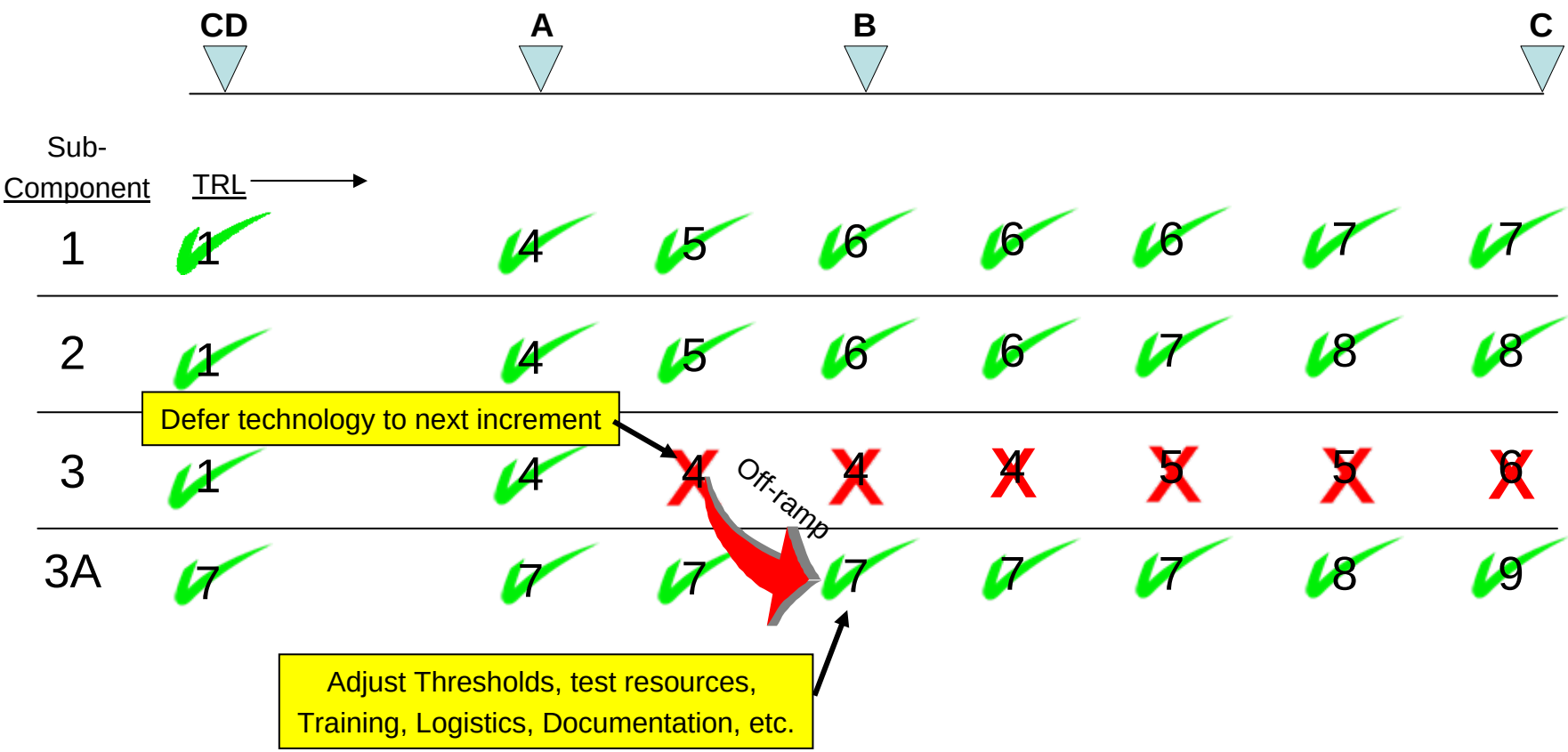
Systems Engineering Reviews

Technical reviews in Life Cycle Framework



TRL Impact on SE

Example of Pre-planned "Off-ramp"



Sub-component "3" does not mature at required rate. Off-ramp to mature sub-component "3A" is chosen before MS B.

