Revitalizing SE: Our Path Forward

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Systems and Software Engineering
Office of the Deputy Under Secretary of Defense (A&T)
20 October 2008

OUSD (AT&L) Organization

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                    │   USD, Acquisition      │
                    │  Technology & Logistics │
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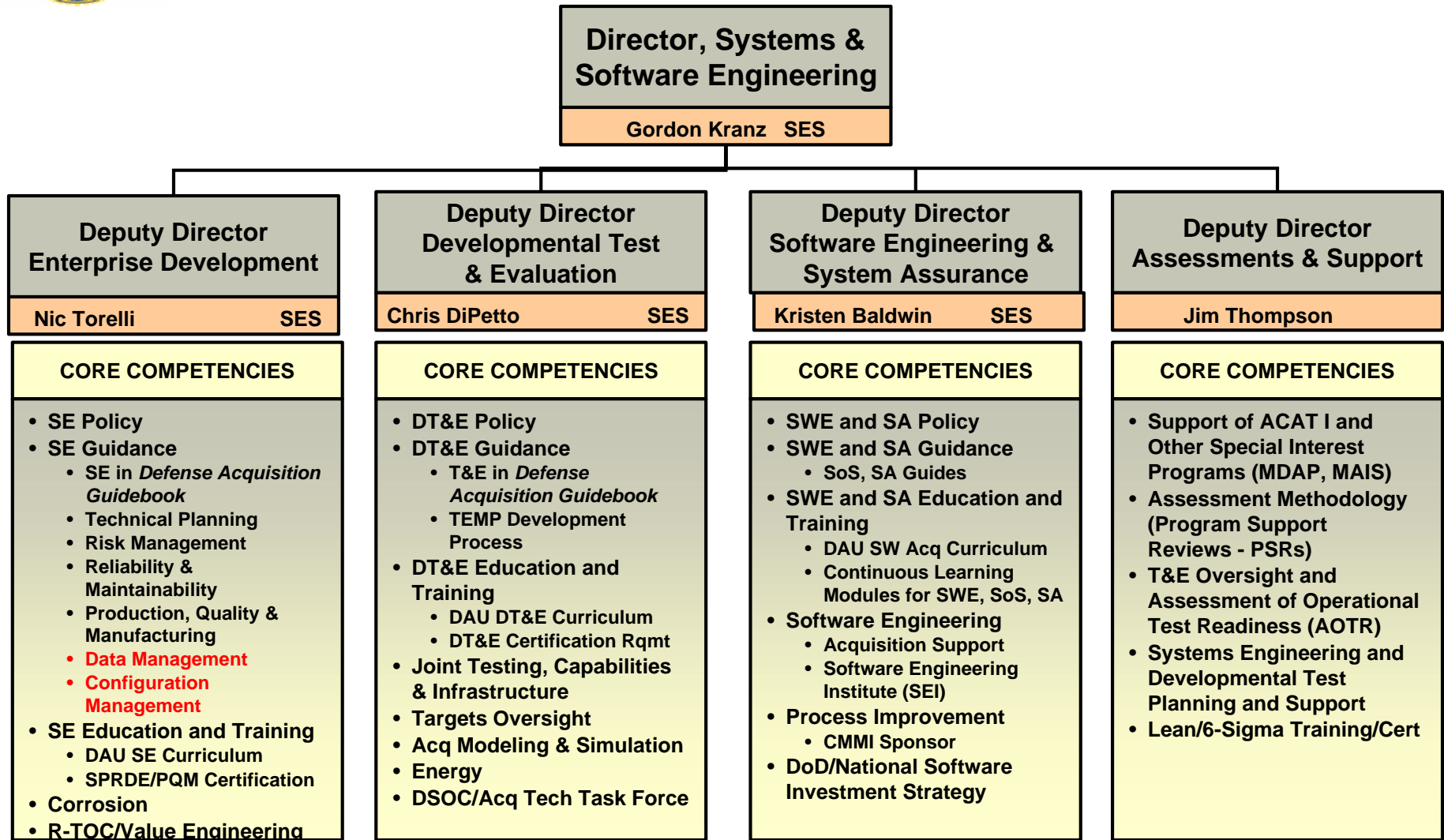| Dir, Joint Advanced Concepts | **Dir, Systems and Software Engineering** | Dir, Portfolio Systems Acquisition | Defense Acquisition University |

| Defense Procurement and Acquisition Policy | Industrial Programs | Small Business Programs | Defense Contract Management Agency |

