Early Systems Engineering to Achieve MS B

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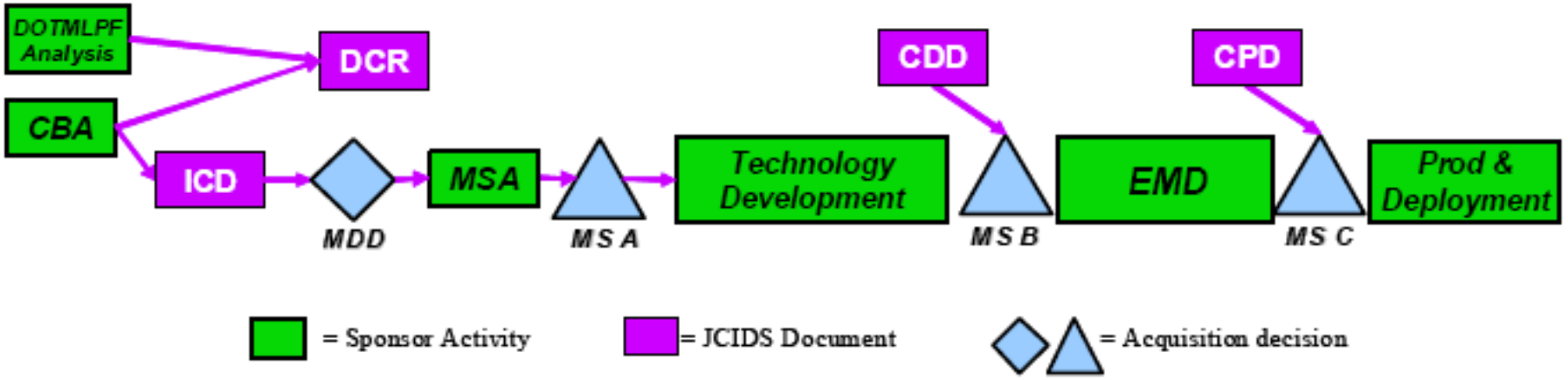
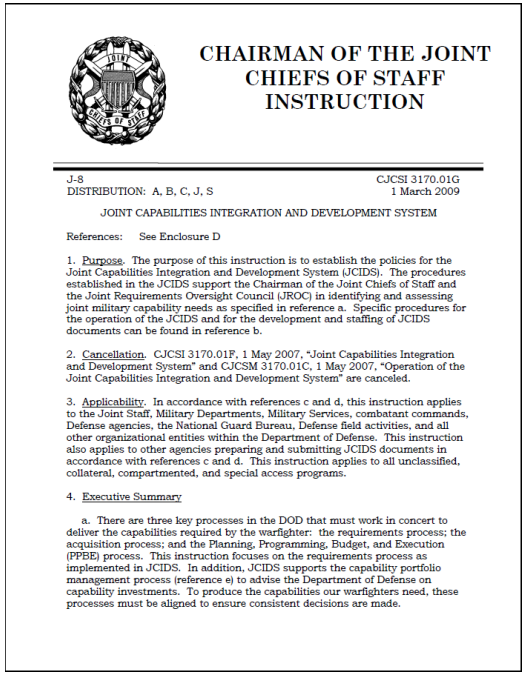
Early Systems Engineering Ground Rules

- **Begins With MDD Decision**
- **Product Focused Approach**
- **Must Involve Engineers**
  - **Requirements Stability Is Outcome Of Early SE**
- **Must Demonstrate Achievable Technology**
  - **Requires TRL 6 Prior To MS B**
  - **Engineering Theory Pushed To Real World Capability**
- **Achieve Low Technical Risk**
  - **Medium Cost & Schedule Risk Environment**
- **Must Balance Cost, Schedule, & Performance**
- **Must Identify Sub-Systems Prior To MS-B**
- **CDD Finalized Just Prior To MS-B**

DOTMLPF Analysis





CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

J-8 CJCSI 3170.01G
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JOINT CAPABILITIES INTEGRATION AND DEVELOPMENT SYSTEM

References: See Enclosure D

1. Purpose. The purpose of this instruction is to establish the policies for the Joint Capabilities Integration and Development System (JCIDS). The procedures established in the JCIDS support the Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council (JROC) in identifying and assessing joint military capability needs as specified in reference a. Specific procedures for the operation of the JCIDS and for the development and staffing of JCIDS documents can be found in reference b.

