



# ACQUISITION & TECHNOLOGY

THE WILL TO CHANGE

## OSD Systems Engineering Efforts

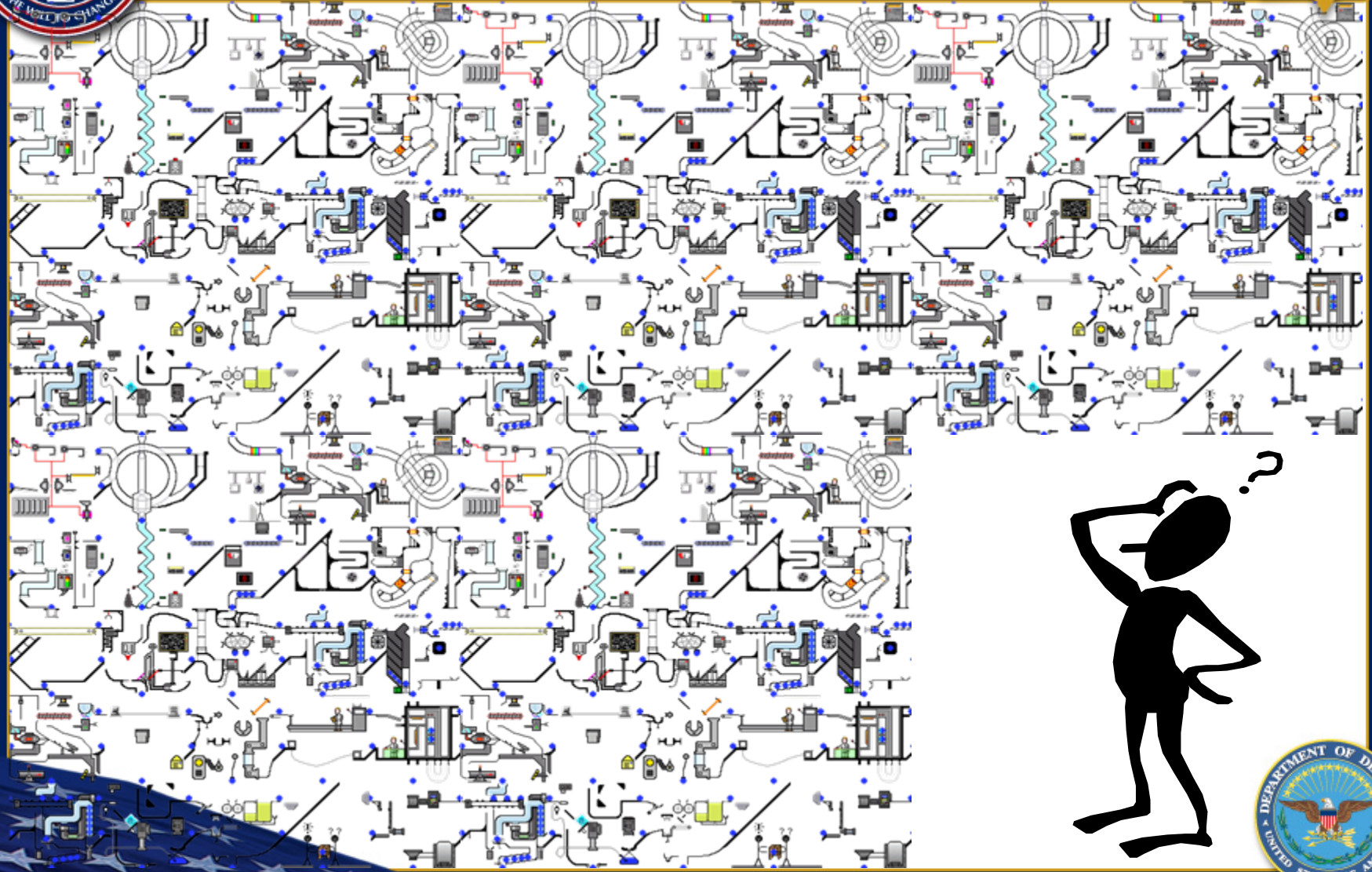
*Systems and Software Engineering  
Office of the Deputy Under Secretary of Defense  
(Acquisition and Technology)*

*presented to:  
Executive Program Managers Course  
Defense Acquisition University  
May 20, 2008*





# Systems Engineering...





# OUSD (AT&L) Organization



USD, Acquisition  
Technology & Logistics

DUSD, Acquisition &  
Technology

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 Mission Statement

- ★ Shape acquisition solutions and promote early technical planning
- ★ Promote the application of sound systems and software engineering, developmental test and evaluation, and related technical disciplines across the Department's acquisition community and programs
- ★ Raise awareness of the importance of effective systems engineering and drive the state-of-the-practice into program planning and execution
- ★ Establish policy, guidance, best practices, education, and training in collaboration with academia, industry, and government communities
- ★ Provide technical insight to program managers and leadership to support decision making

***Evolving System Engineering Challenges***





# Systems and Software Engineering Organizational Core Competencies

**Director, Systems & Software Engineering**

Kristen Baldwin (Acting) SES

**Deputy Director  
Enterprise Development**

Col Rich Hoferkamp (Acting)

**CORE COMPETENCIES**

- SE Policy
- SE Guidance
  - SE in *Defense Acquisition Guidebook*
  - Technical Planning
  - Risk Management
  - Reliability/Maintainability
  - Integrating SE into Systems Acq contracting
  - SoS SE Guide
- SE Education and Training
  - DAU SE Curriculum
  - SPRDE Certification Rqmt
- Corrosion
- R-TOC
- Value Engineering

**Deputy Director  
Developmental Test  
& Evaluation**

Chris DiPetto SES

**CORE COMPETENCIES**

- 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

**Deputy Director  
Software Engineering &  
System Assurance**

Kristen Baldwin SES

**CORE COMPETENCIES**

- 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

**Deputy Director  
Assessments & Support**

Glynn James (Acting)

**CORE COMPETENCIES**

- 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*



# General Outline



- ★ **Policy and Guidance**
- ★ **Program Support Reviews and Systemic Issues**
- ★ **Software Engineering and System Assurance**
- ★ **Discussion**





