



Enhanced Systems Engineering - Starting Programs Right

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(Acquisition & Technology)



Outline



Enhanced Systems Engineering (SE)

- SE Context: Background / Framework
- Early SE: “... right activities at the right time ...”
 - Materiel Solution Analysis Phase
 - Technology Development Phase
- Emphasis on SE “.. the right time in the right way”
 - Competitive Prototyping
 - SE Design Consideration - Reliability, Availability, and Maintainability
 - Preliminary Design Review (PDR)

“Implementing the right activities at the right time in the right way”



Background Program Roles & Activities



	Project Manager	Systems Engineer
Stakeholder Management	Primary	Support
Planning	Primary	Support
Cost Management	Primary	Support
Schedule Management	Primary	Support
Configuration Management	Primary	Support
Contract Management	Primary	Support
Concept Selection	Shared	Shared
Architecture Development	Support	Primary
Requirements Baseline	Support	Primary
Technical Risk Management	Support	Primary
Interface Control	Support	Primary
Integration	Support	Primary
Verification	Support	Primary
Validation	Shared	Shared



“Proposed DoDI 5000.02 Changes” Framework for Enhanced SE

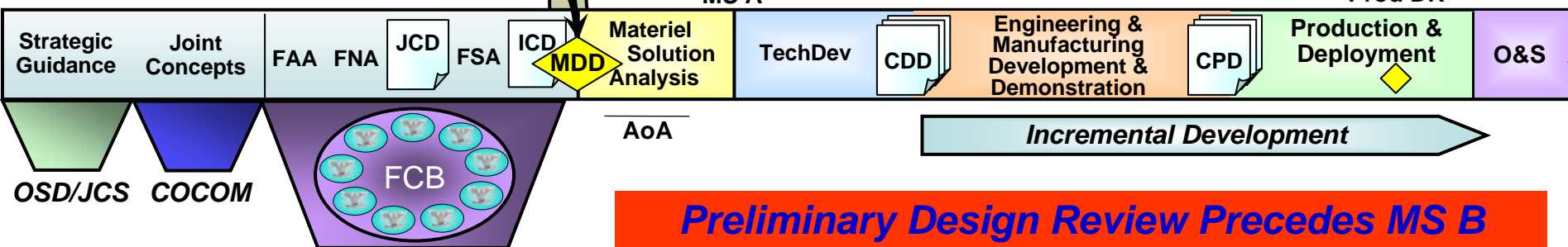


Matériel Development Decision precedes entry into any phase of the acquisition system