Systems and Software Engineering
Organizational Core Competencies

Director, Systems & Software Engineering

Gordon Kranz   SES

Deputy Director Enterprise Development	**Deputy Director Developmental Test & Evaluation**	**Deputy Director Software Engineering & System Assurance**	**Deputy Director Assessments & Support**
Nic Torelli SES	Chris DiPetto SES	Kristen Baldwin SES	Jim Thompson
CORE COMPETENCIES	**CORE COMPETENCIES**	**CORE COMPETENCIES**	**CORE COMPETENCIES**
• SE Policy • SE Guidance • SE in *Defense Acquisition Guidebook* • Technical Planning • Risk Management • Reliability & Maintainability • Production, Quality & Manufacturing • Data Management • Configuration Management • SE Education and Training • DAU SE Curriculum • SPRDE/PQM Certification • Corrosion • R-TOC/Value Engineering	• DT&E Policy • DT&E Guidance • T&E in *Defense Acquisition Guidebook* • TEMP Development Process • DT&E Education and Training • DAU DT&E Curriculum • DT&E Certification Rqmt • Joint Testing, Capabilities & Infrastructure • Targets Oversight • Acq Modeling & Simulation • Energy • DSOC/Acq Tech Task Force	• SWE and SA Policy • SWE and SA Guidance • SoS, SA Guides • SWE and SA Education and Training • DAU SW Acq Curriculum • Continuous Learning Modules for SWE, SoS, SA • Software Engineering • Acquisition Support • Software Engineering Institute (SEI) • Process Improvement • CMMI Sponsor • DoD/National Software Investment Strategy	• Support of ACAT I and Other Special Interest Programs (MDAP, MAIS) • Assessment Methodology (Program Support Reviews - PSRs) • T&E Oversight and Assessment of Operational Test Readiness (AOTR) • Systems Engineering and Developmental Test Planning and Support • Lean/6-Sigma Training/Cert

Acquisition program excellence through sound systems and software engineering

SSE Functions

- ➤ **Acquisition Program Support**
  - • Decision Support to Senior DoD Leadership
  - • Mentoring Acquisition Programs
  - • Technical Reviews of Key Program Documentation
- ➤ **Policy, Guidance, Best Practices**
- ➤ **Acquisition Workforce Education and Training**
  - • SE, Test, Production Quality and Manufacturing, Software
- ➤ **Systemic Root Cause Analysis**
- ➤ **"Discipline" Expertise**

✦ Risk	✦ CMMI	✦ Modeling/Simulation
✦ Reliability	✦ Software	✦ Configuration Management
✦ Architectures	✦ Energy	✦ Data Management
✦ Test/Eval	✦ Safety	✦ System of Systems

Revitalizing DoD SE

- ➢ Issued DoD-wide SE policy – focused effort on up front, sound technical planning
- ➢ Issued guidance on SE, test and evaluation (T&E) and software
- ➢ Revised SE & T&E curricula at Defense Acquisition University
- ➢ Established SE Forum—senior-level focus across DoD
- ➢ Instituted system-level assessments in support of OSD major acquisition program oversight role
- ➢ Integrated, software, system assurance, energy, M&S and system of systems into SE revitalization efforts
- ➢ Established closer working relationships with industry and academia
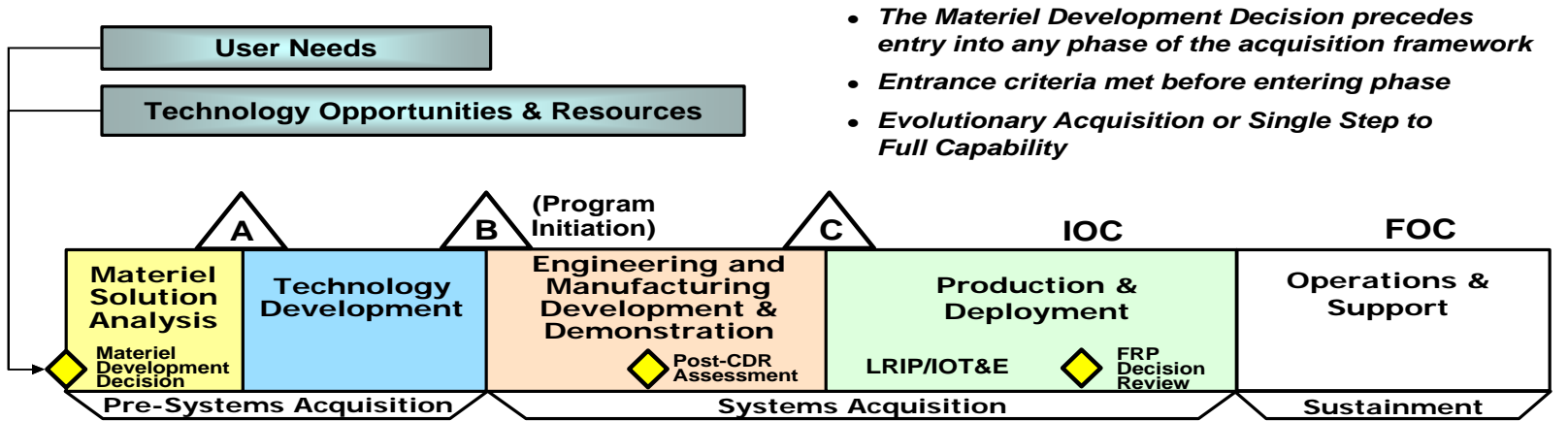
Prescribing Good Practices Is Not Enough…