# Policy and Guidance





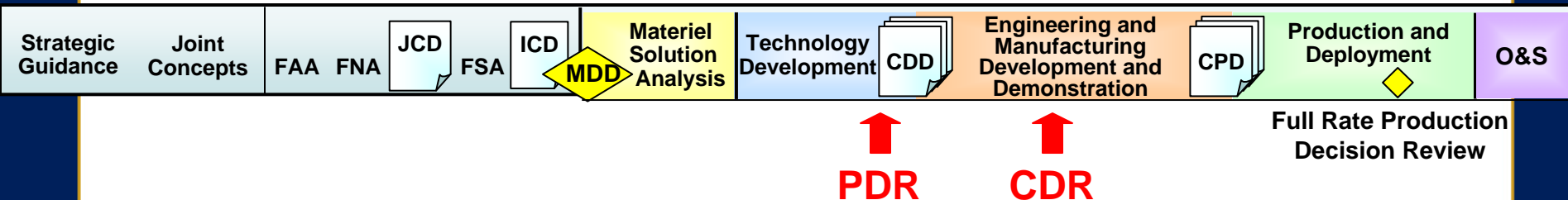
# Overview of Draft Acquisition Policy Changes\*

- ❖ Mandatory Materiel Development Decision
- ❖ Mandatory competing prototypes before MS B
- ❖ PDR and a report to the MDA before MS B (moves MS B to the right)
- ❖ Configuration Steering Boards at Component level to review all requirements changes

MS A

MS B

MS C



- ❖ 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 manufacturing maturity criteria at key decision points
- ❖ Mandatory system-level CDR with an initial product baseline
- ❖ Post-CDR Assessment by the MDA between EMDD sub phases
  - ❖ PSR and AOTR reviews required

\* Proposed by the USD(AT&L)







# Systems and Software Engineering Guidance

## ★ What's available:

- [Systems Engineering Plan \(SEP\) Preparation Guide, V2](#)
- [Risk Management Guide for DoD Acquisition](#)
- [DoD Guide for Achieving Reliability, Availability, and Maintainability](#)
- [Integrated Master Plan/Integrated Master Schedule \(IMP/IMS\) Guide](#)
- [Guide to Integrating SE into DoD Acquisition Contracts](#)
- [Understanding and Leveraging a Supplier's CMMI Efforts: A Guidebook for Acquirers](#)
- [Risk Assessment Technical Review Checklists](#)

## ★ What's coming:

- [Systems of Systems SE Guide](#)
- **Software Assurance Guide**
- [Update to Defense Acquisition Guidebook](#)
  - [Chapter 4 -- Systems Engineering](#)
  - [Chapter 9 -- Test and Evaluation](#)

**SSE Website:** <http://www.acq.osd.mil/sse/>





# Program Support Reviews and Systemic Issues

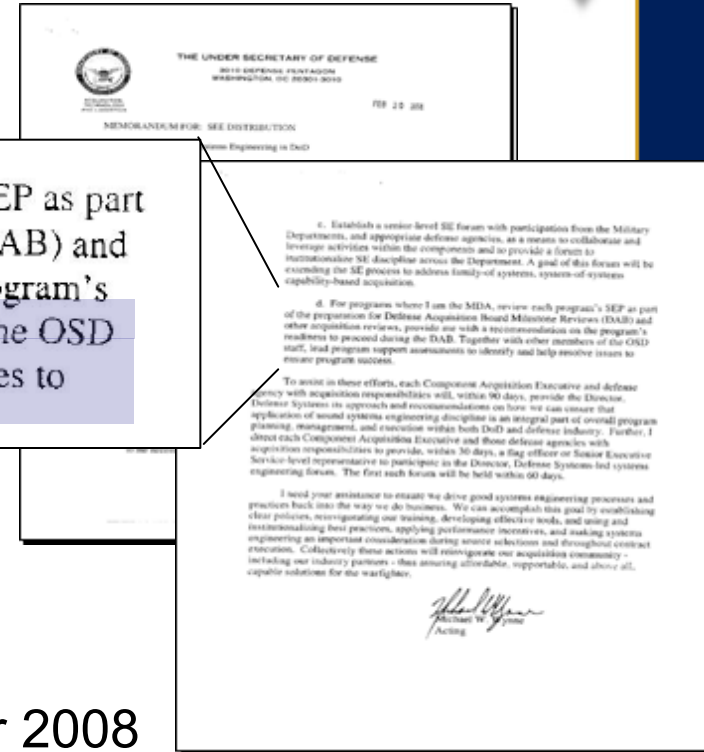




# USD(AT&L) Program Support Requirement

- USD(AT&L) memo, Feb 2004

d. For programs where I am the MDA, review each program's SEP as part of the preparation for Defense Acquisition Board Milestone Reviews (DAB) and other acquisition reviews, provide me with a recommendation on the program's readiness to proceed during the DAB. Together with other members of the OSD staff, lead program support assessments to identify and help resolve issues to ensure program success.



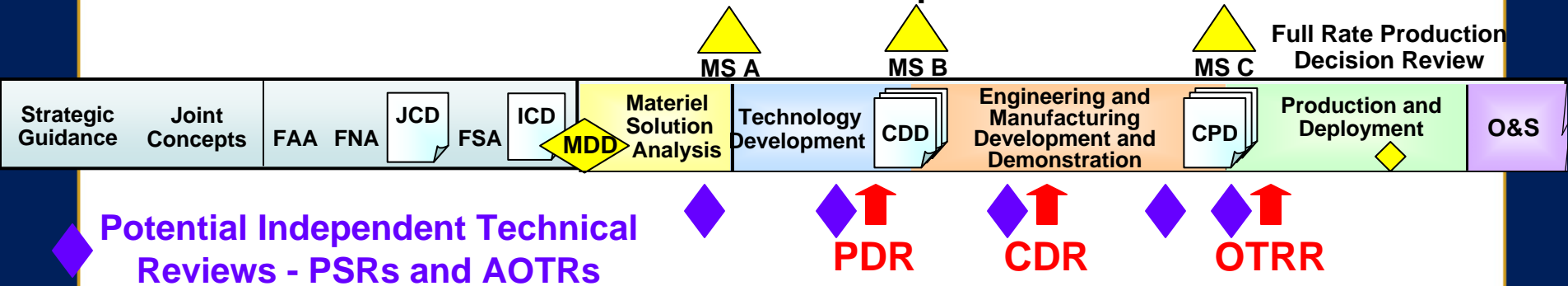
- DoD Instruction 5000.2, Draft version xx, Apr 2008

§ 3.9.6. Program Support Review (PSR). PSRs are a means to inform an MDA and Program Office of the status of technical planning and management processes by identifying cost, schedule, and performance risk and recommendations to mitigate those risks. PSRs shall be conducted by cross-functional and cross-organizational teams appropriate to the program and situation. PSRs for ACAT ID and IAM programs shall be planned by the Director, Systems and Software Engineering to support OIPT program reviews, at other times as directed by the USD(AT&L), and in response to requests from PMs.