2. Cancellation. CJCSI 3170.01F, 1 May 2007, "Joint Capabilities Integration and Development System" and CJCSM 3170.01C, 1 May 2007, "Operation of the Joint Capabilities Integration and Development System" are canceled.

3. Applicability. In accordance with references c and d, this instruction applies to the Joint Staff, Military Departments, Military Services, combatant commands, Defense agencies, the National Guard Bureau, Defense field activities, and all other organizational entities within the Department of Defense. This instruction also applies to other agencies preparing and submitting JCIDS documents in accordance with references c and d. This instruction applies to all unclassified, collateral, compartmented, and special access programs.

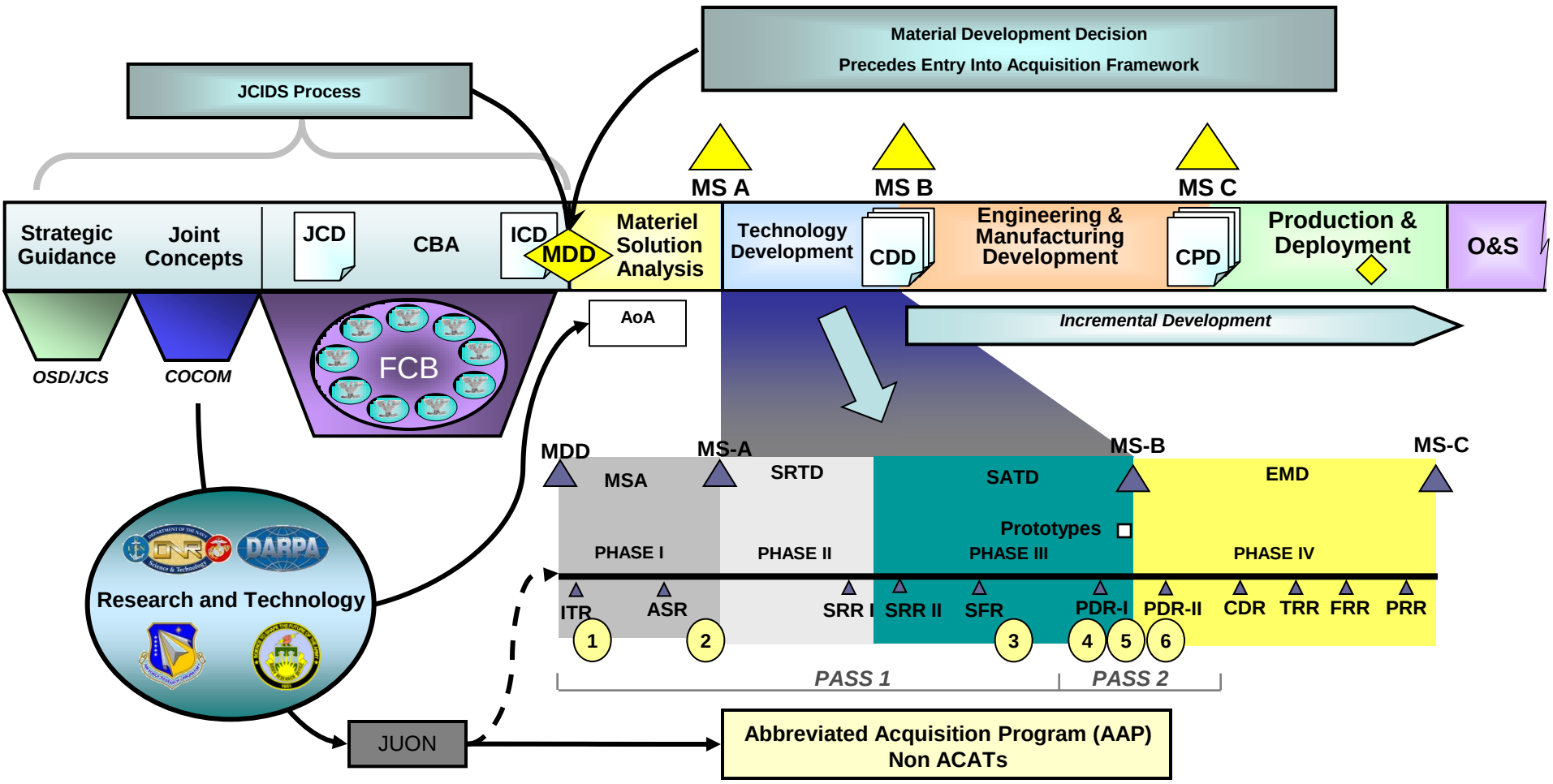
4. Executive Summary

a. There are three key processes in the DOD that must work in concert to deliver the capabilities required by the warfighter: the requirements process; the acquisition process; and the Planning, Programming, Budget, and Execution (PPBE) process. This instruction focuses on the requirements process as implemented in JCIDS. In addition, JCIDS supports the capability portfolio management process (reference e) to advise the Department of Defense on capability investments. To produce the capabilities our warfighters need, these processes must be aligned to ensure consistent decisions are made.

CJCSI 3170.01G Enclosure A

… ***When a materiel solution is required*** by an approved ICD, the milestone decision authority (MDA) determines the scope of the subsequent analysis of alternatives (AoA), the appropriate entrance milestone, and designates the lead component(s) in a Materiel Development Decision (MDD). ***The purpose of the Materiel Solution Analysis (MSA) phase is to assess potential materiel solutions*** and to satisfy the entrance criteria for the next program milestone as designated by the MDA. If the next phase per the MDA is Milestone (MS) A, then the ICD along with the results of the AoA form the basis for the MS A decision.