Next Steps

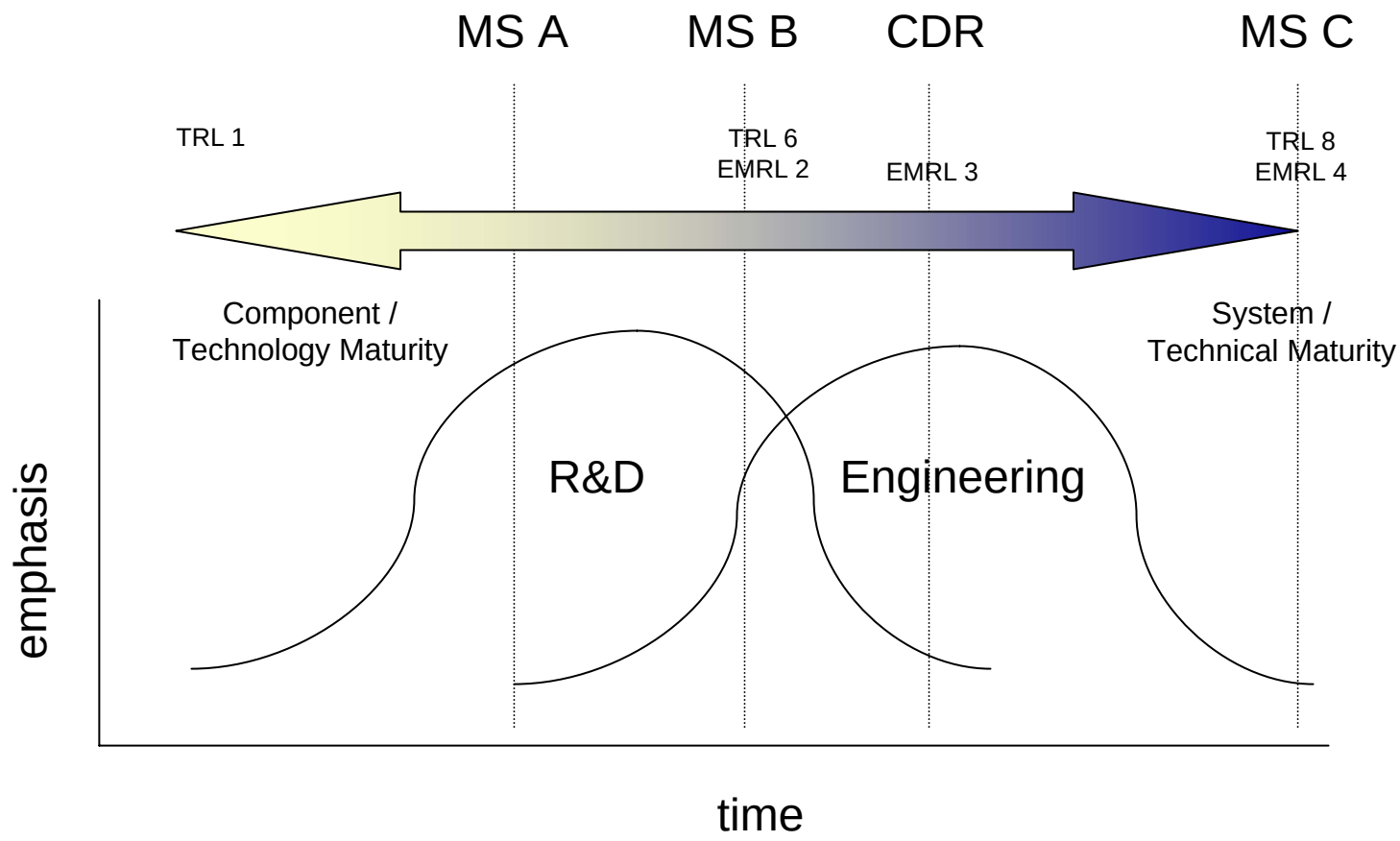
Update DAG
- SE Chapter
- T&E Chapter

Reconcile terminology across acquisition documents
- TRA Deskbook, 5000.2 SE & T&E enclosures,
- SEP, TES, TEMP, DAPS

Incorporate into Education & Training
- DAU Courses
- Continuous Learning Module (CLM)

Publicize to SE and T&E Communities
- NDIA, ITEA, PEO/SYSCOM,
Conferences, publications, symposia