Technology Opportunities & Resources

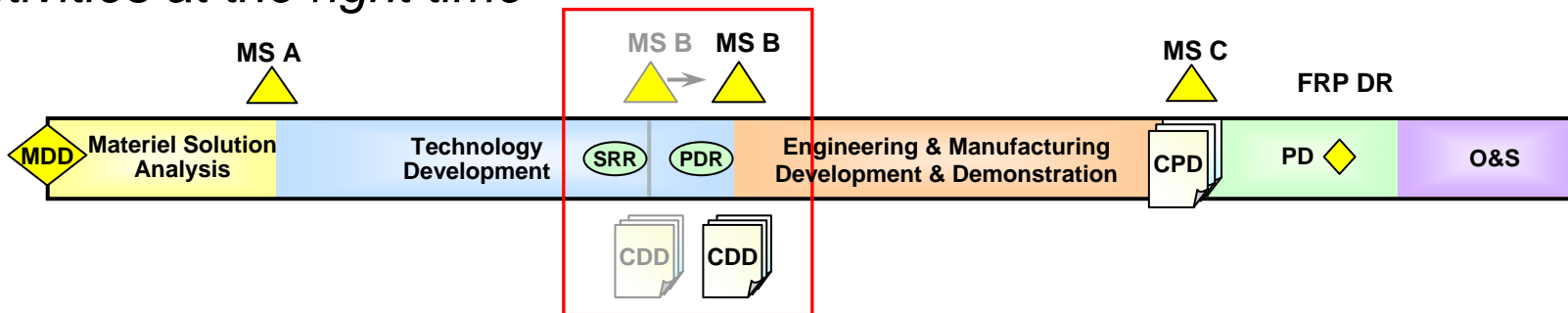
User Needs

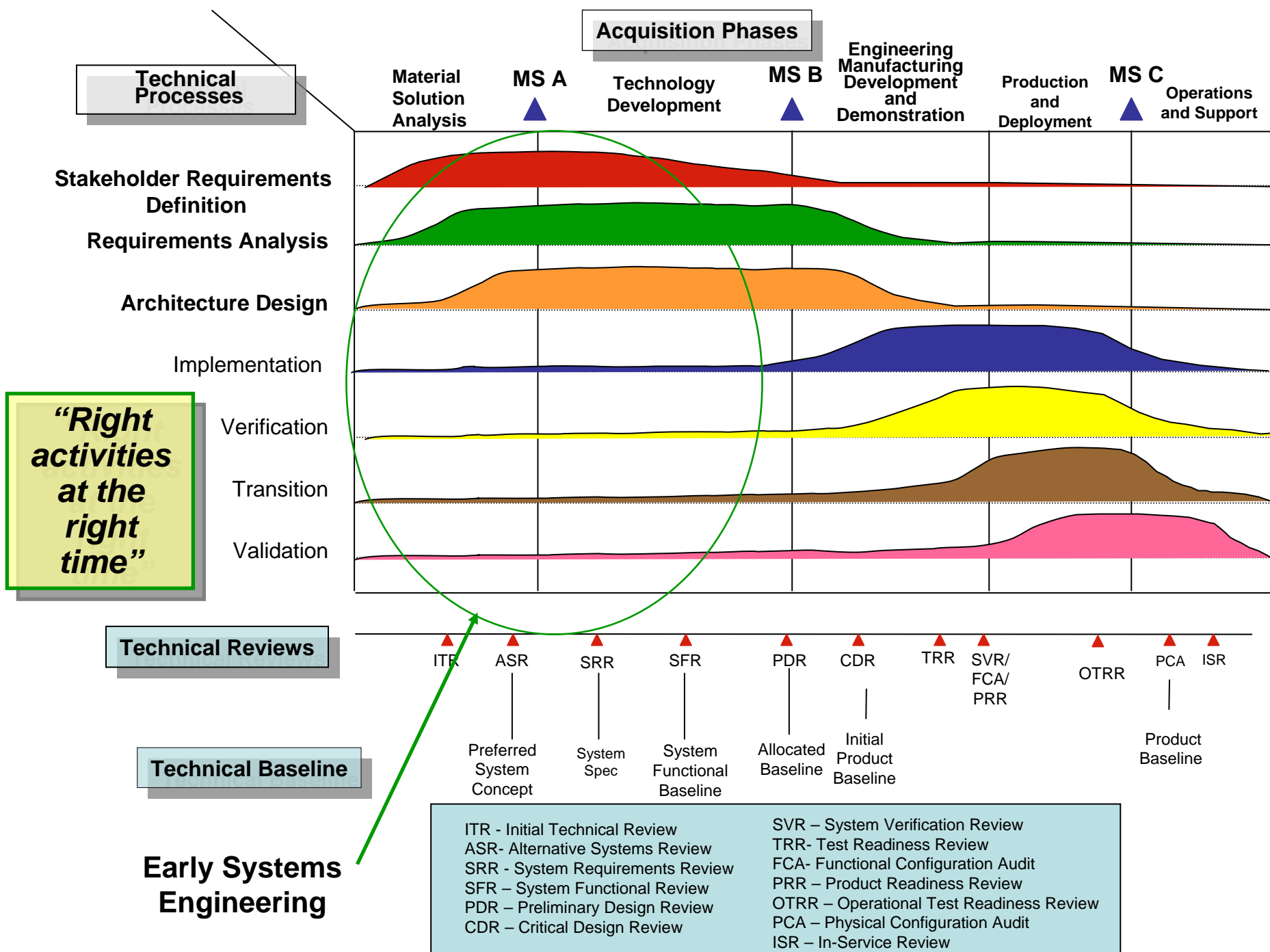
- Entrance criteria met before entering phase
- Evolutionary Acquisition or Single Step to Full Capability



Preliminary Design Review Precedes MS B

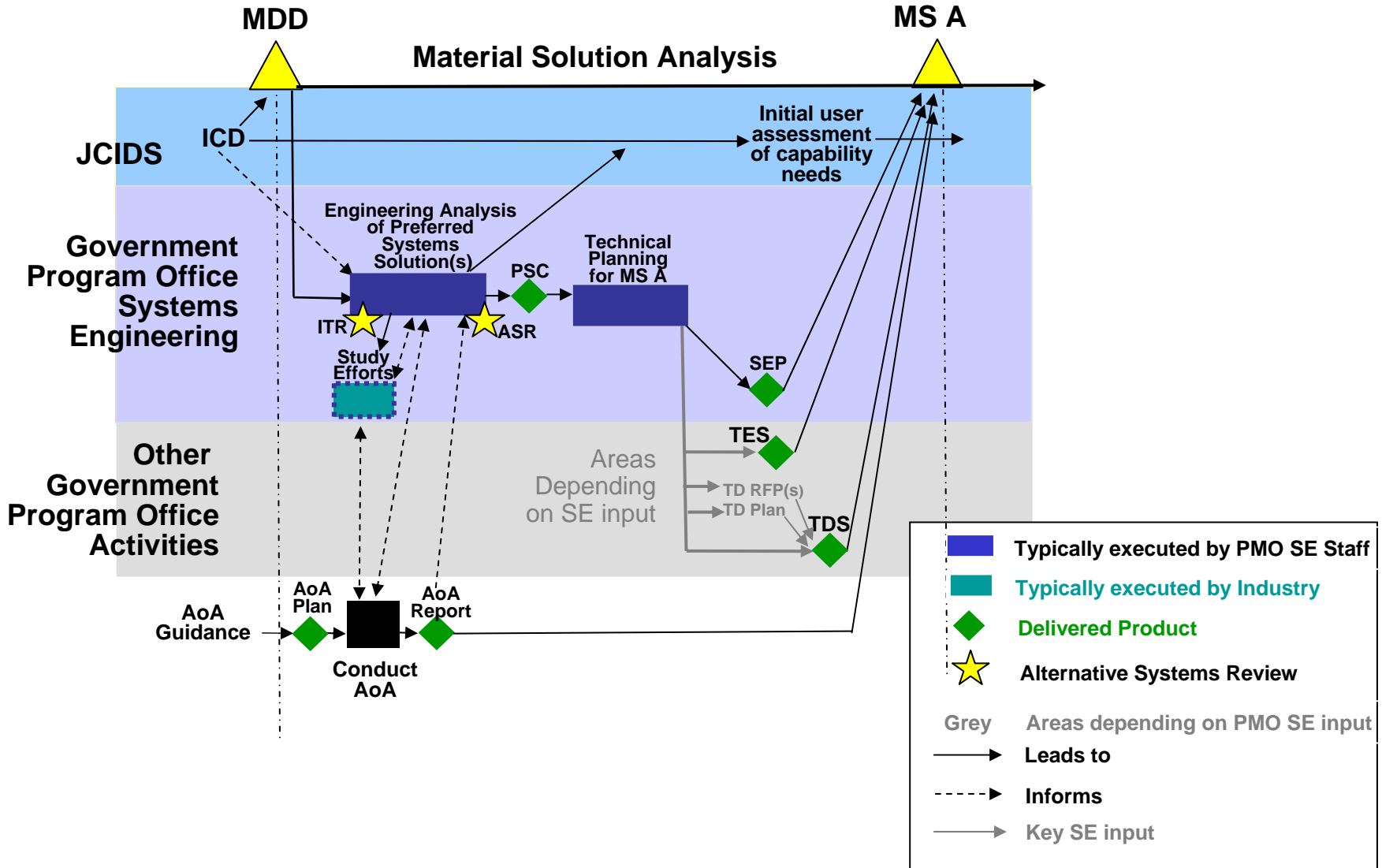
“Right activities at the right time”