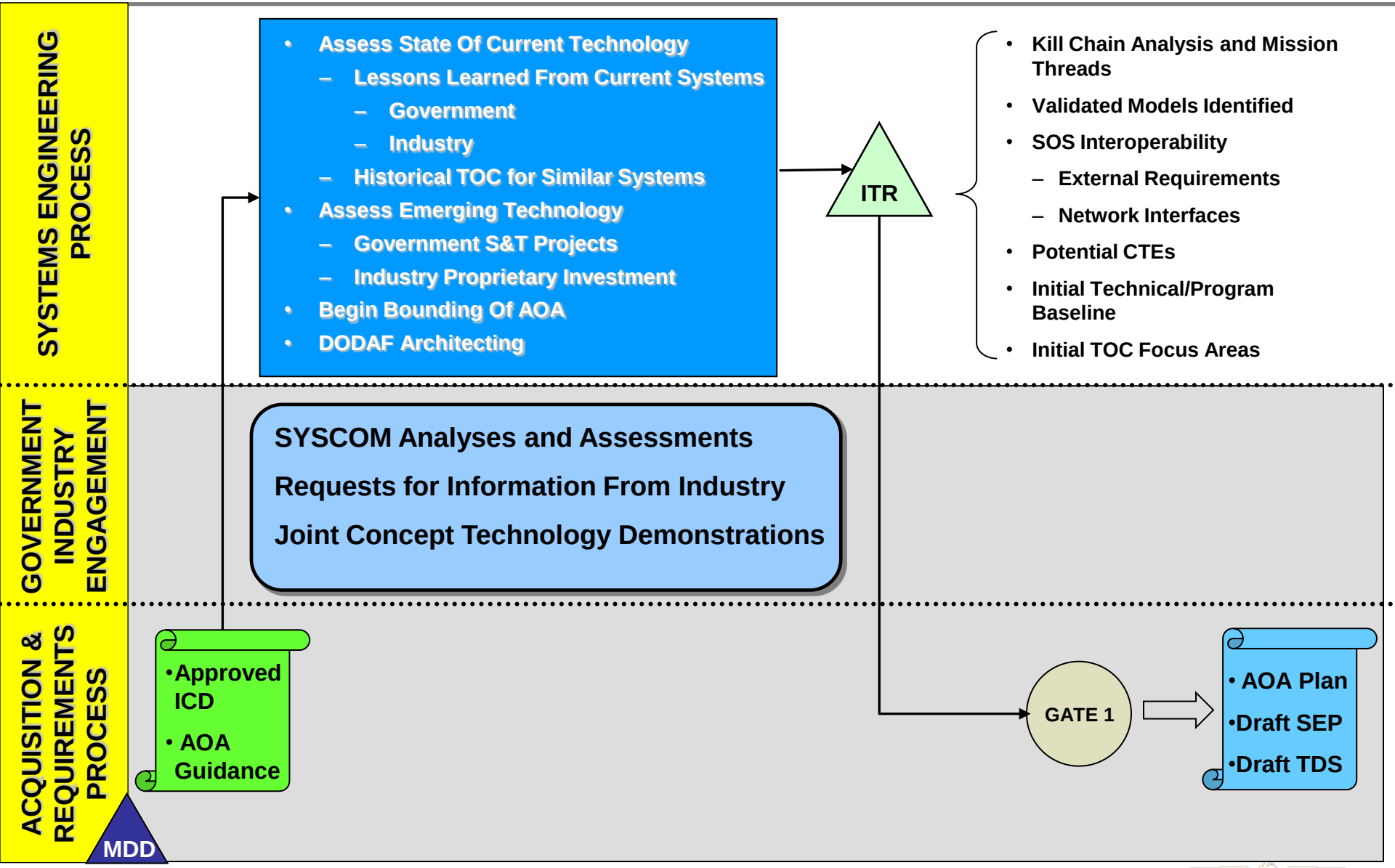
NAVAIR Engineering Process



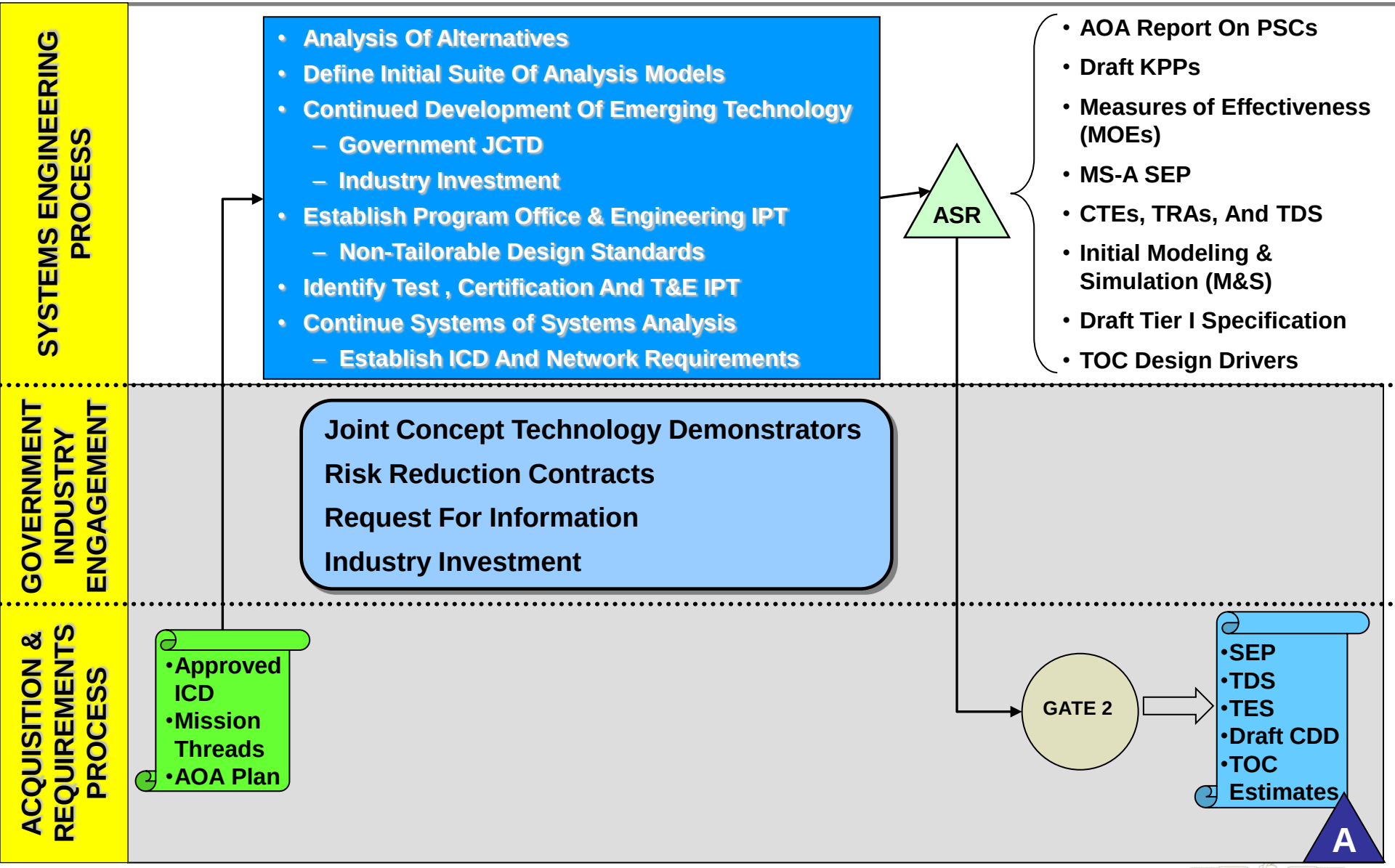
NAVAIR 4 Phase SE Process

- **Phase I – Materiel Solution Analysis (MSA)**
  - Establish initial set of Operational Capabilities and resolve to a Candidate Materiel Solution (aviation, ship, ground)
  - Broad focus to ensure all types of solutions receive appropriate consideration
  - Maximize leverage of gov't and industry knowledge base
- **Phase II – System Requirements & Technology Development (SRTD)**
  - Establish system performance requirements and detailed CONOPS
  - Develop critical technologies to support engineering final product
  - Relatively broad focus to maximize leverage of emerging technologies (stay ahead of the threat)
- **Phase III – System Architecture & Technology Demonstration (SATD)**
  - Complete the system architecture – requirements derivation and decomposition to subsystems
  - Demonstrate maturity of critical technologies
  - Narrowing focus down to a complete system architecture and preliminary design while allowing for optimization against cost and schedule
- **Phase IV –Engineering and Manufacturing Development (EMD)**
  - Complete the design, development and verification