Transition of Emphasis



Back-up

Hardware TRL Definitions

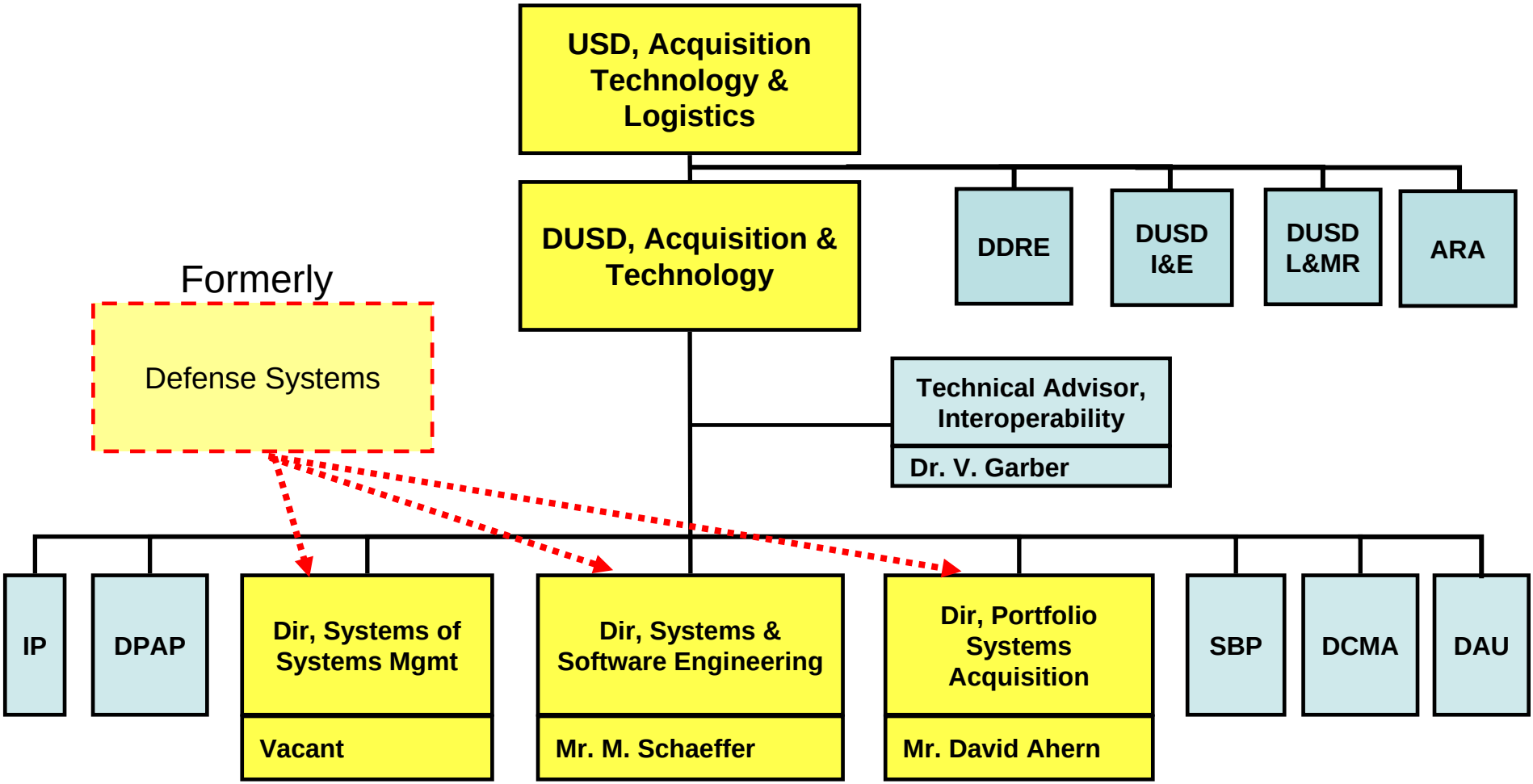
Decision:

CD*	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
MS A*	4.	Component and/or breadboard validation in a laboratory environment
EOA/CD*	5.	Component and/or breadboard validation in a relevant environment
MS B	6.	System/subsystem model or prototype demonstration in a relevant environment
	7.	System prototype demonstration in an operational environment
MS C*	8.	Actual system completed and qualified through test and demonstration
	9.	Actual system proven through successful mission operations

* Guidance, not statute

A&T Reorganization

DUSD, Acquisition & Technology (A&T)



Revitalization of Systems Engineering

Under Secretary of Defense for Acquisition, Technology and Logistics:

- Provide a context within which I can make decisions about individual programs.
- Achieve credibility and effectiveness in the acquisition and logistics support processes.
- Help drive good systems engineering practices back into the way we do business.

"I should note … that we have taken important steps that will help us to produce improved capability on time and within budget by re-energizing our approach to systems engineering. This critical discipline has always contributed significantly to effective program management at every level and will receive sustained emphasis during my tenure."