# New Opportunities for Independent Reviews

- What's relevant:**
- **Mandatory Milestone A** for all “major weapon systems”
  - **MS B** after system-level PDR\* and a PDR Report to the MDA
  - **EMDD with Post-CDR\* Report and MDA Assessment**
  - **PSR and AOTR reviews required**



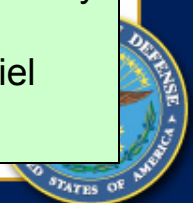
## Potential Independent Technical Reviews - PSRs and AOTRs

### Program Support Reviews (PSRs)

- ❖ All ACAT ID & IAM
- ❖ To inform the MDA on technical planning and management processes thru risk identification and mitigation recommendations
- ❖ To support OIPT program reviews and others as requested by the MDA

### Assessments of Operational Test Readiness (AOTRs)

- ❖ All ACAT ID and special interest programs
- ❖ To inform the MDA, DOTE, & CAE of risk of a system failing to meet operational suitability and effectiveness goals
- ❖ To support CAE determination of materiel readiness for IOT&E



\* PDR – Preliminary Design Review

\* CDR – Critical Design Review

\* OTRR – Operational Test Readiness Review

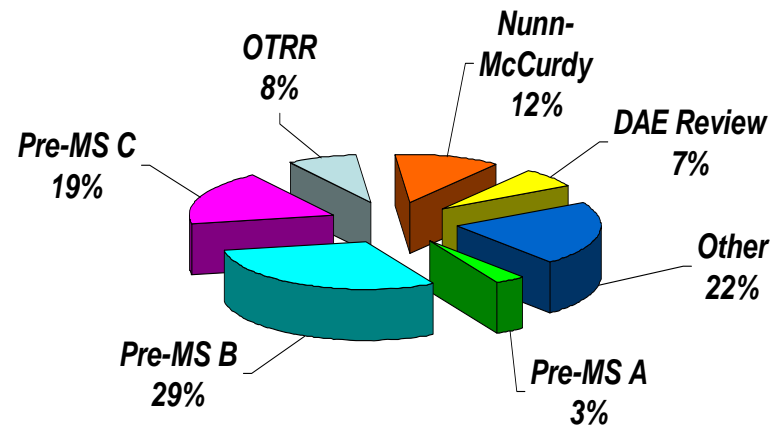


# OSD/SSE Program Support Review Activity

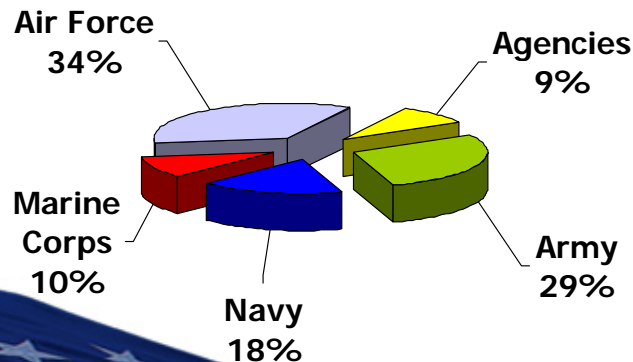
(Since March 2004)

- PSRs/NARs completed: 52
- AOTRs completed: 12
- Nunn-McCurdy Certification: 11
- Participation on Service-led IRTs: 2
- Technical Reviews: 14
- Reviews planned for FY08:
  - PSRs/NARs: 17
  - AOTRs: 3
  - Nunn-McCurdy: 1

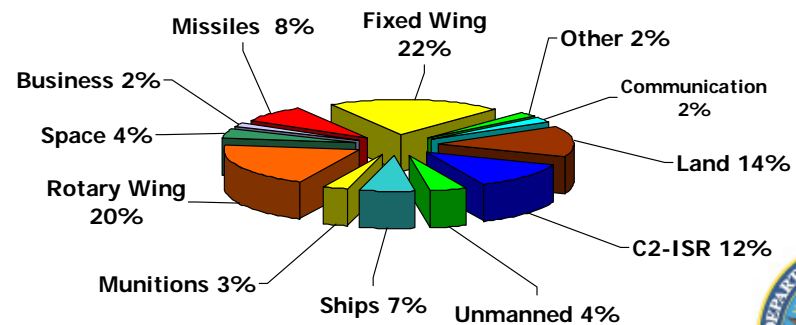
## Decision Support Reviews



## Service-Managed Acquisitions



## Programs by Domain Area





# Analysis of Program Failure

- ★ Acquisition cost growth over 11 years (SAR data FY 1995–2005):
  - ★ Estimation changes: \$201B
  - ★ Engineering changes: \$147B
  - ★ Schedule changes: \$70B
- ★ Over the past 10 years, DoD systems have experienced a 33% cost growth due to “RDT&E mistakes”
- ★ DoD IOT&E results, FY2001-2006
  - ★ 29 systems; mix of ACAT II, 1C, 1D across 3 Services
  - ★ Approx. 50% were deemed “Not Suitable”, or partially NS
  - ★ Approx. 33% were deemed “Not Effective”, or partially NE
- ★ Specific Causes of Program Failure (Systemic Root Cause Analysis findings)

## We do not start programs right

- ★ Insufficient requirements analysis and definition at program initiation
- ★ Lack of rigorous SE approach
- ★ Optimistic/realistic reliability growth – not a priority during development
- ★ Inadequate software architectures, design/development discipline, and organizational competencies

## We do not manage programs right

- ★ Insufficient trade space
- ★ Insufficient risk management
- ★ Inadequate IMP, IMS, EVMS
- ★ Most programs lack quantifiable entrance/exit criteria
- ★ Maturing “suitability” (e.g., RAM) is not always a priority