Subtle, But Substantial Changes

Old Life Cycle

**User Needs & Technology Opportunities**

- *Process entry at Milestones A, B, or C*
- *Entrance criteria met before entering phase*
- *Evolutionary Acquisition or Single Step to Full Capability*

△ A
△ B (Program Initiation)
△ C
IOC
FOC

Concept Refinement	Technology Development	System Development & Demonstration	Production & Deployment	Operations & Support
◆ Concept Decision		◆ Design Readiness Review	LRIP/IOT&E ◆ FRP Decision Review	

Pre-Systems Acquisition   **Systems Acquisition**   **Sustainment**

New Life Cycle

User Needs

Technology Opportunities & Resources

- *The Materiel Development Decision precedes entry into any phase of the acquisition framework*
- *Entrance criteria met before entering phase*
- *Evolutionary Acquisition or Single Step to Full Capability*

△ A
△ B (Program Initiation)
△ C
IOC
FOC

Materiel Solution Analysis	Technology Development	Engineering and Manufacturing Development & Demonstration	Production & Deployment	Operations & Support
◆ Materiel Development Decision		◆ Post-CDR Assessment	LRIP/IOT&E ◆ FRP Decision Review	

Pre-Systems Acquisition   **Systems Acquisition**   **Sustainment**

◆ = Decision Point   △ = Milestone Review

Overview of Draft Acquisition Policy Changes*

❖ **Mandatory Materiel Development Decision (MDD)**

❖ **Mandatory competing prototypes before MS B**

❖ **Mandatory PDR and a report to the MDA before MS B** *(moves MS B to the right)*

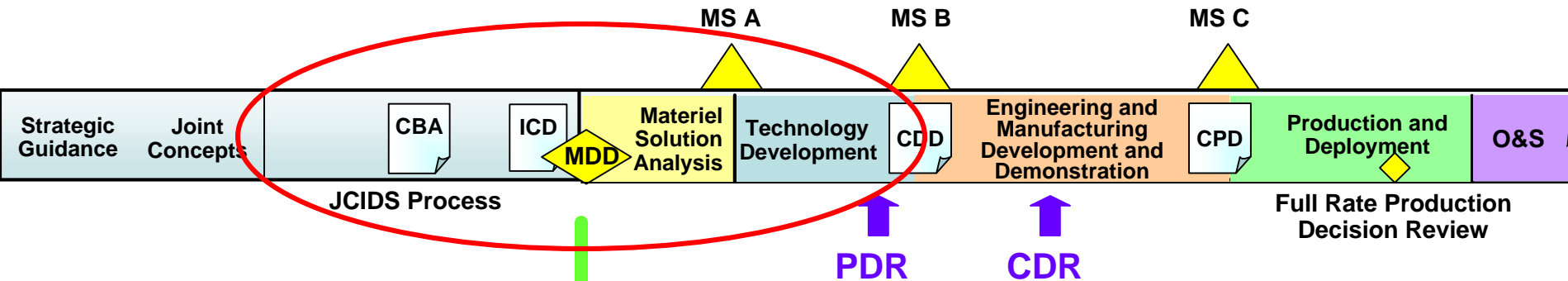❖ **Configuration Steering Boards at Component level**
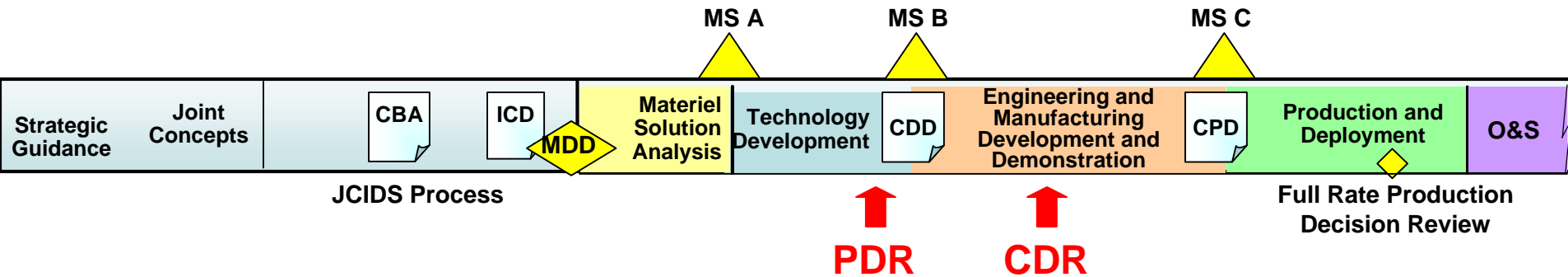
❖ **Renewed emphasis on manufacturing during system development:**

- **Re-titles SDD phase to EMDD with two sub phases: Integrated System Design and System Capability and Manufacturing Process Demonstration**

- **Establishes consideration of manufacturing maturity at key decision points**

❖ **Mandatory system-level CDR with an initial product baseline and followed by a Post-CDR Report to the MDA**

❖ **Post-CDR Assessment by the MDA between EMDD sub phases**

New Opportunities for Enhanced SE – Starting Programs Right

What's relevant:
- *Mandatory* Materiel Development Decision
- *Mandatory* Milestone A for all "major weapon systems"
- MS B *after* system-level PDR* and a PDR Report to the MDA*