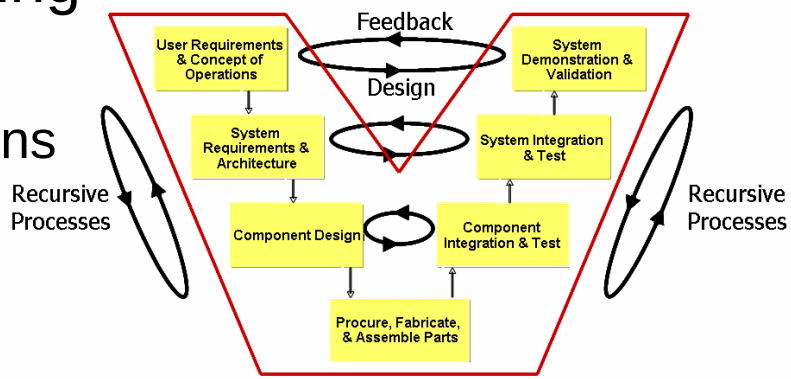
Testimony of The Honorable Kenneth J. Krieg, USD(AT&L), before US Committee on Armed Services, September 27, 2005

DT&E Mission and Functions

- MISSION
  - Lead office within AT&L and A&T for all matters pertaining to developmental test and evaluation policy
  - DT&E is responsible for all developmental test matters that are not program-specific
- DT&E ROLES and FUNCTIONS
  - Developing DT&E policy (Title 10, USC)
  - DT&E Champion
  - Sound DT&E practices
  - Advisor to Senior Leadership—Test Issues
  - Education & Training of the T&E Workforce
  - Represent AT&L on Defense Safety Oversight Council (DSOC)
  - Test Training Range and Resource Management
  - Outreach to the Services, academia, and industry
  - Energy

Role of DT&E in SE

- Critical part of systems engineering
  - Verifies system performance
  - Confirms design meets specifications
  - Provides traceability
  - Lowers life-cycle costs
  - Reduces technical risk
  - Provides indicator of system *technical* maturity



- *DT&E is integral to successfully fielding weapon systems*
  - Key determinant of successful OT&E

  - **Most Significantly –**
    Rigorous DT&E is Important to the Warfighter
    Weapons meet Requirements & Perform as Designed

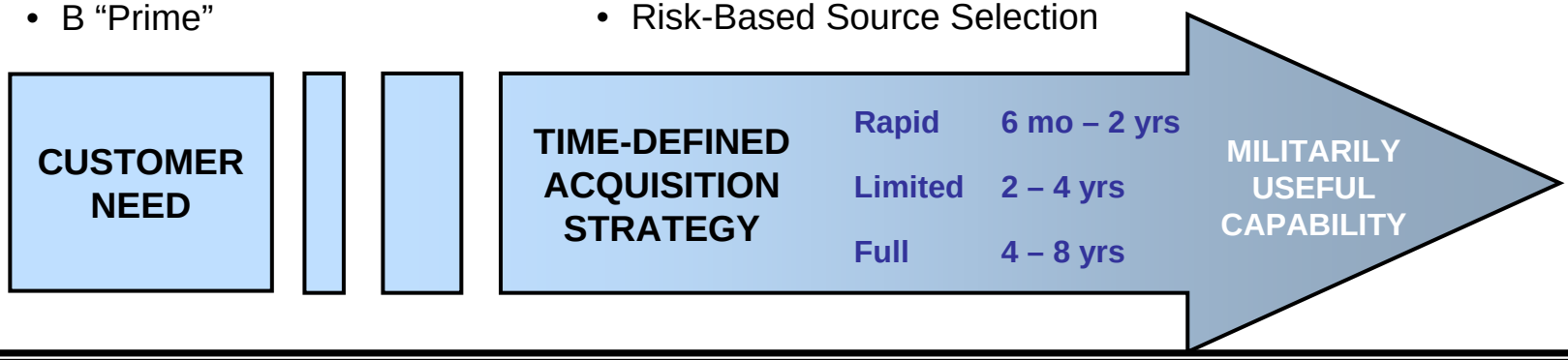
Acquisition Initiatives

INITIATIVE	QUANTITATIVE/ QUALITATIVE METRIC	STATUS	TGT COMP DATE
Time-Defined Acquisition	• Cost, Schedule, Performance • Reduced Cycle Time	• Concept Designed • Business Rules in Staffing	Early 2007
Risk-Based Source Selection	• Improved Cost Estimates • Quantified Risk	• Concept Designed • Business Rules in Staffing	Early 2007