# Top 10 Emerging Systemic Issues

(from 52 Program Reviews since Mar 04)

1. Management
  - IPT roles, responsibilities, authority, poor communication
  - Inexperienced staff, lack of technical expertise
2. Requirements
  - Creep/stability
  - Tangible, measurable, testable
3. Systems Engineering
  - Lack of a rigorous approach, technical expertise
  - Process compliance
4. Staffing
  - Inadequate Government program office staff
5. Reliability
  - Ambitious growth curves, unrealistic requirements
  - Inadequate “test time” for statistical calculations
6. Acquisition Strategy
  - Competing budget priorities, schedule-driven
  - Contracting issues, poor technical assumptions
7. Schedule
  - Realism, compression
8. Test Planning
  - Breadth, depth, resources
9. Software
  - Architecture, design/development discipline
  - Staffing/skill levels, organizational competency (process)
10. Maintainability/Logistics
  - Sustainment costs not fully considered (short-sighted)
  - Supportability considerations traded

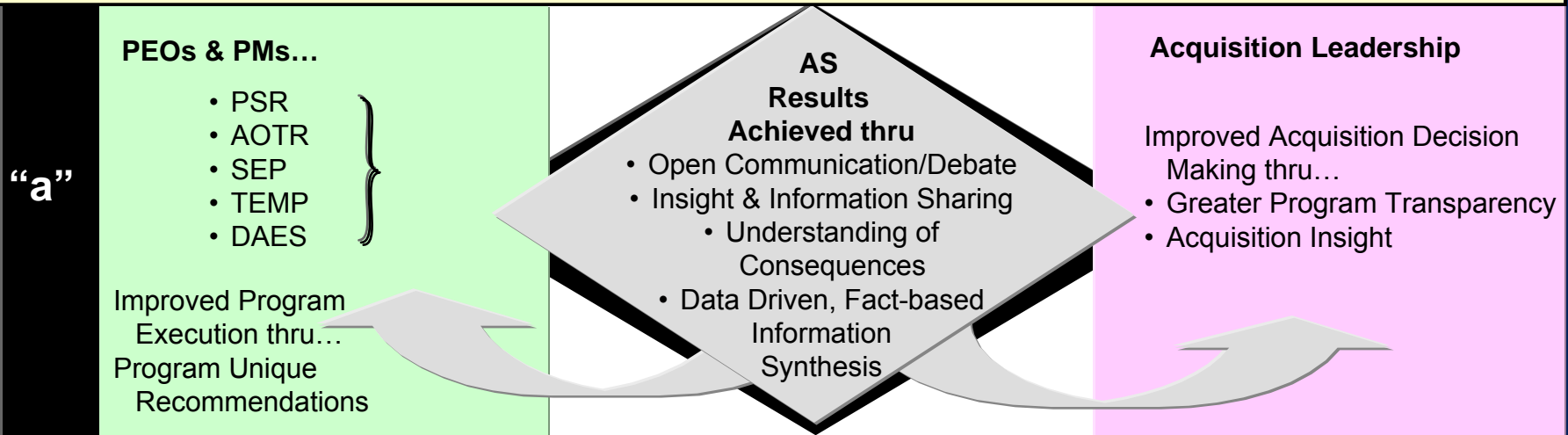
***Major contributors to poor program performance***





# Providing Value Added Oversight & Support

## • Tactical, Program and Portfolio Management



## • Strategic Management



- Policy/Guidance
- Education & Training
- Best Practices
- Other Processes (JCIDS, etc)
- Oversight (DABS/ITAB)
- Execution (staffing)