MS A   MS B   MS C

| Strategic Guidance | Joint Concepts | CBA | ICD | MDD | Materiel Solution Analysis | Technology Development | CDD | Engineering and Manufacturing Development and Demonstration | CPD | Production and Deployment | O&S |

JCIDS Process

PDR   CDR

Full Rate Production Decision Review

Pre-MDD "SE Touch Points"

- **Initial Capabilities Document (ICD)**
- **Analysis of Alternatives study plan**

Pre-Milestone A "SE Touch Points"

- **Systems Engineering Plan**
- **Technology Development Strategy**
- **Test and Evaluation Strategy**
- **Analysis of Alternatives**

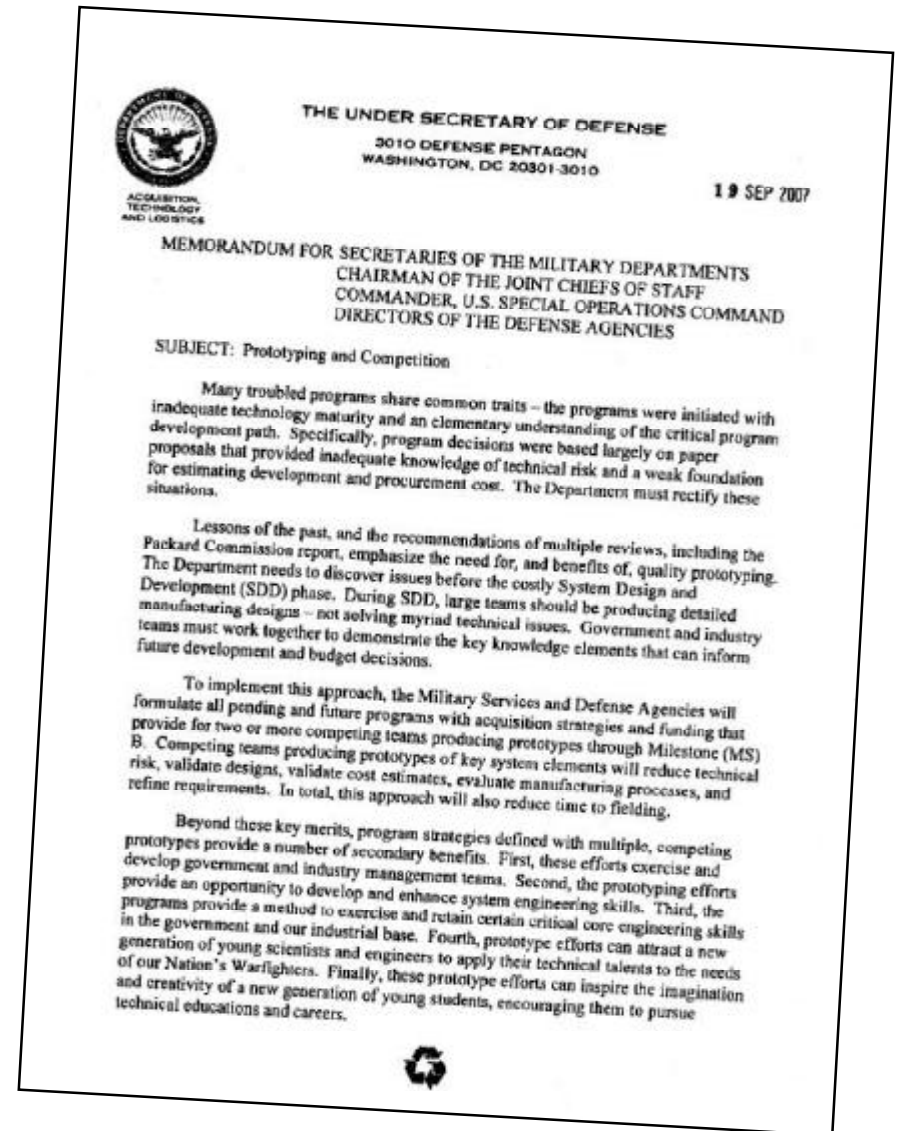** PDR – Preliminary Design Review*   ** CDR – Critical Design Review*   ** MDA - Milestone Decision Authority*
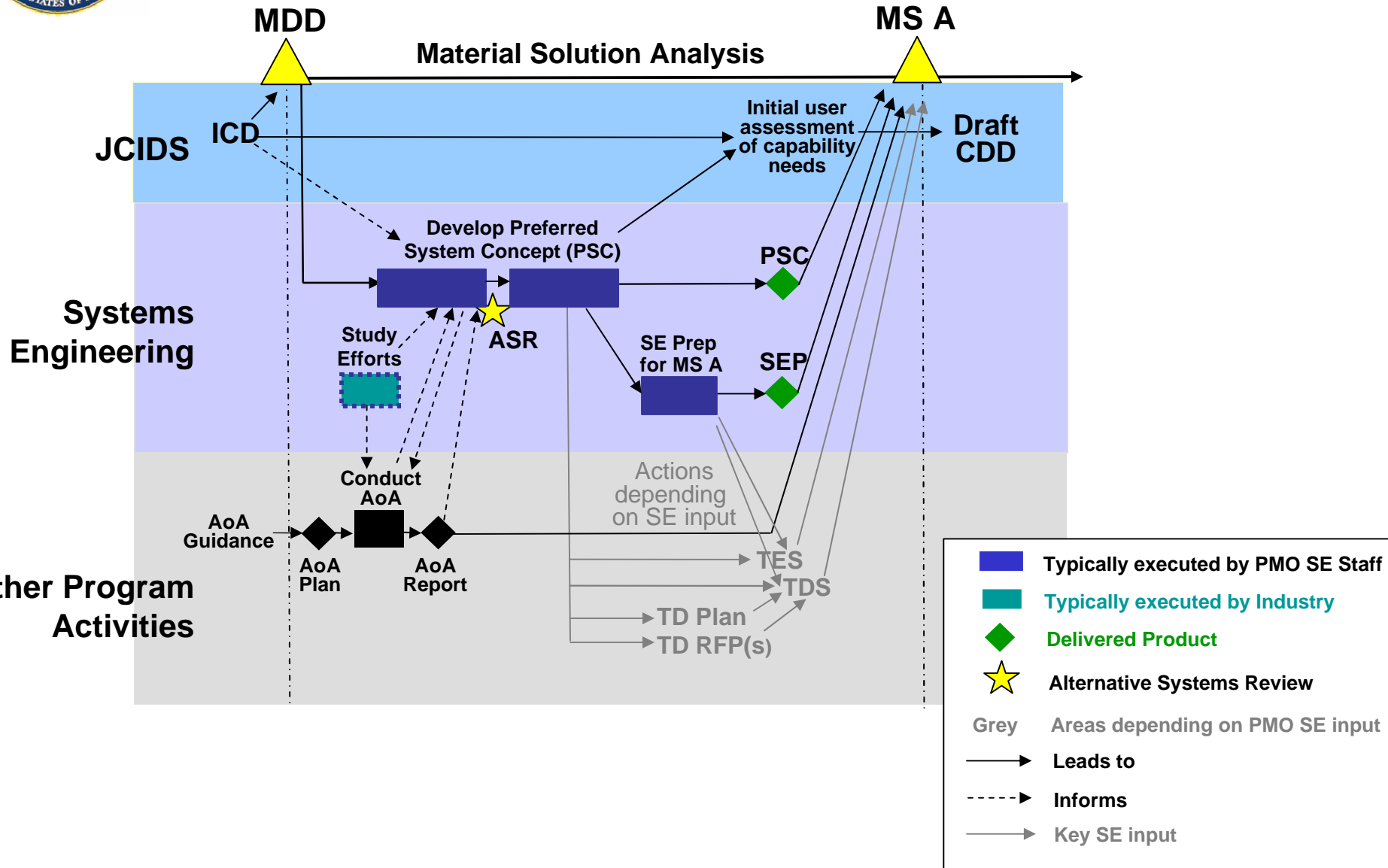
"**Evolutionary acquisition requires . . . Technology development preceding initiation of an increment shall continue until the required level of maturity is achieved, prototypes of the system or key system elements are produced, and a preliminary design is completed. . . .**"