Time-Defined Acquisition

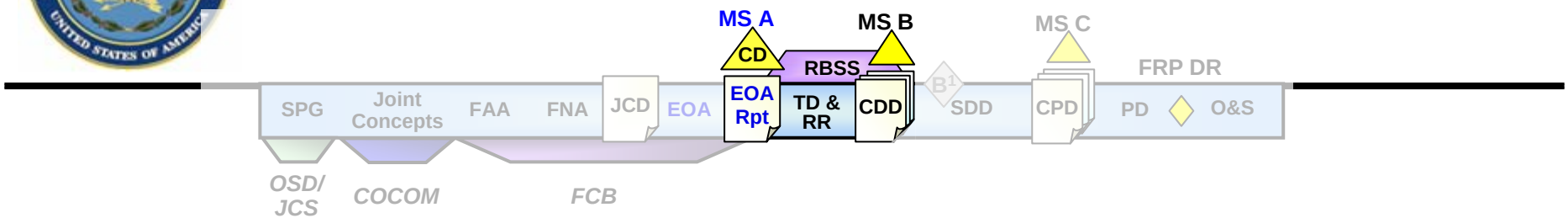
An Evolving Customer-Focused Concept that:

- Enhances system agility
- Capitalizes on Rapid Acquisition Authority and the Concept Decision
- Employs a time-sensitive acquisition approach emphasizing Customer Response and designed to provide capability when it is needed
- Uses three risk-based criteria to determine the Acquisition Strategy:
  - Time to delivery
  - Requirement certainty
  - Technology maturity
- Enhanced by Enabling Initiatives:
  - Program Baseline Assurance
  - B "Prime"
  - Capital Budgeting
  - Risk-Based Source Selection