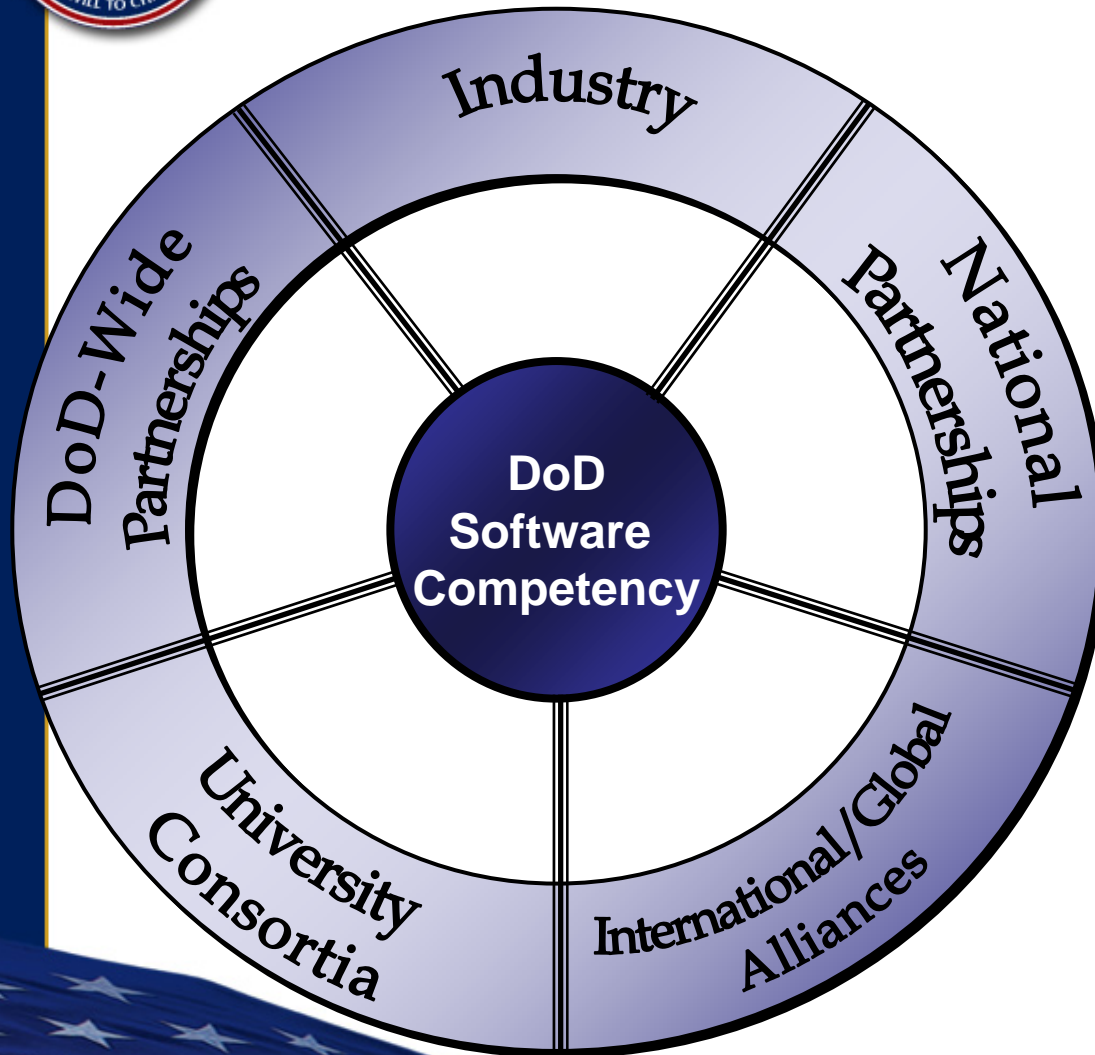


# Software Engineering and System Assurance





# Establishing a DoD Software Competency



## DoD Software Competency

- Support Acquisition Success
- Improve State-of-the-Practice of Software Engineering
- Leadership, Outreach and Advocacy
- Foster Resources to Meet DoD Needs

## Activities to Date

- Documented software issues, needs
- Assessed ongoing software initiatives
- Performed gap analysis
- Developed collaborative work plan



# Top Software Issues\*

1. The impact of requirements upon software is not consistently quantified and managed in development or sustainment. **“Requirements”**
2. Fundamental systems engineering decisions are made without full participation of software engineering. **“SE/SW Integration”**
3. Software life-cycle planning and management by acquirers and suppliers is ineffective. **“SW Sustainment”**
4. The quantity and quality of software engineering expertise is insufficient to meet the demands of government and the defense industry. **“Human Capital”**
5. Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems. **“SW Testing”**
6. There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments. **“SW Assurance”**
7. Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk. **“SW COTS/NDI/Reuse”**

**\*NDIA Top Software Issues Workshop  
August 2006**





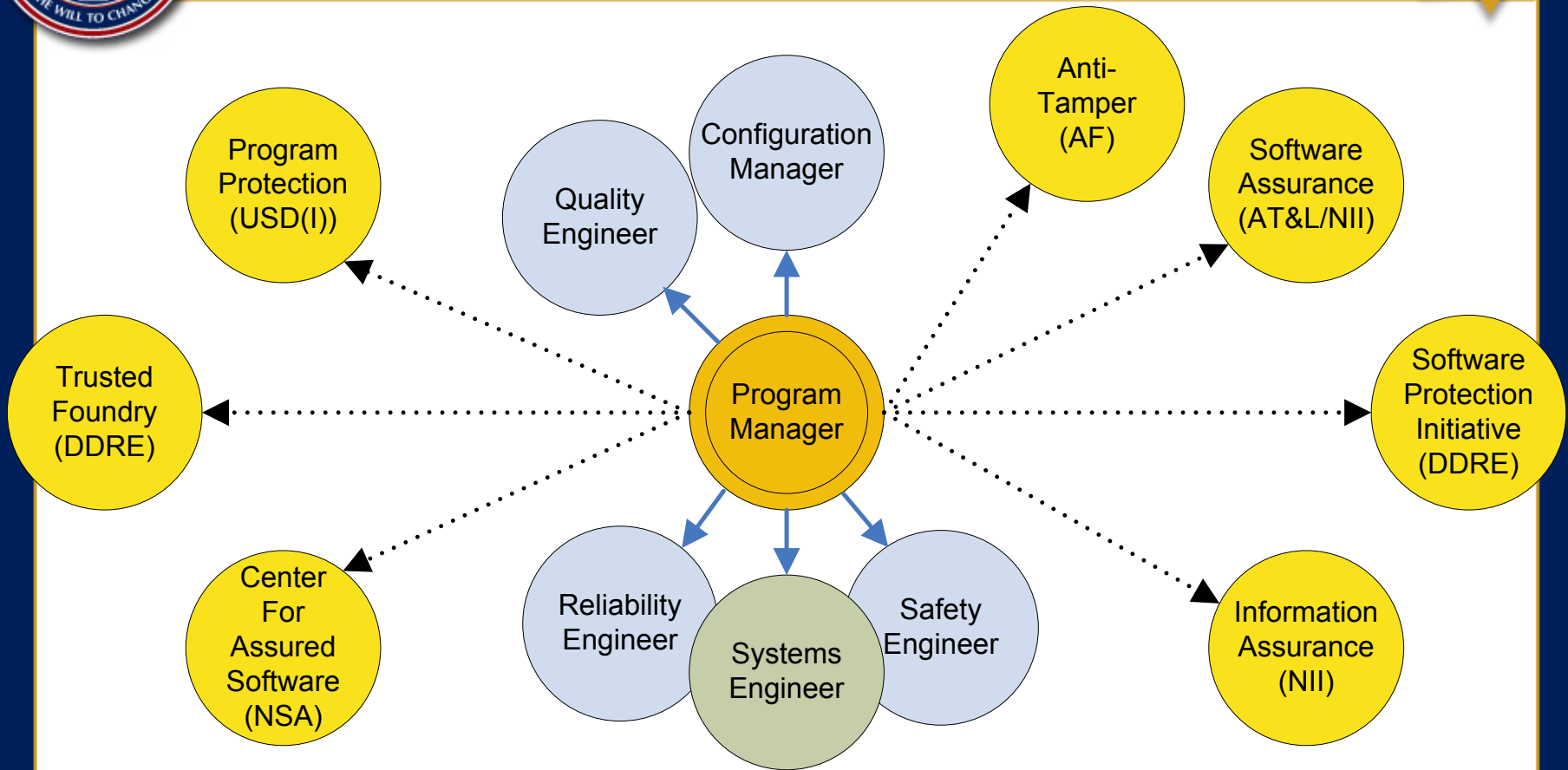
# Software Engineering Path Forward

- ★ **SSA Plan: Strategy and activity to address all top software issues and gaps**
  - ★ **Update Guidance**
    - Defense Acquisition Guidebook Chap 4 highlights software
    - SEP Prep Guide highlights key software activities
  - ★ **Update program support methods**
    - PSR method calls out key software activities
  - ★ **Develop guidance for key areas**
    - Software cost-schedule estimates
    - Use of metrics to support decisions
    - Software earned value management
    - SE/SW Integration
  - ★ **Strategic initiatives**
    - Software Human Capital Strategy
    - National Software Engineering Strategy
    - Software Sustainment