  - Deliver the compliant weapon system to Operational Test/IOC

Phase I: MSA


SYSTEMS ENGINEERING PROCESS
GOVERNMENT INDUSTRY ENGAGEMENT
ACQUISITION & REQUIREMENTS PROCESS
• Assess State Of Current Technology
– Lessons Learned From Current Systems
– Government
– Industry
– Historical TOC for Similar Systems
• Assess Emerging Technology
– Government S&T Projects
– Industry Proprietary Investment
• Begin Bounding Of AOA
• DODAF Architecting
ITR
• Kill Chain Analysis and Mission Threads
• Validated Models Identified
• SOS Interoperability
– External Requirements
– Network Interfaces
• Potential CTEs
• Initial Technical/Program Baseline
• Initial TOC Focus Areas
SYSCOM Analyses and Assessments
Requests for Information From Industry
Joint Concept Technology Demonstrations
•Approved ICD
• AOA Guidance
MDD
GATE 1
• AOA Plan
•Draft SEP
•Draft TDS

Phase I: AOA


SYSTEMS ENGINEERING PROCESS
GOVERNMENT INDUSTRY ENGAGEMENT
ACQUISITION & REQUIREMENTS PROCESS
• Analysis Of Alternatives
• Define Initial Suite Of Analysis Models
• Continued Development Of Emerging Technology
– Government JCTD
– Industry Investment
• Establish Program Office & Engineering IPT
– Non-Tailorable Design Standards
• Identify Test , Certification And T&E IPT