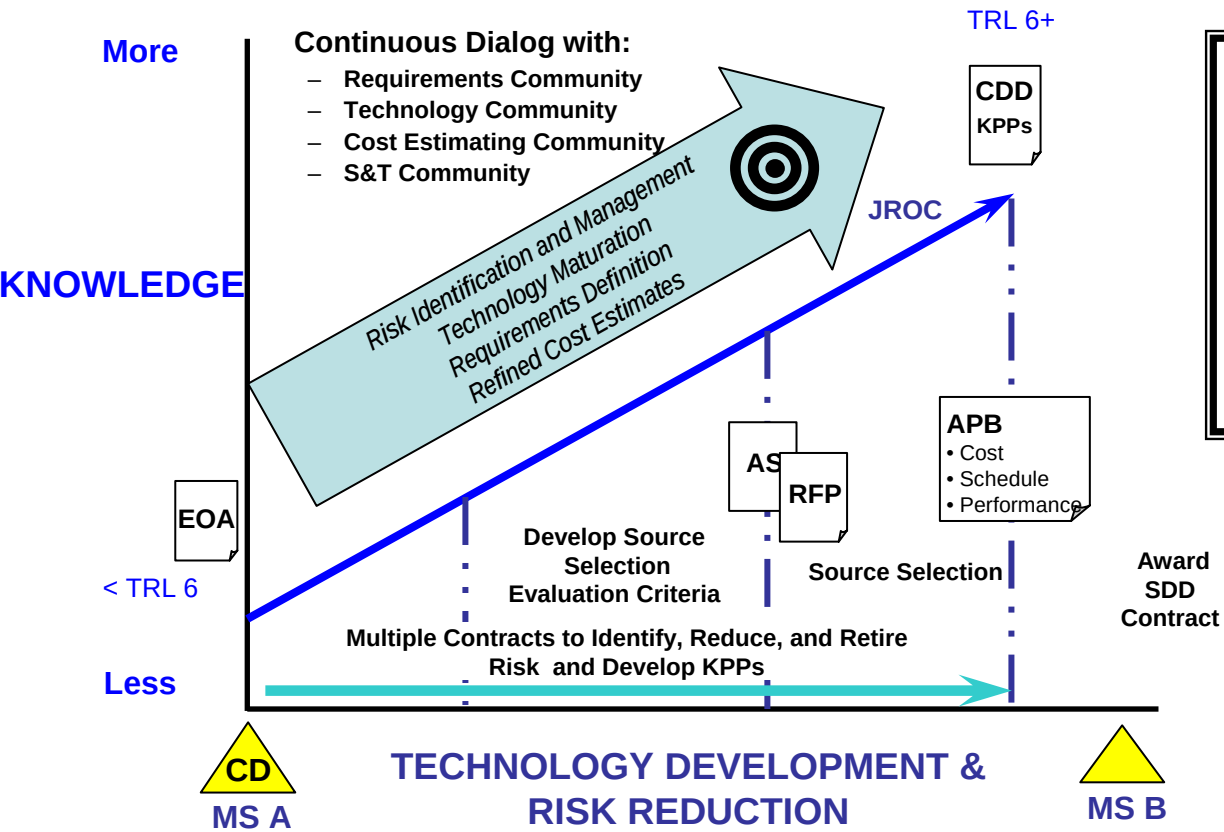


Objective: More Responsive Acquisition Solutions

Risk-Based Source Selection



CONCEPT APPROACH

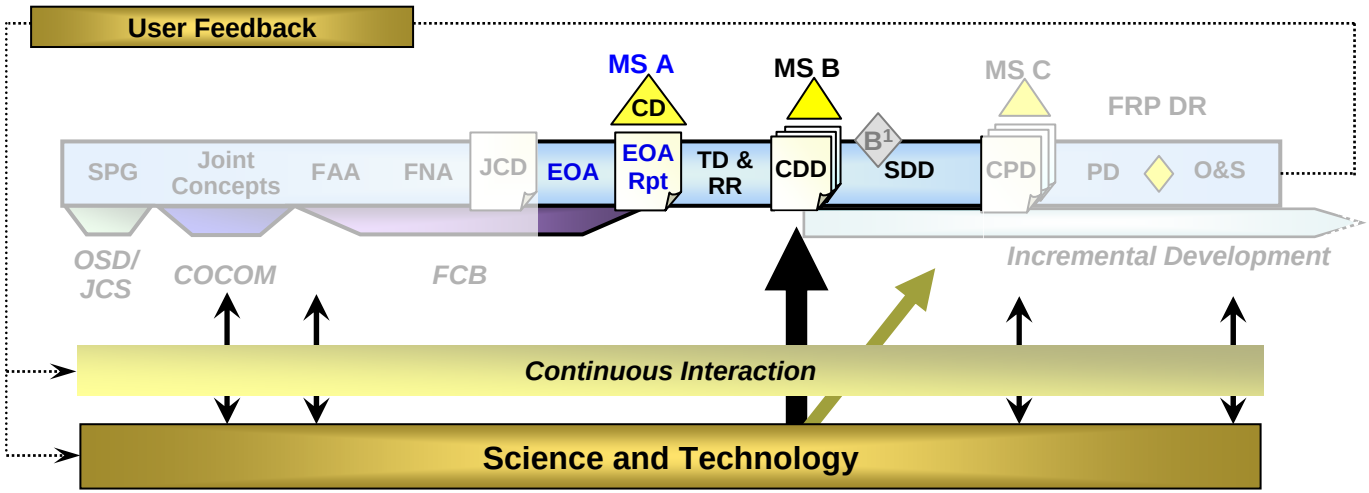


Risk-Based source selection employs one or more approved and funded efforts designed to identify, quantify and reduce risk, enhance requirements definition, refine cost estimation, and improve source selection

Objective: Starting Programs Right

DELIBERATIVE DOCUMENT:
For discussion purposes only. Draft working papers. Do not release under FOIA.