# Program Manger's View of System Assurance



## System Assurance – Working Definition

*Level of confidence that a system functions as intended, is free of exploitable vulnerabilities, and protects critical program information*





# System Assurance Acquisition Path Forward

- ★ Create a 'framework' to integrate multiple security disciplines and policies
  - ★ Leverage 5200.39 – requires a Program Protection Plan (PPP)
  - ★ DoD 5000.2 requires PPP at MS B
- ★ PPP identifies Critical Program Information and countermeasures
  - ★ Links to engineering plans, e.g., Anti-Tamper, Software Protection, Systems Engineering, Information Assurance
- ★ Develop and modify acquisition & systems engineering guidance to integrate system assurance across the lifecycle
  - ★ Defense Acquisition Guidebook Chapter 4, 8, SEP, TEMP
  - ★ Guidebook on Engineering for Assurance provides detailed guidance to program managers/engineers
  - ★ Supplier Assurance

Raise the bar:	
Awareness of Supply Chain	- Knowledge of the supply chain - Who has access to our critical assets
System Protection	- Protect critical assets through security practices - Engineer our systems for assurance





# System of Systems in DoD

- ★ Typically an overlay or ensemble of individual systems brought together to satisfy user capability needs
- ★ Not new acquisitions per se
  - ★ Cases like FCS are rare and, in practice, still must integrate with legacy systems
- ★ SoS 'manager' does not control the requirements or funding for the individual systems
  - ★ May be in a role of influencing rather than directing, which impacts systems engineering approach
- ★ Focus of SoS is on evolution of capability over time
- ★ Individual systems must understand and plan for SoS-driven requirements & constraints
- ★ Most military systems are part of an SoS operationally
  - ★ Only by exception do we manage and engineer at SoS level

Draft SoS Guide for Systems Engineering v1.0 Available





# Discussion



- ★ **How do you know if your program is on track to achieve and deliver to the warfighter the desired result?**
- ★ **What should you be asking your Chief Engineer?**
  - ★ **In planning phases, what should you be considering?**
  - ★ **At Milestone B, what should be on contract?**
  - ★ **What should you look for at SDD events like PDR and CDR?**
  - ★ **At Milestone C, how do you know you're ready to produce and deliver a quality product?**
- ★ **What help do you need to execute your program?**
- ★ **What does it take to deploy effective SE across your program?**
- ★ **What resources do you have available for SE and how do you train them?**





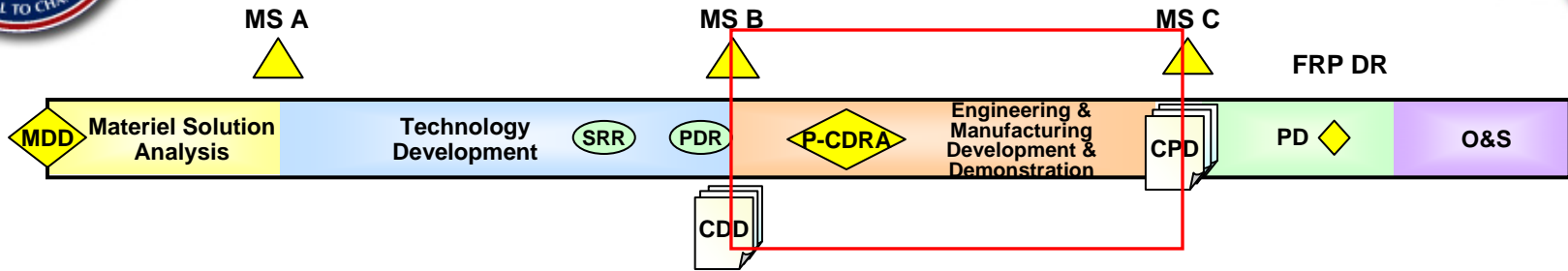


# Backup Slides





# Re-Titled Engineering and Manufacturing Development and Demonstration Phase



**Purpose of the EMDD Phase.** The purpose of this phase is to develop a system or an increment of capability; complete full system integration (technology risk reduction occurs during Technology Development); develop an affordable and executable manufacturing process; ensure operational supportability with particular attention to reducing the logistics footprint; implement human systems integration (HSI); design for producibility; ensure affordability; protect CPI by implementing appropriate techniques such as anti-tamper; and demonstrate system integration, interoperability, safety, and utility.

**Integrated System Design.** This effort is intended to define system and system-of-systems functionality and interfaces, complete hardware and software detailed design, and reduce system-level risk. Integrated System Design shall include the establishment of the product baseline for all configuration items. The CDD and Systems Engineering Plan shall guide this effort.

**System Capability and Manufacturing Process Demonstration.** This effort is intended to demonstrate the ability of the system to operate in a useful way consistent with the approved KPPs and that system production can be supported by demonstrated manufacturing processes. The program shall enter System Capability and Manufacturing Process Demonstration upon completion of the Post-CDR Assessment and establishment of an initial product baseline. This effort shall end when the system meets approved requirements and is demonstrated in its intended environment using the selected production-representative article; manufacturing processes have been effectively demonstrated; industrial capabilities are reasonably available; and the system meets or exceeds exit criteria and Milestone C entrance requirements.