Material Solution Analysis Phase





SE Activities During MSA Phase



Systems Engineering Processes/Documents/Plans

- Key Technical Processes
- Systems Engineering Plan (SEP)
- Test and Evaluation Strategy (TES)
- Analysis of Alternatives (AOA)
- Input to the Technology Development Strategy
- Input to the Cost Estimate

Assessments

- Program Support Review (PSR)

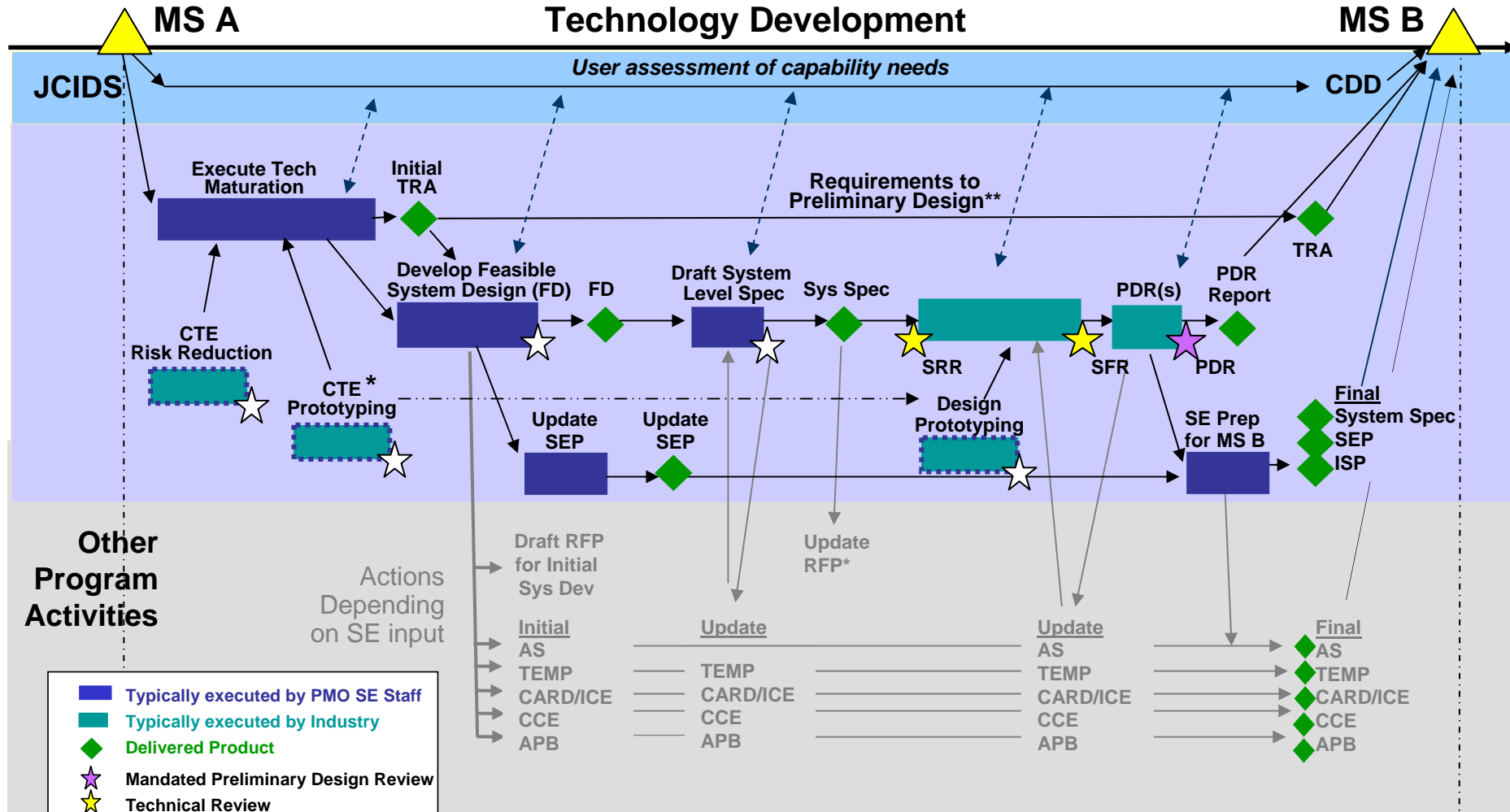
Technical Reviews

- Initial Technical Review (ITR)
- Alternative System Review (ASR)

SE COP (<https://acc.dau.mil/TechRevChklst>).