• Continue Systems of Systems Analysis
– Establish ICD And Network Requirements
ASR
• AOA Report On PSCs
• Draft KPPs
• Measures of Effectiveness (MOEs)
• MS-A SEP
• CTEs, TRAs, And TDS
• Initial Modeling & Simulation (M&S)
• Draft Tier I Specification
• TOC Design Drivers
Joint Concept Technology Demonstrators
Risk Reduction Contracts
Request For Information
Industry Investment
•Approved ICD
•Mission Threads
•AOA Plan
GATE 2
•SEP
•TDS
•TES
•Draft CDD
•TOC Estimates
A

Phase II: TD Phase RFP

SYSTEMS ENGINEERING PROCESS

- Translation Of Draft CDD Into Tier I Specification By SMEs
  - Clearly Identify Design Standards
  - Define Certification Standards
- Technology Development Of CTEs
  - Required To Set Performance Thresholds
  - Establish Prototype Demo Requirements
- Establish Draft MS B Source Selection Criteria
  - Criteria For Design Evaluation In TD Phase

SRR-I

- Tier I Specification
- Draft CDD To Specification Traceability
- MOEs and MOPs
- Non-Tailorable Design Requirements
- Certification Requirements Defined
- Objective Trade Space Defined

GOVERNMENT INDUSTRY ENGAGEMENT

Joint Concept Technology Demonstrators
Risk Reduction Contracts
Request For Information
Industry Investment