# Systems Engineering Plan Trends

## ★ What's working:

- ★ Programs beginning to establish SE WIPTs early in the life cycle to develop and document their technical planning
- ★ Increased Program Executive Office level Lead/Chief Systems Engineers involvement in SEP development
- ★ Movement to event-driven versus schedule-driven programs
  - More focus entry and exit criteria for technical reviews

## ★ What needs work:

- ★ Firming up technical planning prior to RFP release
- ★ Proposed processes for a program not always tailored to fit program
  - Often appear to be copied from a manual or guide.
- ★ SEP author is someone in program office (contractor or junior person) who is not familiar with the technical strategy.
- ★ SEPs need to be consistent with key program documents





# Education & Training



## ★ What's available

- ★ **On-line Continuous Learning Modules (CLMs):**
  - Reliability and Maintainability
  - Technical Reviews
  - Technical Planning
  - MOSA
  - Trade Studies
  - Engineering Change Proposals
- ★ **On-line introductory course SYS 101**
- ★ **On-line intermediate course SYS 202**
- ★ **Intermediate classroom course SYS 203**
- ★ **Advanced classroom course SYS 302**
- ★ **“SPRDE/Program Systems Engineer” track**
- ★ **“Core Plus” career guidance**

## ★ What's Coming

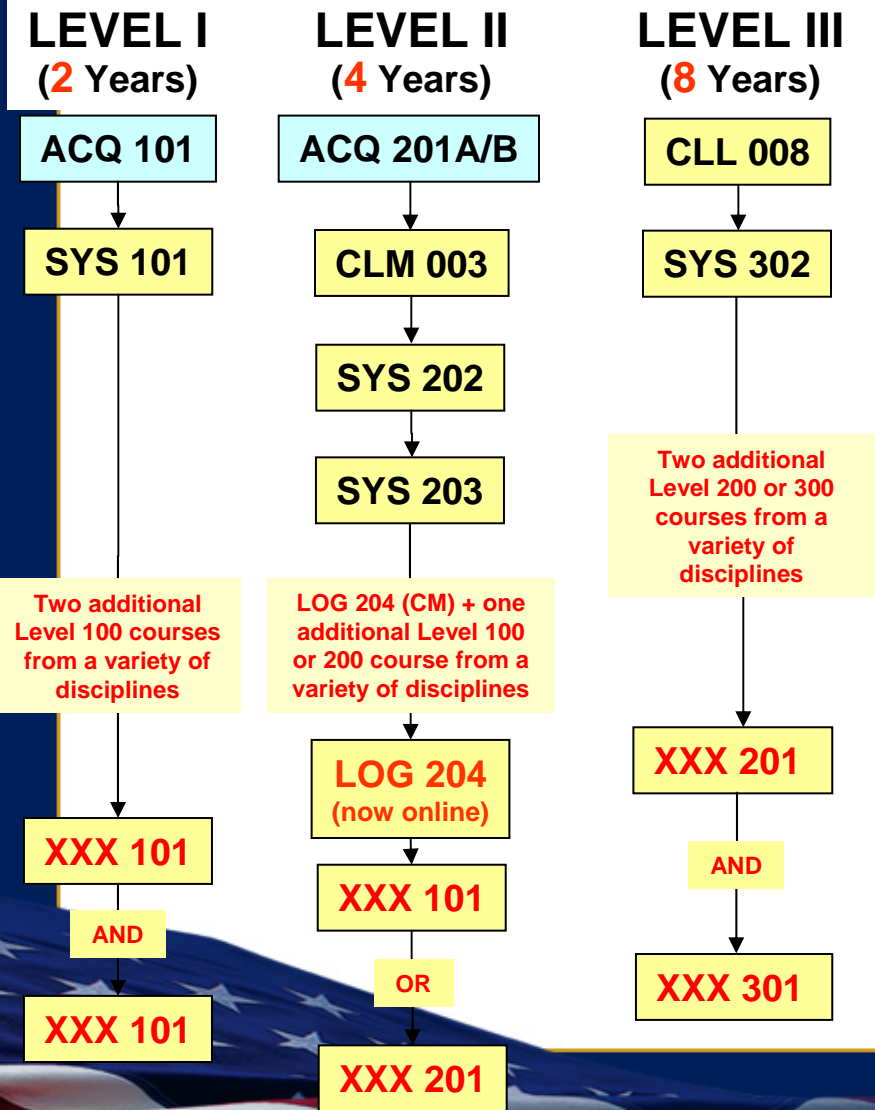
- ★ **Contracting For DT&E CLM**
- ★ **Manufacturing Readiness CLM**