Technology Development Phase



- Typically executed by PMO SE Staff
- Typically executed by Industry
- Delivered Product
- Mandated Preliminary Design Review
- Technical Review
- Technical Assessment
- Grey Areas depending on PMO SE input
- Leads to
- Informs
- Key SE input

* Prototyping for CTE and for design may be independent efforts
 ** May vary with contracting strategy (e.g., multiple designs)



SE Activities During TD Phase



Systems Engineering Processes/Documents/Plans

- Key Technical Processes
- Competitive Prototyping
- Technology Maturation
- Test and Evaluation Master Plan (TEMP)
- Cost Analysis Requirements Description (CARD)
- Input to the Acquisition Program Baseline (APB)

Assessments

- Technology Readiness Assessment (TRA)
- Program Support Review (PSR)

Technical Reviews

- Systems Requirements Review (SRR)
- Systems Functional Review (SFR)
- Preliminary Design Review (PDR)

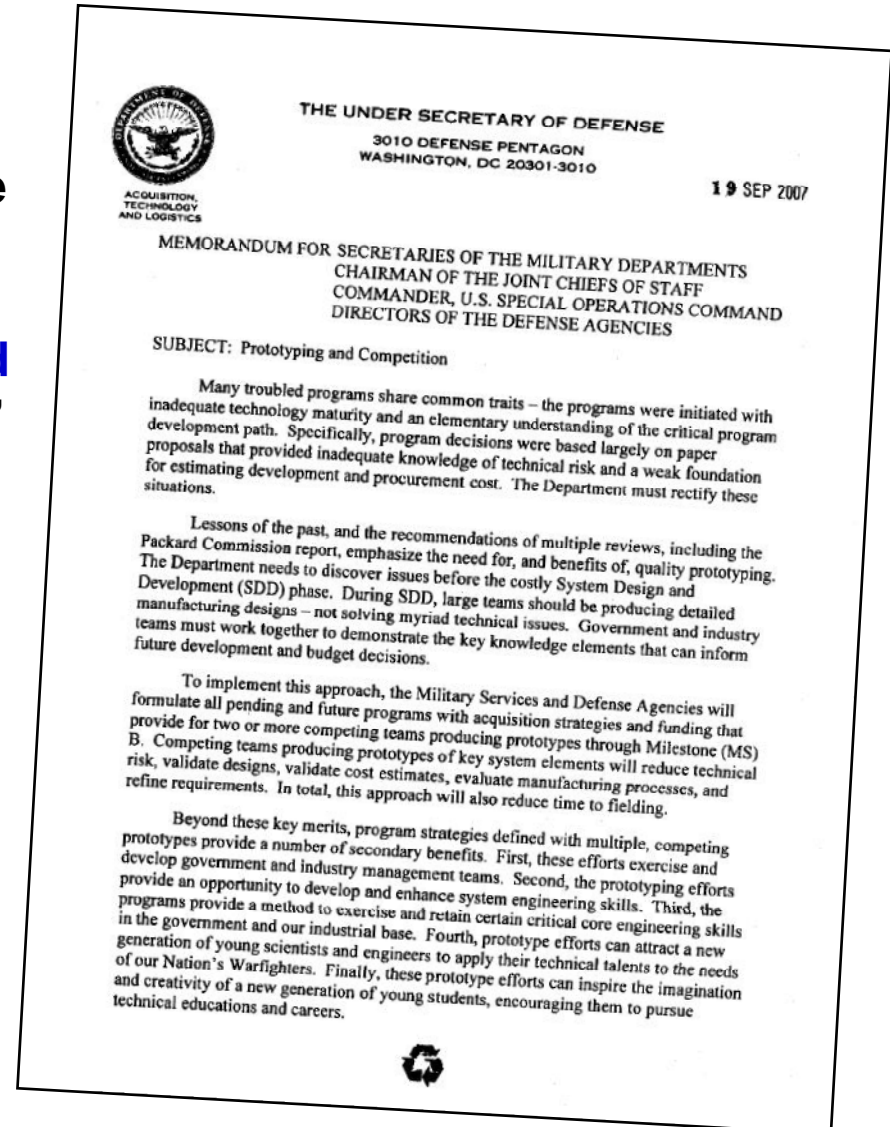


Prototyping and Competition

“... in the right way”

“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. . . .”

“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.”





Competitive Prototyping “Done in the Right Way”



- Need to know earlier on what will make the program successful and prototype that (i.e. challenges)
- Decide what is important – cost, integration, technology, etc – and determine how to measure / assess success
- Cost in prototyping should be a factor but the not dominant decision point
- Get domain experts to assist in determining what needs to be prototyped
- Do proof of concept but also to fill in the other holes
- Achieved at any level – system or key system elements (sub-system, assembly, or component)
- Prototype the critical path items first
- Need to spend money smartly up front – get smart at low burn rate



Enhanced Systems Engineering SE Design Consideration - RAM



Reliability, Availability, & Maintainability (RAM)

- Defense Science Board Report on DT&E (dtd May 08) recommended to improve RAM
- DoD Working Group formed to implement recommendations
- Reliability, Availability, and Maintainability Policy (dtd 21 Jul 08); Directs Components to set policy actions to ensure:
 - Collaboration in the establishment of RAM requirements
 - Development contracts and acquisition plans evaluate RAM during system design
 - Maturation of RAM throughout the acquisition life cycle
 - Use of contract incentives to achieve RAM goals