"**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. Prototypes shall be employed to reduce technical risk, validate designs and cost estimates, evaluate manufacturing processes, and refine requirements. . . .**"
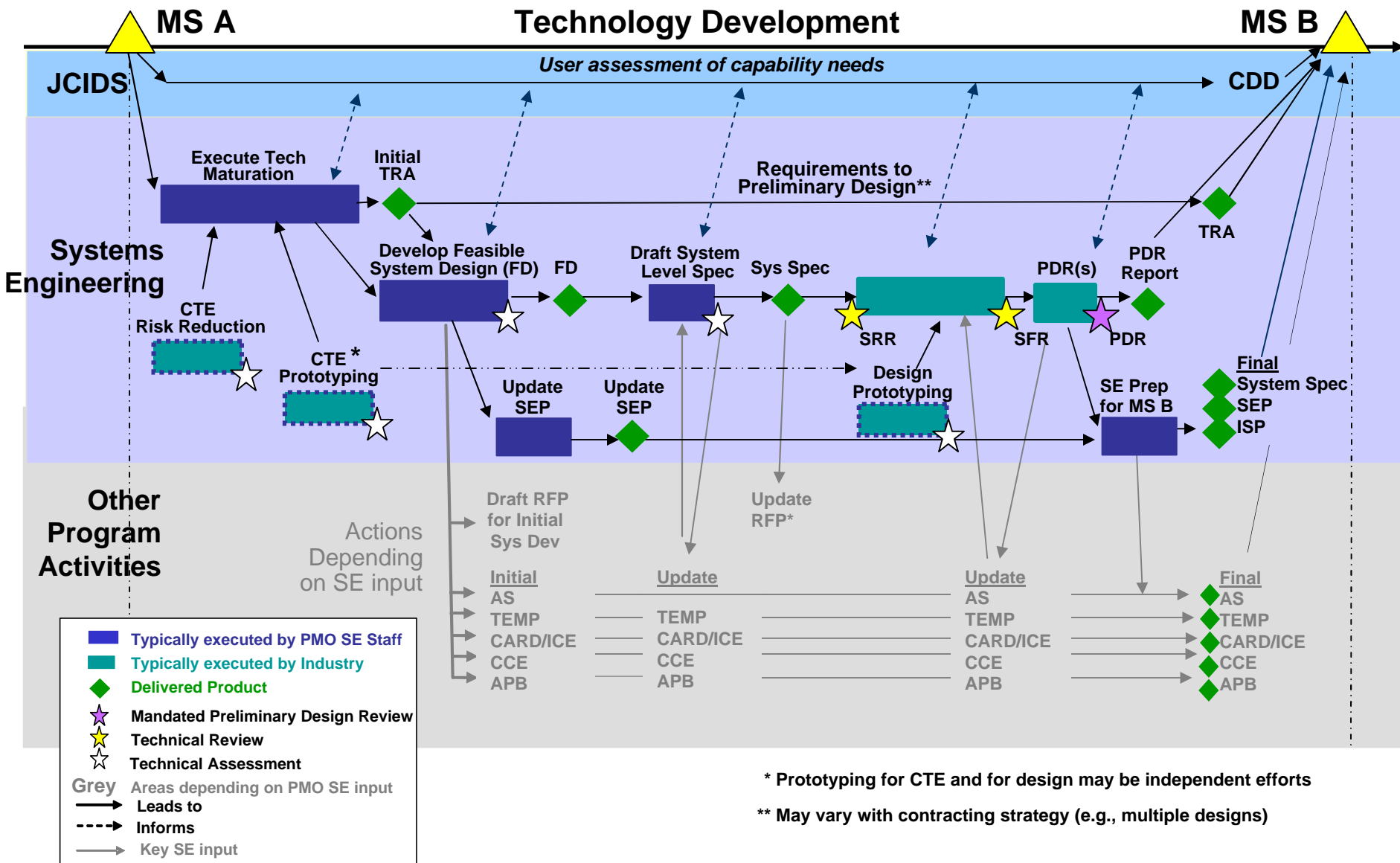