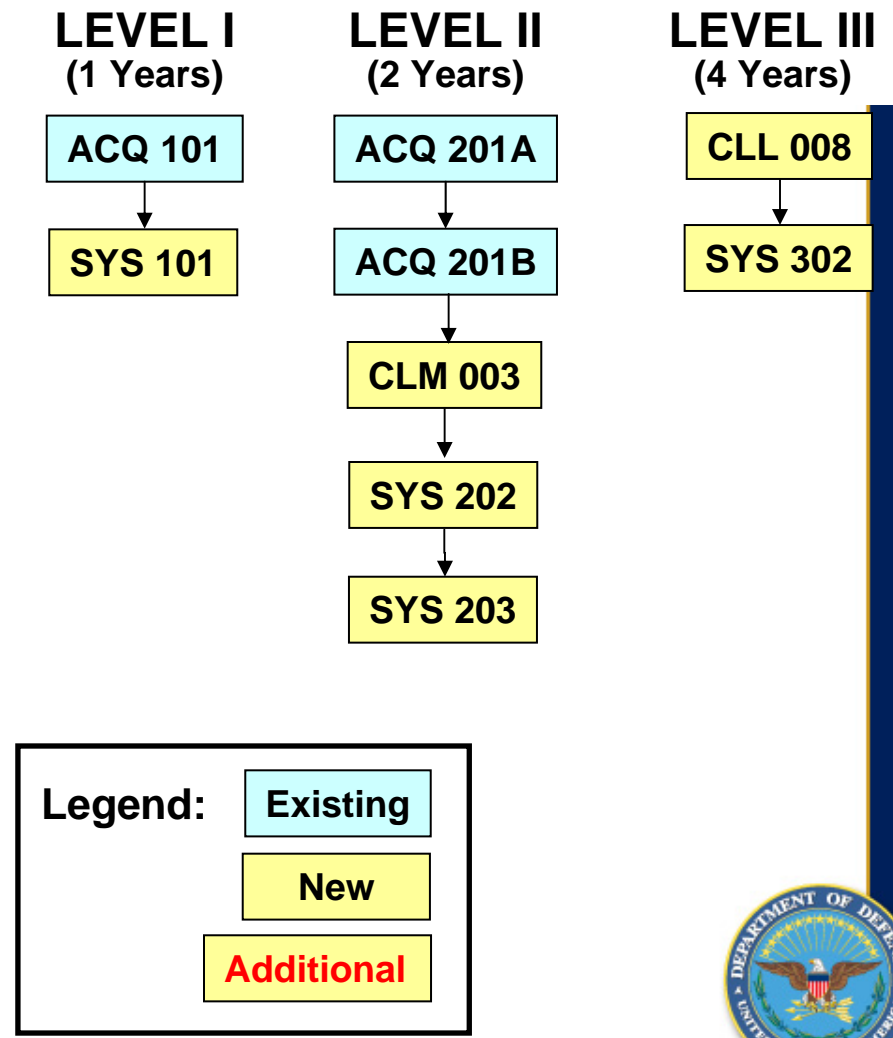


# New SPRDE/PSE & SE Career Path Certification Criteria

## SPRDE-Program Systems Engineer



## SPRDE-Systems Engineering





# Activities to Establish Software Strategy and Action Plan

- ★ **Documented software issues, needs**
  - ★ Software Industrial Base Study completed
  - ★ NDIA Top Software Issues Workshop Report
  - ★ Software-related feedback from PSRs and Systemic Analysis
  - ★ Defense Software Strategy Summit Report
- ★ **Initiated assessment of ongoing software initiatives**
  - ★ Established network of DoD software POCs
  - ★ Chartered NDIA Software Committee and Industry Expert Panel
  - ★ Bi-weekly software collaboration exchanges with Government, Academia, and Industry
  - ★ Restructured the US-UK-AUS Trilateral Working Group
- ★ **Performed gap analysis**
  - ★ Mapped ongoing software initiatives to issue areas
  - ★ Two outcomes:
    1. Identified initiatives that deserve cross-DoD attention
    2. Identified gaps where attention is needed





# System Assurance

- ★ We continue to be concerned with assurance of our critical DoD Assets:
  - ★ Critical information
  - ★ Critical technologies
  - ★ Critical systems / components
- ★ Observations:
  - ★ Increasing numbers of network attacks (internal and external to DoD) against unclassified networks
- ★ Trends that exacerbate our concerns:
  - ★ Globalization of our contracts, expanding the number of international participants in our systems developments
  - ★ Complex contracting arrangements that further decrease transparency below prime, and visibility into individual components
  - ★ Advanced technology sold to foreign countries

*These trends increase the opportunity for access to our critical assets, and for tampering*

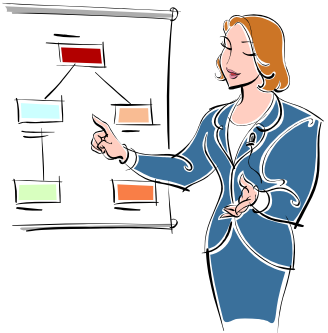


# Program Protection Process

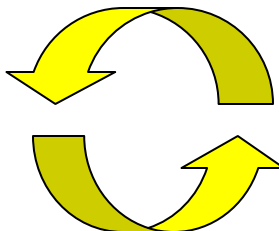
**AT&L**  
Provides focal point; guides and training



1. Define **Critical Assets for protection**



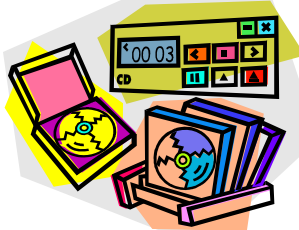
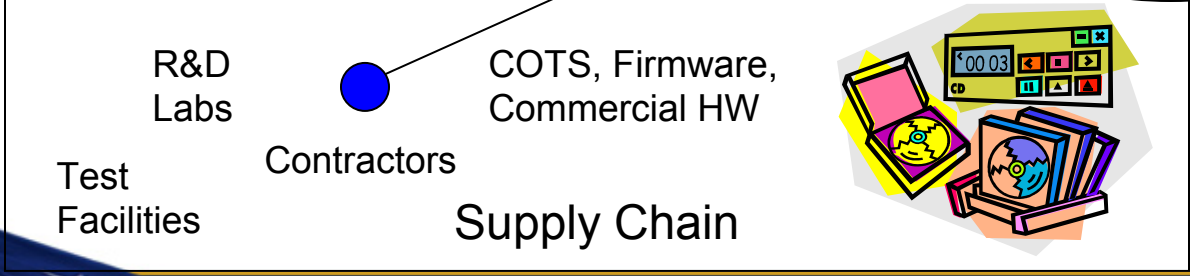
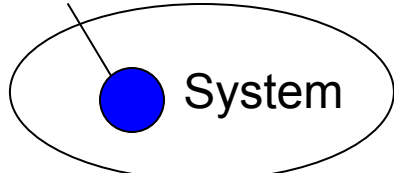
2. Request **Threat Assessments**



3. Identify **Vulnerabilities and assess Risk**

5. Document in **PPP**

4. Develop cost effective **Countermeasures**







# SoS SE Guide Pilot Participants

Objective of the pilots was to gain a 'boots on the ground' perspective

## Research Community

**INCOSE:** International Council on SE  
**MIT:** Massachusetts Institute of Technology  
**MITRE:** MITRE Corporation  
**Purdue:** School of Engineering  
**SEI:** Software Engineering Institute  
**Stevens:** Institute of Technology  
**USC:** University of Southern California  
**UCSD:** University of California San Diego  
**NDIA:** National Defense Industry Assoc.  
**Australia:** Defence Materiel Organisation

## SE Practitioners

**ABCS:** Army Battle Command System  
**AOC:** Air Operations Center  
**BMDS:** Ballistic Missile Defense System  
**CAC2S:** Common Aviation Command & Control System  
**DCGS-AF:** Distributed Common Ground Station (MITRE)  
**DoDIIS:** DoD Intelligence Information System (MITRE)  
**FCS:** Future Combat Systems  
**MILSATCOM:** Military Satellite Communications  
**NIFC-CA:** Naval Integrated Fire Control – Counter Air  
**SR:** Space Radar  
**NSA:** National Security Agency  
**NSWC:** Naval Surface Warfare Center Dahlgren  
**PEO GCS:** Ground Combat Systems  
**SIAP:** Single Integrated Air Picture  
**SMC:** Space and Missile Systems Center  
**TMIP:** Theater Medical Information Systems – Joint  
**USGC:** US Coast Guard C2 Convergence (MITRE)