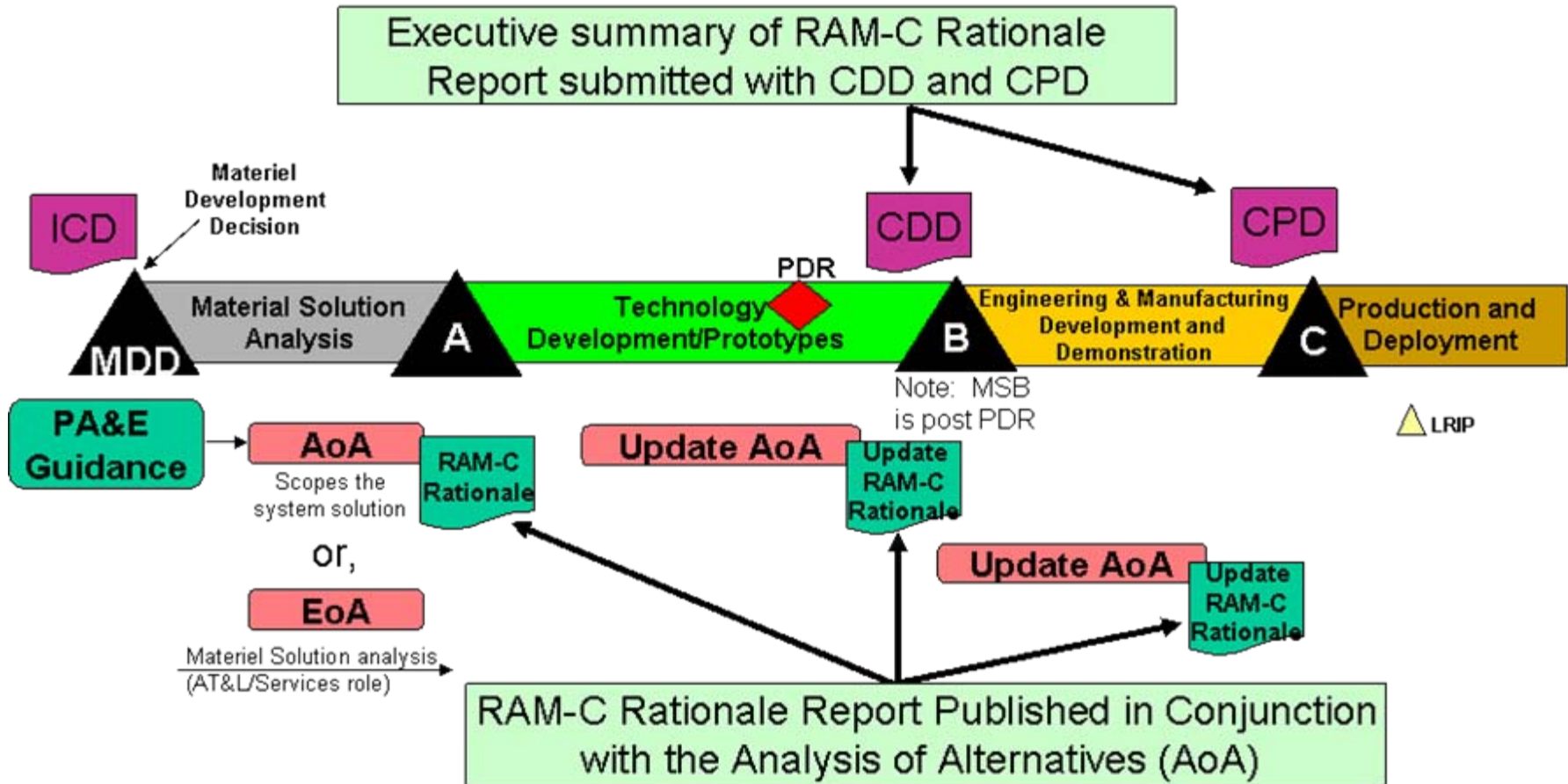
(<http://www.acq.osd.mil/sse/dte/docs/USD-ATLMemo-RAM-Policy-21Jul08.pdf>)



Implementing RAM-C



“ ... right activities at the right time ... ”





Implementing RAM-C

“... in the right way”