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

19 SEP 2007

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
COMMANDER, U.S. SPECIAL OPERATIONS COMMAND
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Prototyping and Competition

Many troubled programs share common traits – the programs were initiated with inadequate technology maturity and an elementary understanding of the critical program development path. Specifically, program decisions were based largely on paper proposals that provided inadequate knowledge of technical risk and a weak foundation for estimating development and procurement cost. The Department must rectify these situations.

Lessons of the past, and the recommendations of multiple reviews, including the Packard Commission report, emphasize the need for, and benefits of, quality prototyping. The Department needs to discover issues before the costly System Design and Development (SDD) phase. During SDD, large teams should be producing detailed manufacturing designs – not solving myriad technical issues. Government and industry teams must work together to demonstrate the key knowledge elements that can inform future development and budget decisions.

To implement this approach, the Military Services and Defense Agencies will formulate all pending and future programs with acquisition strategies and funding that provide for two or more competing teams producing prototypes through Milestone (MS) B. Competing teams producing prototypes of key system elements will reduce technical risk, validate designs, validate cost estimates, evaluate manufacturing processes, and refine requirements. In total, this approach will also reduce time to fielding.

Beyond these key merits, program strategies defined with multiple, competing prototypes provide a number of secondary benefits. First, these efforts exercise and develop government and industry management teams. Second, the prototyping efforts provide an opportunity to develop and enhance system engineering skills. Third, the programs provide a method to exercise and retain certain critical core engineering skills in the government and our industrial base. Fourth, prototype efforts can attract a new generation of young scientists and engineers to apply their technical talents to the needs of our Nation's Warfighters. Finally, these prototype efforts can inspire the imagination and creativity of a new generation of young students, encouraging them to pursue technical educations and careers.

SE Focus: Materiel Solution Analysis

SE Focus: Technology Development

MS A — **Technology Development** — **MS B**

User assessment of capability needs

JCIDS → CDD

Systems Engineering

Execute Tech Maturation → Initial TRA

Requirements to Preliminary Design**

Develop Feasible System Design (FD) → FD → Draft System Level Spec → Sys Spec → SRR → SFR → PDR(s) → PDR → PDR Report → TRA

CTE Risk Reduction

CTE * Prototyping

Update SEP → Update SEP

Design Prototyping

SE Prep for MS B

Final System Spec / SEP / ISP

Other Program Activities

Actions Depending on SE input

Draft RFP for Initial Sys Dev

Update RFP*

Initial	**Update**	**Update**	**Final**
AS	TEMP	AS	AS
TEMP	CARD/ICE	TEMP	TEMP
CARD/ICE	CCE	CARD/ICE	CARD/ICE
CCE	APB	CCE	CCE
APB		APB	APB

Legend

- ■ **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)

New Systems Engineering Enclosure

❖ **Codifies three previous SE policy memoranda**

❖ **Codifies a number of SE-related policies and Statutes since 2003:**

  ▪ **Environment, Safety, and Occupational Health**

  ▪ **Corrosion Prevention and Control**

  ▪ **Modular Open Systems Approach**

  ▪ **Data Management and Technical Data Rights**

  ▪ **Item Unique Identification**

  ▪ **Reliability, Availability, and Maintainability**

❖ **Introduces new policy on Configuration Management**

Enclosure 12. Systems Engineering

E12.1. Systems Engineering Across the Acquisition Lifecycle.