Improving Synergy with S&T

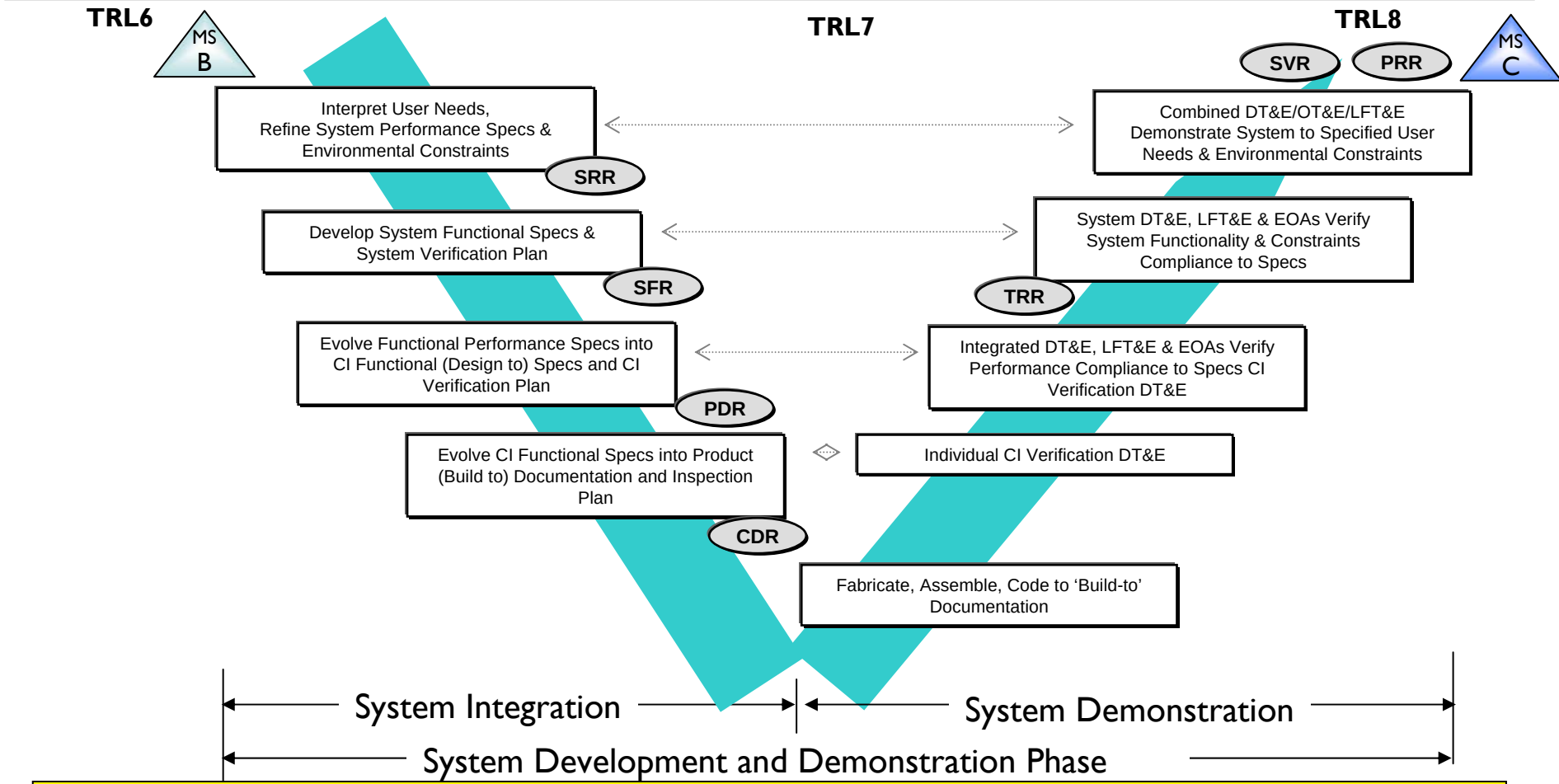


Technology Considerations

- **Technology assessed during the Evaluation of Alternatives**
- **Technology matured in support of Risk-based Source Selection**
- **Mature technology transitioned for development; immature technology deferred to later increments**
- **Long Term technology investment considered at Milestone A/Concept Decision**

Achieving a More Complimentary Relationship

Beyond TRLs - The 'V' Diagram in SDD



TRLs lack granularity and alignment with established program activities in the Life Cycle Framework

Gaps and Shortfalls

- Current SE guidance regarding TM is reactive, vice proactive
  - “Off-ramp” decision occurs too late, and “Off-ramp” is not pre-planned

    “If any technology is not mature enough to be used in the current increment, the program manager should integrate and test an alternative, mature, technology in its place. The program manager should relegate the immature technology to the next increment of the system.”*

  - Current guidance does not address changes to performance, T&E, logistics, training, etc. in response to “Off-ramp” changes in system design

* Defense Acquisition Guidebook: 4.3.3.3.5.; Fabricate, Assemble, Code to "Build-to" Documentation

Why?

- **QDR –** "provide information and analysis necessary to make timely and well reasoned decisions—facilitate effective decision making"
- **DAPA** – "competitive pressure to win… results in programs being structured without due consideration for… technology maturity, and in setting unrealistic scheduling for program success ." **,**

  "programs do not establish "*offramps*" to identify and close-in on risk and technical readiness."
- **GAO –** "invention cannot be scheduled and its cost is difficult to estimate."
- **Congressional** – FY06 NDAA, PL 109-163, Section 801
- **A&T Objectives** – Increase process efficiencies and improve core competencies

All have raised issues and concerns regarding the lack of a viable technology maturity process for DoD systems

FY06, PL 109-163, Section 801

Sec. 2366a. Major defense acquisition programs: 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--

(1) the technology in the program has been demonstrated in a relevant environment;