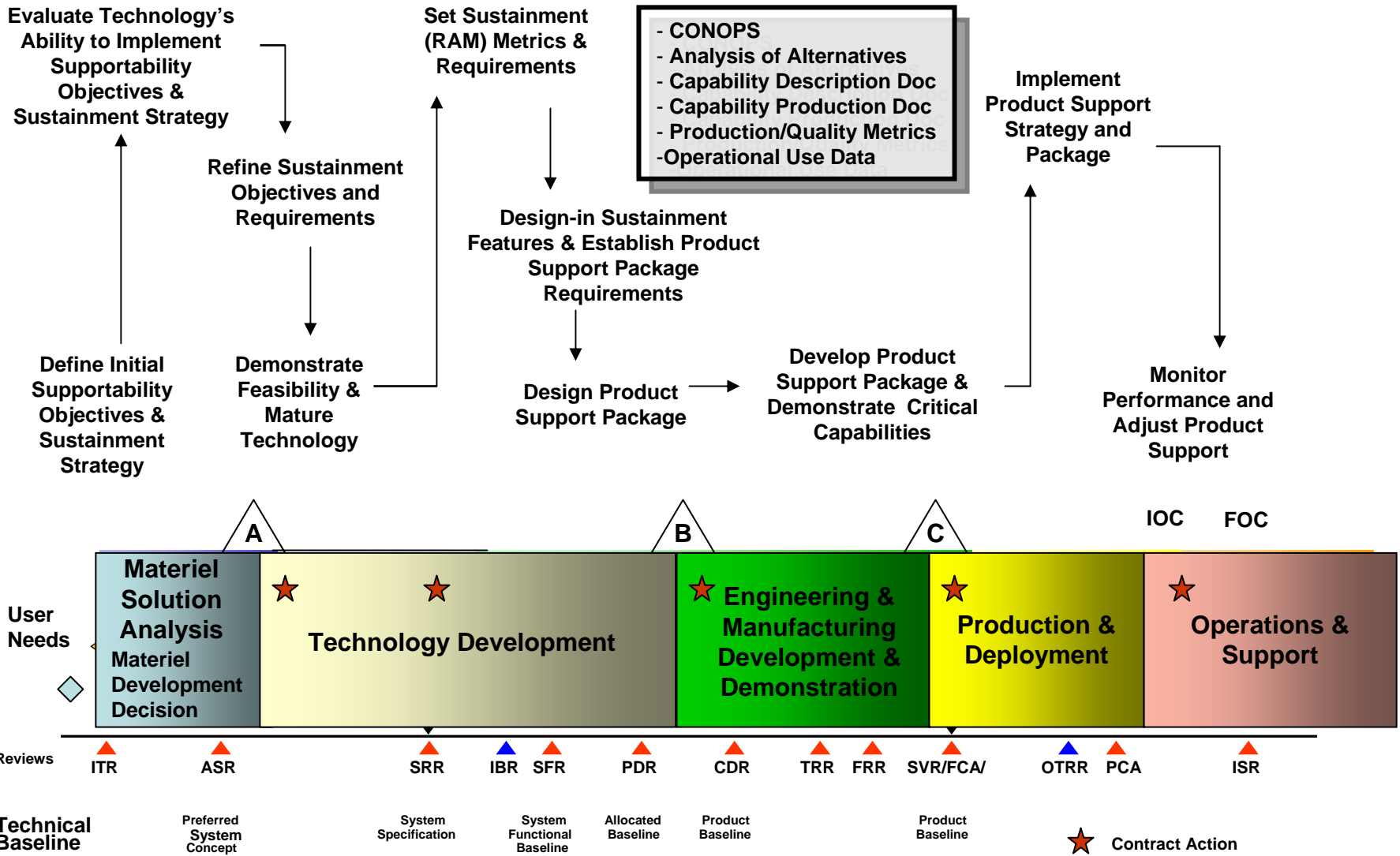


SE Design consideration “... in the right way”

- Template for Reliability Contract Language
 - Sections C, L, and M
 - Guidance on Performance Incentives for Reliability
- GEIA-STD-0009, Reliability Program Standard for Systems Design, Development, and Manufacturing
- RAM Planning Template by each Technical Review
- Evaluation Criteria (Reliability Program Detailed Scorecard) to assess a program
- Early T&E Involvement in RFP Development
- DoD Reliability, Availability, Maintainability and Cost Rationale Report Manual, October XX, 2008
(<http://www.acq.osd.mil/sse/dte/spec-studies.html>)

*“Having performance is important,
but not as important in most cases, as having reliability”*

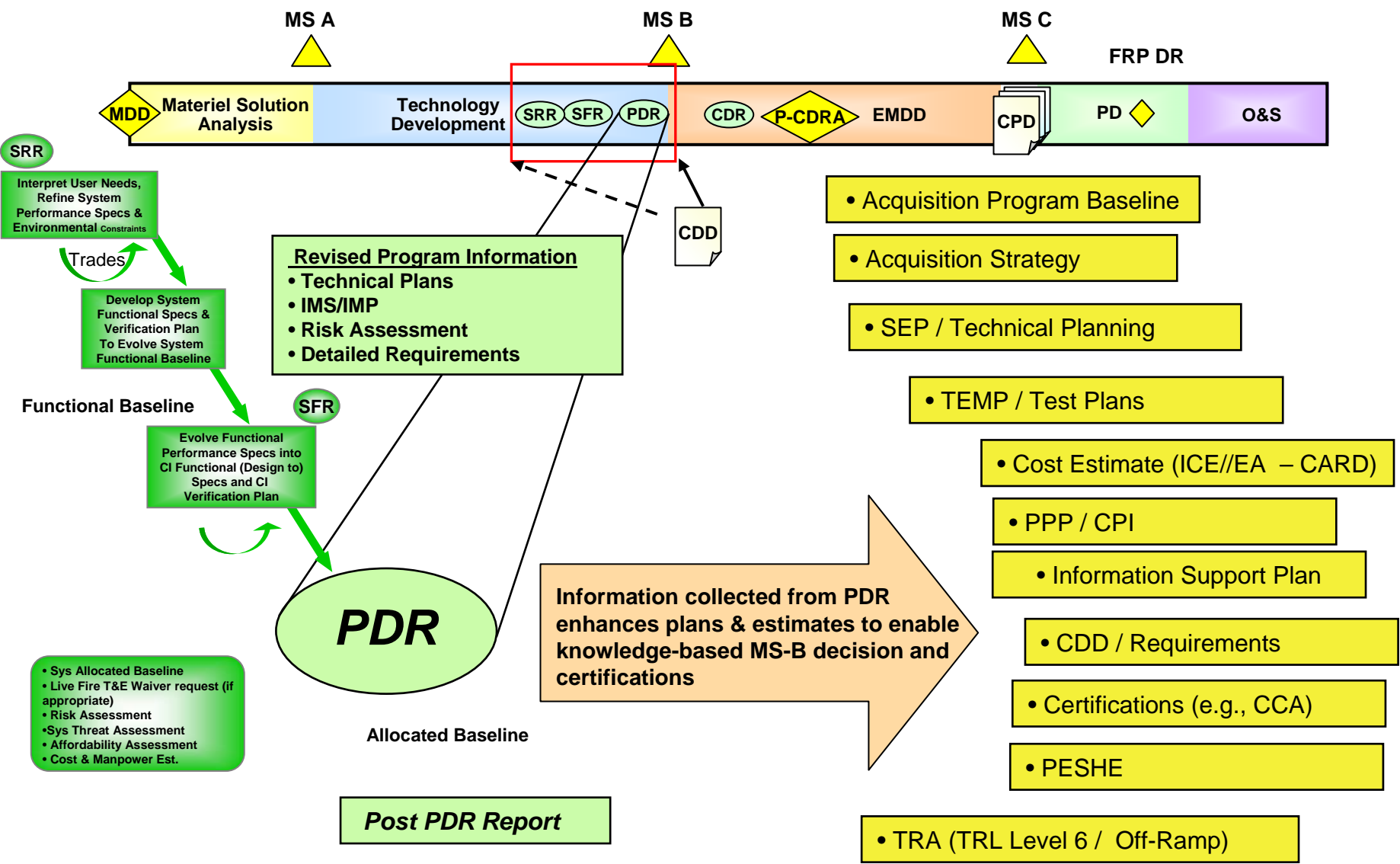
Life Cycle Logistics Flow (RAM)