E12.2. Systems Engineering Plan (SEP).
    E12.2.1. PMs shall prepare a SEP for each milestone review, beginning with Milestone A. At Milestone A, the SEP shall support the TDS; at Milestone B or later, the SEP shall support the Acquisition Strategy.
    E12.2.2. The DUSD (A&T) shall be the SEP approval authority for programs that will be reviewed by the DAB/ITAB.

E12.3. Systems Engineering Leadership. Each PEO, or equivalent, shall have a lead or chief systems engineer on his or her staff responsible to the PEO for systems engineering across the PEO's portfolio of programs. … and shall:
    E12.3.1. Review assigned programs' SEPs and oversee their implementation.
    E12.3.2. Assess performance of subordinate lead or chief system engineers ...

E12.4. Technical Reviews. Technical reviews shall be event driven, conducted when documented entrance criteria are met, and include participation by subject matter experts who are independent of the program.

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E12.5.   <u>Configuration Management</u>. The PM shall use a configuration management approach to establish and control product attributes and the technical baseline across the total system life cycle. This approach shall identify, document, audit, and control the functional and physical characteristics of the system design; track any changes; provide an audit trail of program design decisions and design modifications; and be integrated with the SEP and technical planning. **At completion of the system level Critical Design Review, the PM shall assume control of the initial product baseline for all Class 1 configuration changes.**

E12.6.   <u>Environment, Safety, and Occupational Health (ESOH)</u>. The PM shall use the methodology in MIL-STD-882D to assess ESOH risk, eliminate ESOH hazards where possible, manage the risks that cannot be eliminated, and report on the status of ESOH risk at technical reviews.

   E12.6.1.   <u>Programmatic ESOH Evaluation (PESHE)</u>. The PM for all programs, regardless of ACAT level, shall prepare a PESHE and summarize it in the acquisition strategy.

   E12.5.2.   <u>NEPA/EO 12114</u>. The PM shall conduct and document NEPA/EO 12114 analyses, to be approved by the CAE, for which the PM is the action proponent.

   E12.6.3.   <u>Mishap Investigation Support</u>. The PM will support system-related Class A and B mishap investigations.

E12.7. <u>Corrosion Prevention and Control</u>. Each ACAT I program shall document its strategy in a Corrosion Prevention Control Plan at Milestones B and C.

E12.8. <u>Modular Open Systems Approach (MOSA)</u>. Program managers shall employ MOSA.

E12.9. <u>Data Management and Technical Data Rights</u>. Program Managers for ACAT I and II programs, regardless of planned sustainment approach, shall assess the long-term technical data needs of their systems and reflect that assessment in a Data Management Strategy (DMS).

E12.10. <u>Item Unique Identification (IUID)</u>. To enhance life-cycle management of assets in systems acquisition and sustainment, and to provide more accurate asset valuation, all PMs shall plan for and implement IUID to identify and track applicable major end items, configuration-controlled items, and Government-furnished property. IUID planning and implementation shall be documented in an IUID Implementation Plan and summarized in the program's Systems Engineering Plan (Reference (al) and DoD Instruction 8320.04,

E12.11. <u>Reliability, Availability, and Maintainability (RAM)</u>. PMs for all programs shall formulate a viable RAM strategy that includes a reliability growth program as an integral part of design and development. RAM shall be integrated within the Systems Engineering processes, documented in the program's SEP and LCSP, and assessed during technical reviews, T&E, and PSRs.

Initiatives Supported by OSD/SSE

- ➢ DM Guidebook
  - Provides the "how", "what", and "what data" to support services/agencies on DM.
- ➢ DI-MGMT-81024- Systems Engineering Management Plan (SEMP) DID Update
  - Focus is to Government and Contractor technical planning using the Systems Engineering Plan (SEP) as a basis.
- ➢ Draft MIL-HNBK-132 – DoD Handbook on Acquisition Management
  - Submitted for formal review
- ➢ MIL-DTL-3000 Tech Data Package Update
  - Working group has just been formed to revise and modernize the the approach to Tech Data Packages.
- ➢ ISO 1303 STandard for the Exchange of Product (STEP) Model Data
  - Application Protocol (AP) – 233 for Systems Engineering is in the final approval process