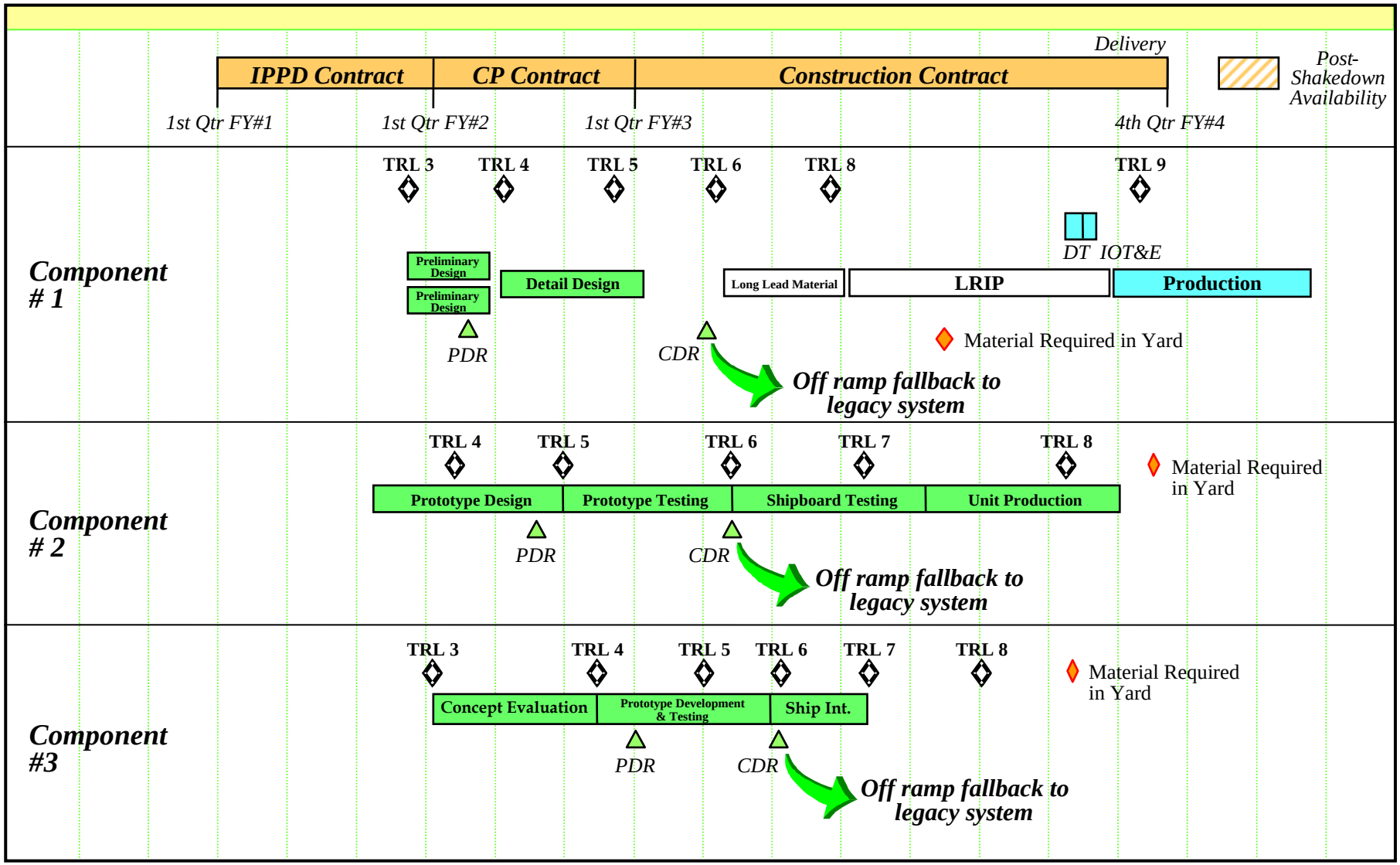
(2) the program demonstrates a high likelihood of accomplishing its intended mission;

(3) the program is affordable when considering the per unit cost and the total acquisition cost in the context of the total resources available during the period covered by the future-years defense program submitted during the fiscal year in which the certification is made;

(4) the Department of Defense has completed an analysis of alternatives with respect to the program;

(5) the program is affordable when considering the ability of the Department of Defense to accomplish the program's mission using alternative systems;

(6) the Joint Requirements Oversight Council has accomplished its duties with respect to the program pursuant to section 181(b) of this title, including an analysis of the operational requirements for the program; and

(7) the program complies with all relevant policies, regulations, and directives of the Department of Defense.

Critical Technology "Off-Ramps"