RAM included in Systems Engineering Tech Reviews



Enhanced Role of PDR





PDR – “... in the right way”



- Certification and Accreditation activities scoped and identified
- Configuration Management Plan and procedures scoped and implemented
- Integrated Master Schedule showing Critical Path through Critical Design Review
- Software Development Plan scoped and documented at the Configuration Item level
- FMECA scheduled to support System Hazard Analysis
- Modeling and Simulation role in testing and life cycle planning scoped
- Representative mission profiles finalized



PDR – “... in the right way”



(Continued)

- Engineering data requirements needed from testing identified
- Data element identification procedures established – IDE procedures established
- Test Verification Matrix covering subsystem allocations
- Physical properties (i.e., weight, power, cooling, etc.) allocated to subsystems
- Human Systems Integration design standards flowed to subsystems
- R&M diagnostics addressed in design allocations
- Interface Control Documents between subsystems completed



PDR Report to MDA



DRAFT PDR Report Guidance to require the following:

- A comprehensive list of the systems engineering products that make up the Allocated Baseline, per the PDR review,
- A list of the participants in the review. including the independent (of the program) chair, applicable technical authorities, independent subject matter experts, membership of the Technical Review Board, and other key stakeholders,
- A summary of the Action Items and their closure status/plan
- A resulting risk assessment using a PDR risk assessment checklist and readiness to commit to full detail design,
- A recommendation from the PDR as to the approval of the program's system Allocated Baseline to support detail design.

Proposed Source: DAG para 4.3.2.4.2.3



Enhanced SE Provides key information for the MS B Decision



Enhanced SE contributes to key MS B prerequisites

- Acquisition Strategy (including core logistics analysis/source of repair; cooperative opportunity; etc.)
- Independent Cost Estimate
- Cost Analysis Requirements Description (CARD)
- Manpower estimate
- Acquisition Program Baseline
- Analysis of Alternatives
- System Threat Assessment
- Technology Readiness Assessment (TRA)
- Affordability Assessment
- Selected Acquisition Report (SAR)
- SEP, TEMP, Program Protection Plan, and PESHE
- Clinger-Cohan Act compliance



Enhanced SE Summary



Enhanced Systems Engineering is the lynchpin to start programs right!

- Early SE in support of MDD, MS A, and B
- SE activities in support of Technical Reviews and essential program planning efforts
- Implementing SEin the right way
 - Competitive Prototyping
 - Reliability, Availability, Maintainability – Cost implementation

“Implementing the right activities at the right time in the right way”

Defense Acquisition Guidebook (DAG) (<http://akss.dau.mil/dag/>)
The Systems Engineering Community of Practice
(<https://acc.dau.mil/CommunityBrowser.aspx?id=17608>);