Key Challenges

- Effectively communicating the value of "data"
  - Recognition propagated to other disciplines within the life cycle development process
- Better process and practice integration with SE, DM, CM and Logistics practices.
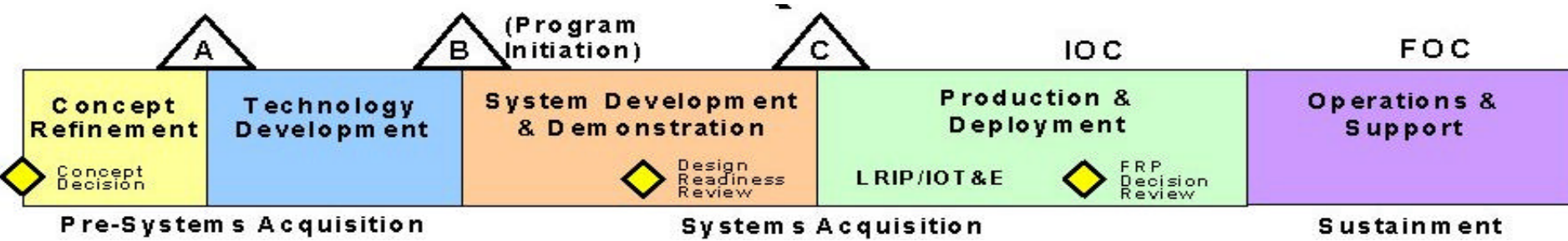- Systems and Software process integration

Thank You

Back Up

STEP for the DoD Acquisition Cycle

			Design		Analysis	Manufacturing		Data Management

AP 233 – Systems Engineering Data Representation

Design
- AP 227 – Plant spatial configuration
- AP 218 – Ship structures
- AP 216 – Ship molded forms
- AP 215 – Ship arrangement
- AP 214 – Automotive mechanical design processes
- AP 212 – Electrotechnical design and installation
- AP 210 – Electronic assembly, interconnect & pack.
- AP 207 – Sheet metal die planning & design
- AP 203 – Configuration controlled design
- AP 202 – Associative drafting
- AP 201 – Explicit drafting
- piping systems
- cable trays
- HVAC systems
- mechanical systems

Analysis
- AP 209 – Composite & metal structural analysis

Manufacturing
- AP 219 – Dimensional inspection for parts
- AP 223 – Design & manufacturing of cast parts
- AP 224 – Machining features for process planning
- AP 229 – Design and manufacturing of forged parts
- AP 238 – Computer numerical controllers
- AP 240 – Process plans for machined parts

Data Management
- AP 214 cc6 – PDM Schema
- AP 232 – Technical data packaging
- AP 239 – Product lifecycle support

Configuration Steering Boards

Configuration Steering Boards (CSB). The Acquisition Executive of each DoD Component shall establish a CSB with broad executive membership including senior representatives from the Office of the USD(AT&L) and the Joint Staff.

• **The CSB shall review all requirements changes and any significant technical configuration changes** for ACAT I and IA programs in development which have the potential to result in cost and schedule impacts to the program. **Such changes will generally be rejected,** deferring them to future blocks or increments. **Changes shall not be approved unless funds are identified and schedule impacts mitigated.**

• **Program Managers shall, on a roughly annual basis, identify and propose a set of descoping options to the CSB that reduce program cost or moderate requirements.** The CSB shall recommend to the MDA (if an ACAT ID or IAM program) which of these options should be implemented. Final decisions on de-scoping option implementation shall be coordinated with the Joint Staff and military department requirements officials.

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ACQUISITION
TECHNOLOGY
AND LOGISTICS

30 JUL 2007

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
COMMANDER, U.S. SPECIAL OPERATIONS COMMAND

SUBJECT: Configuration Steering Boards

In a number of programs, the Department of Defense has experienced significant growth over the original estimates in the development and procurement cost of weapon systems. These cost increases are detrimental to the Warfighter and the taxpayer. The result is generally a later delivery of capability and a reduction in the quantity purchased. Further, to pay the cost increases, the Department is generally forced to reduce a number of other development and procurement programs, correspondingly increasing the unit cost of these systems and delaying their delivery.

As one measure to avoid cost increases in major defense acquisition programs, the Military Departments will establish Configuration Steering Boards (CSBs) for every current and future ACAT I program in development. It is a repeatedly recognized best practice, highlighted in reviews such as the Packard Commission report, that managers must seek to diligently control requirements and technical authority adjustments. In general, the CSBs will be chaired by the Service Acquisition Executive. The CSBs will consist of broad membership, including senior representatives from the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics and the Joint Staff. The CSBs will review all requirements changes and any significant technical configuration changes which have the potential to result in cost and schedule impacts to the program. Such changes will generally be rejected, deferring them to future blocks or increments. Changes may not be approved unless funds are identified and schedule impacts mitigated.

Program managers will work on a roughly annual basis to identify a set of descoping options that reduce program cost or moderate requirements. These descoping options will be presented to the CSB. The CSB will recommend which of these options should be implemented to reduce the cost to the Department of Defense and the taxpayer and to provide a reserve against emergent technical risks. Final decisions on descoping option implementation will be coordinated with the Joint Staff and the appropriate Military Department officials responsible for the requirements.