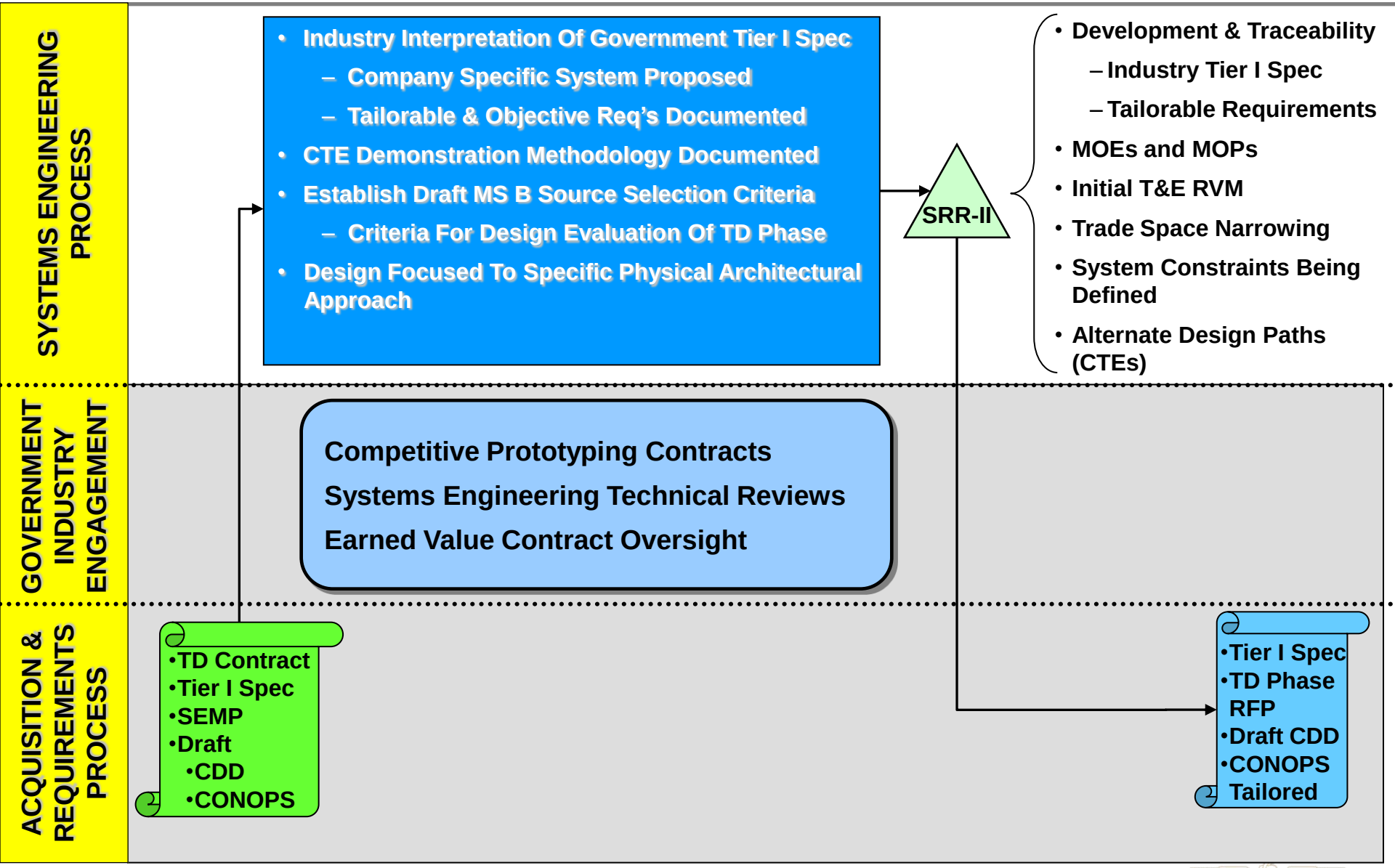
ACQUISITION & REQUIREMENTS PROCESS

- SEP
- TDS
- Draft
  - CDD
  - CONOPS
- TES

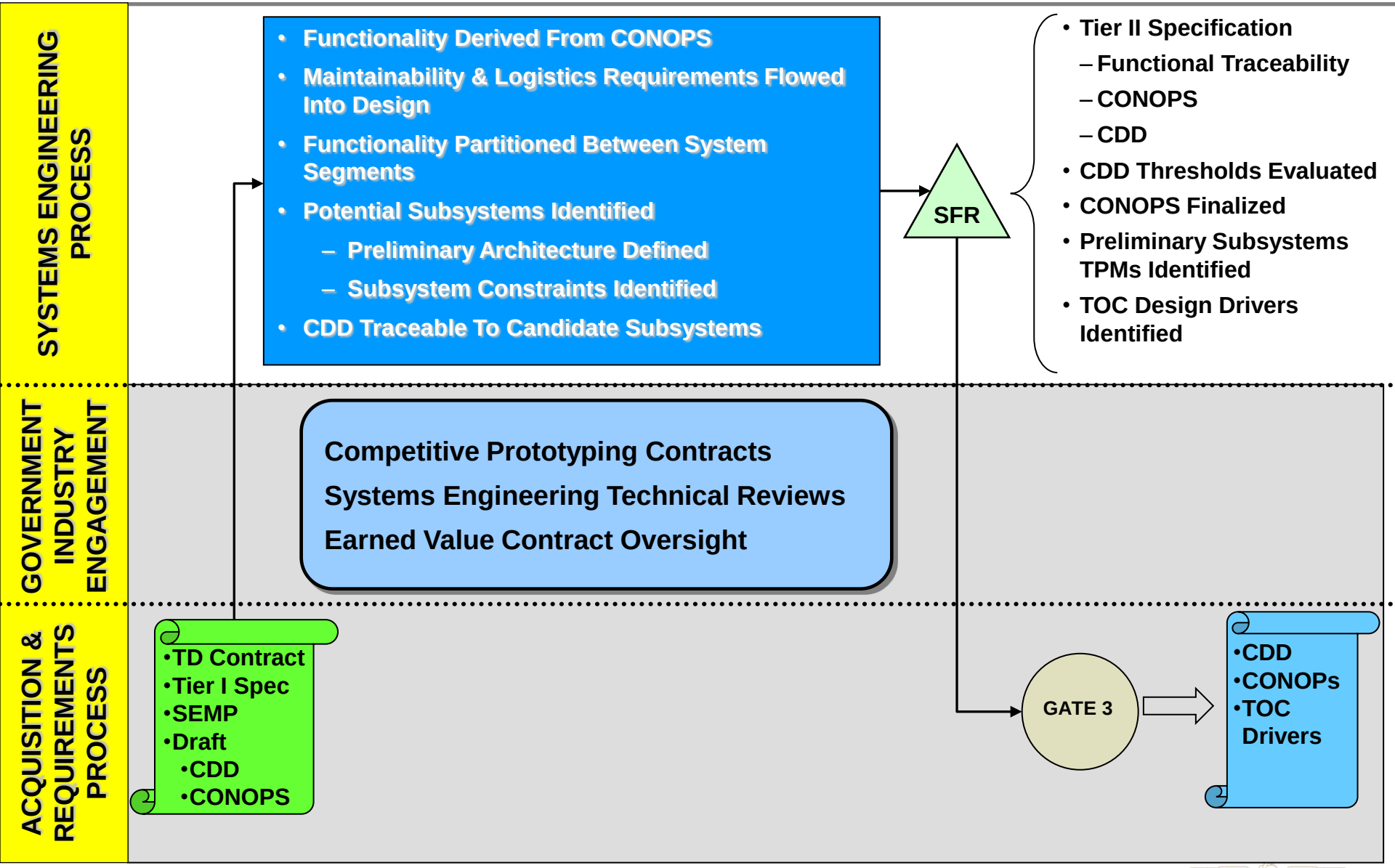
A

- Tier I Spec
- TD Phase RFP
- Draft CDD

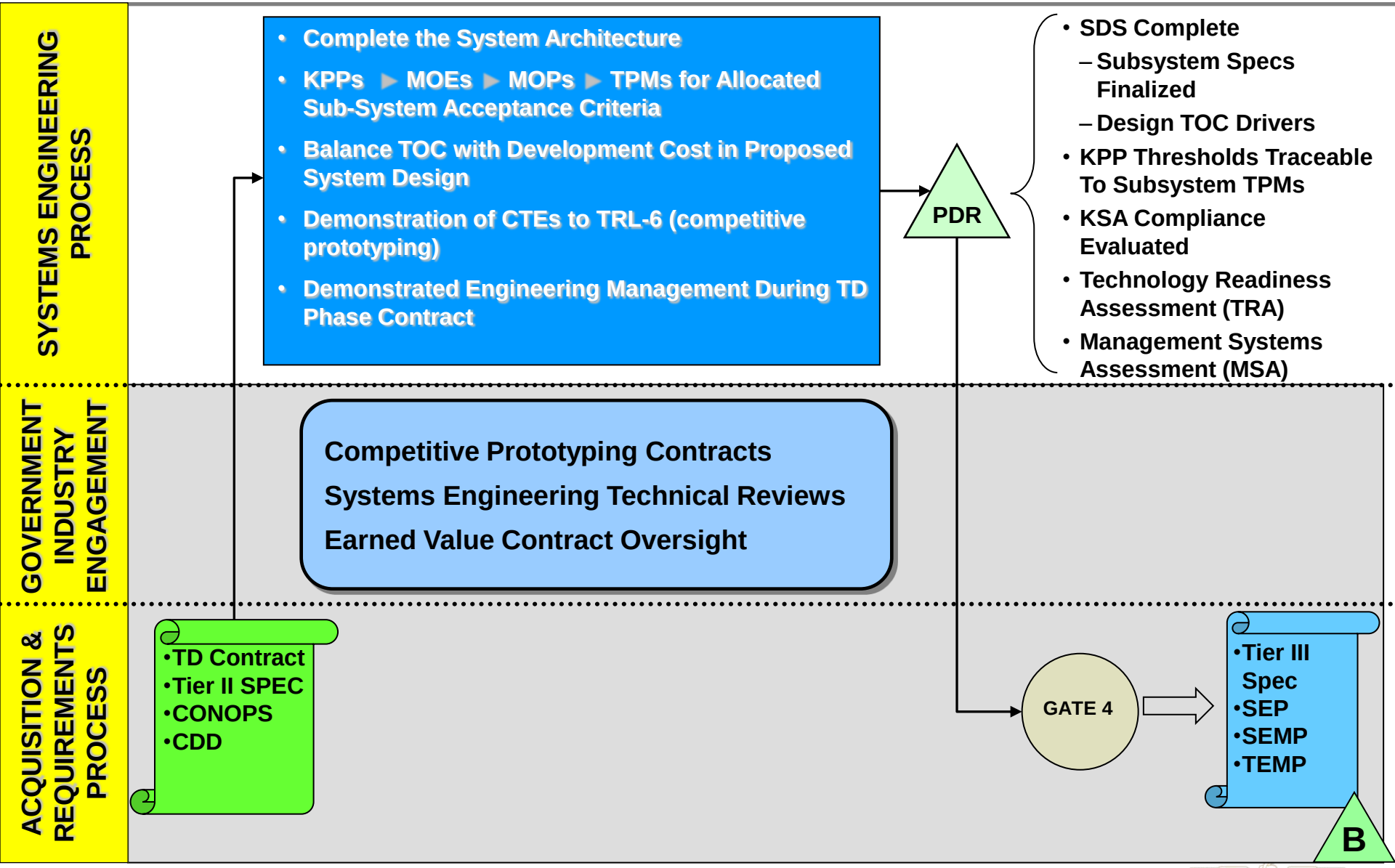
Phase III: Tailored PSCs



Phase III: Finalize CDD



Phase III: Pre-MS B PDR



Controlling Program Inertia

- **Recognize MS B As True Decision Point**
  - **Only 3-5% Of TOC Expended By MS B**
  - **95% Of System Money Leveraged At MS B**
- **Not All Sunk Costs Are Wasted**
  - **Technology Developed And Demonstrated**
  - **Potential Weapon Systems Architectures Explored**
  - **Demonstrated Performance vice Previous CPRs**
- **Underlying System Engineering Approach Sound**

"If you find yourself in a hole, the first thing to do is stop digging"

– Will Rogers

Summary

- **Early Systems Engineering Is The Front End Of The Traditional Tried & True SE Process**
- **Aligning Business And Acquisition Decisions**
  - **Decisions Are Based On Depth Of Knowledge**
  - **Stability Is Output Of Systems Engineering Not The Input**
  - **PDR Is The First Physical Manifestation Of A System In Development**
- **Evolving Guidance**
  - **To Shorten Post MDD Development Move Engineering Timeline To Left**
    - **MDD "the old MS-A?"**
  - **Technology Development Timelines Unpredictable**
    - **Existing Technology Deploys Quicker**