Backup



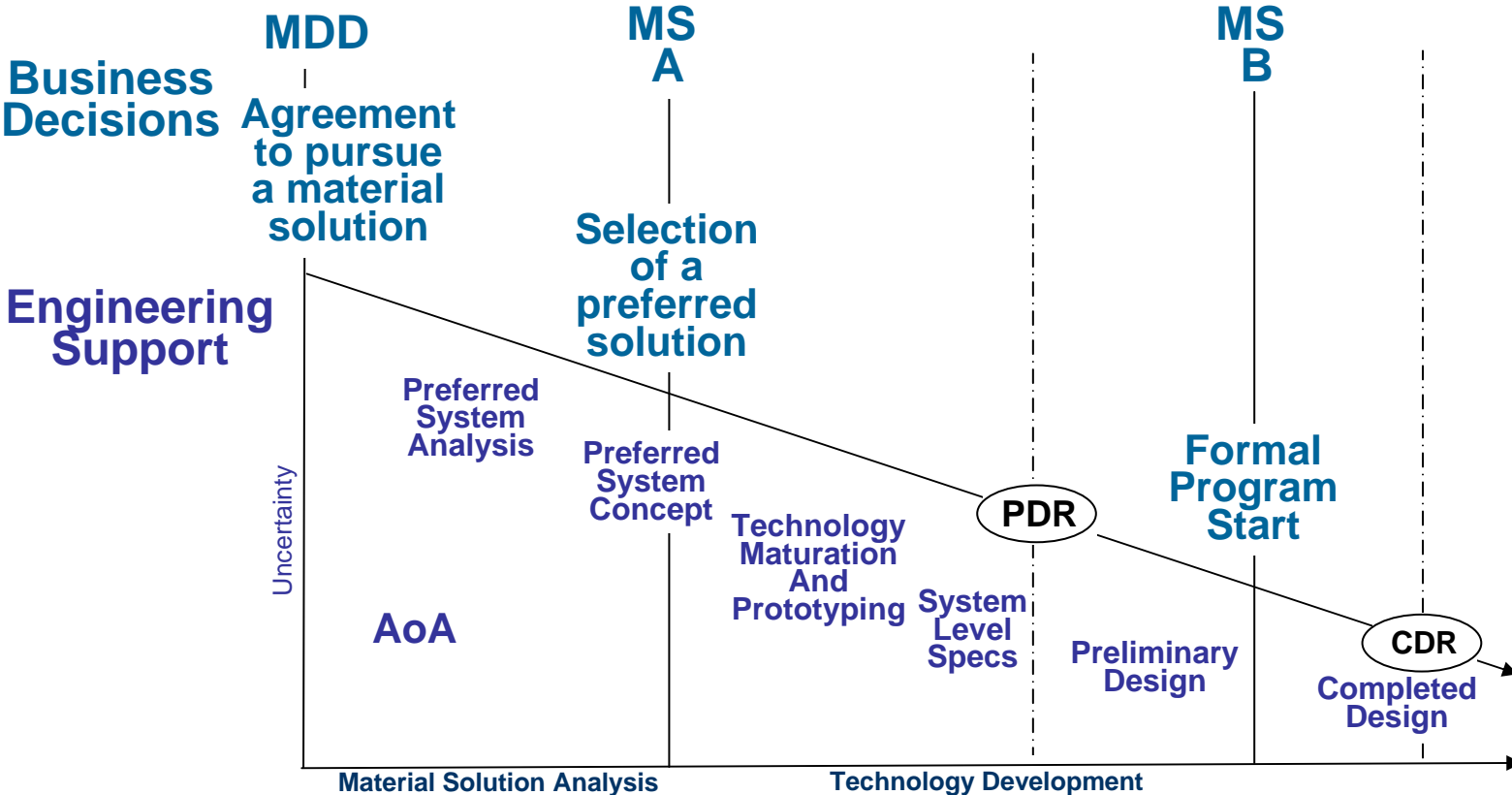
RAM Improvement Efforts



- Some RAM Pitfalls to avoid when executing a sound systems engineering process include:
 - Inadequate planning for reliability and maintainability
 - Failure to identify mission context or intended use profile when stating RAM requirements
 - Failure to design-in reliability early
 - Reliance on predictions instead of design analysis
 - Inadequate lower level testing
 - Lack of proper planning, managing, and executing reliability growth activities, and
 - Lack of reliability incentives



SE Provides a Technical Foundation for Acquisition

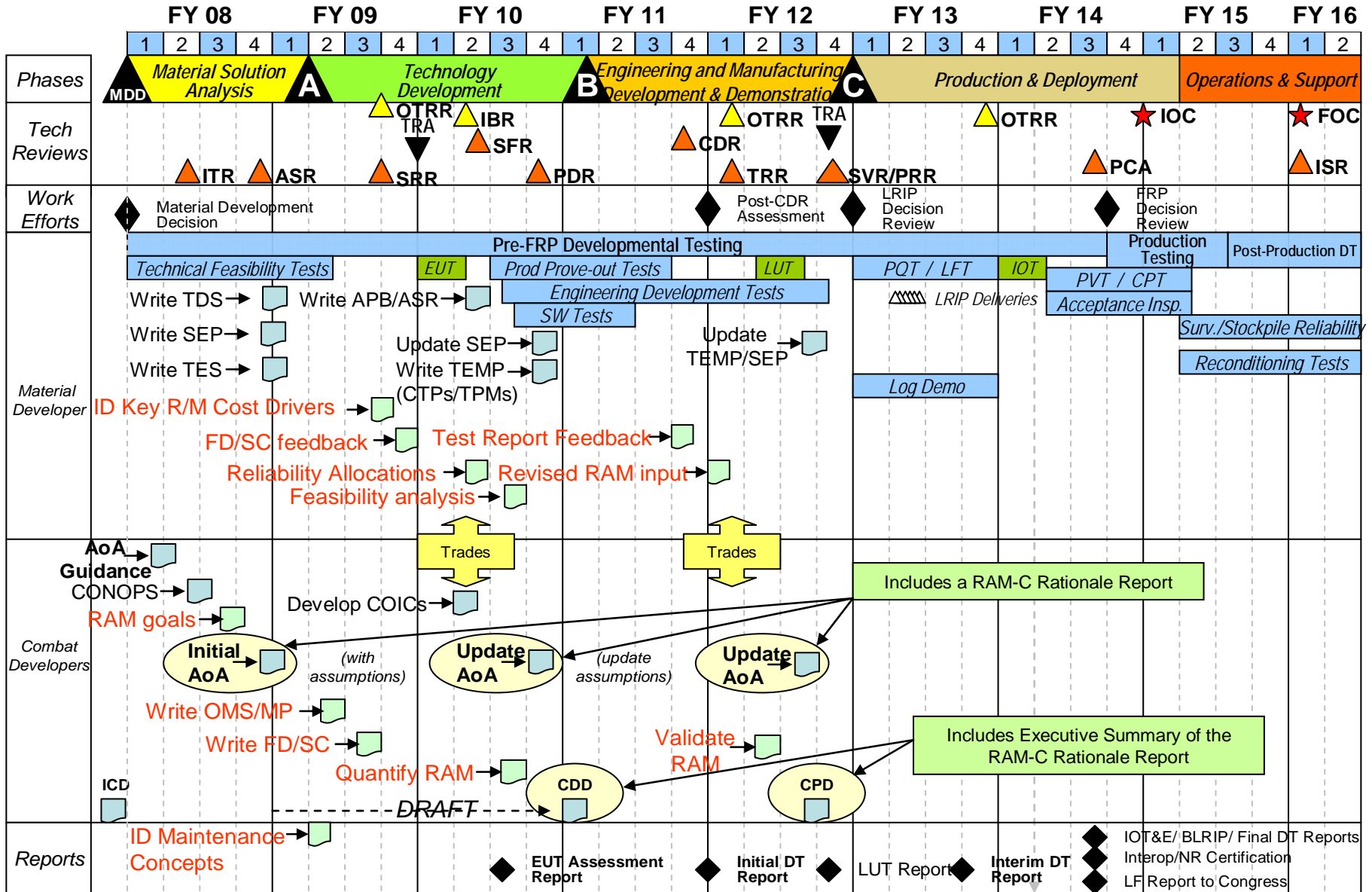


National Research Council

“Pre-Milestone A and Early-Phase Systems Engineering”
Jan 2008

Systems Engineering is most effective when it initiated early to start a program right!

RAM-C Activities



■ DT
 ■ OT
 ▲ Software Build/LRIP Delivery
 ▲ Tech Reviews
 ▲ Program Reviews
 ▼ Technology Readiness Assessment

Pre-Milestone B Sustainment Requirement Process

