# Converting High-Level Systems Engineering Policy to a Workable Program


**26 Oct 05**

James C. Miller
Chief Engineer
327th CLSG
Phone: 736-4294
james.c.miller@tinker.af.mil

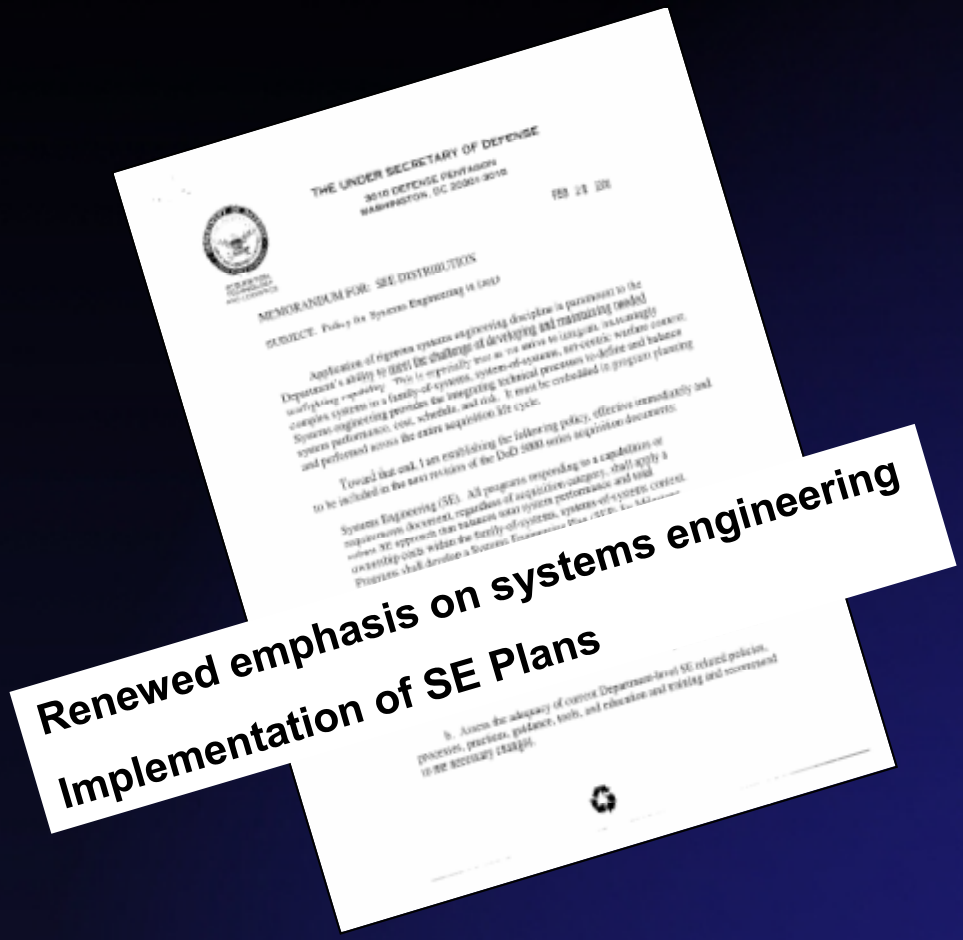
# Background

- Prior to 1997, numerous incidents, mishaps and configuration occurred in the Air Force (AF)
- AF recognized need for a disciplined technical process for the development and sustainment of AF systems
- In 1997, AF instituted the Operational Safety, Suitability and Effectiveness (OSS&E) Program
- OSS&E Focused on *sustainment* due to trend in field support process deficiencies

# Background (Cont)

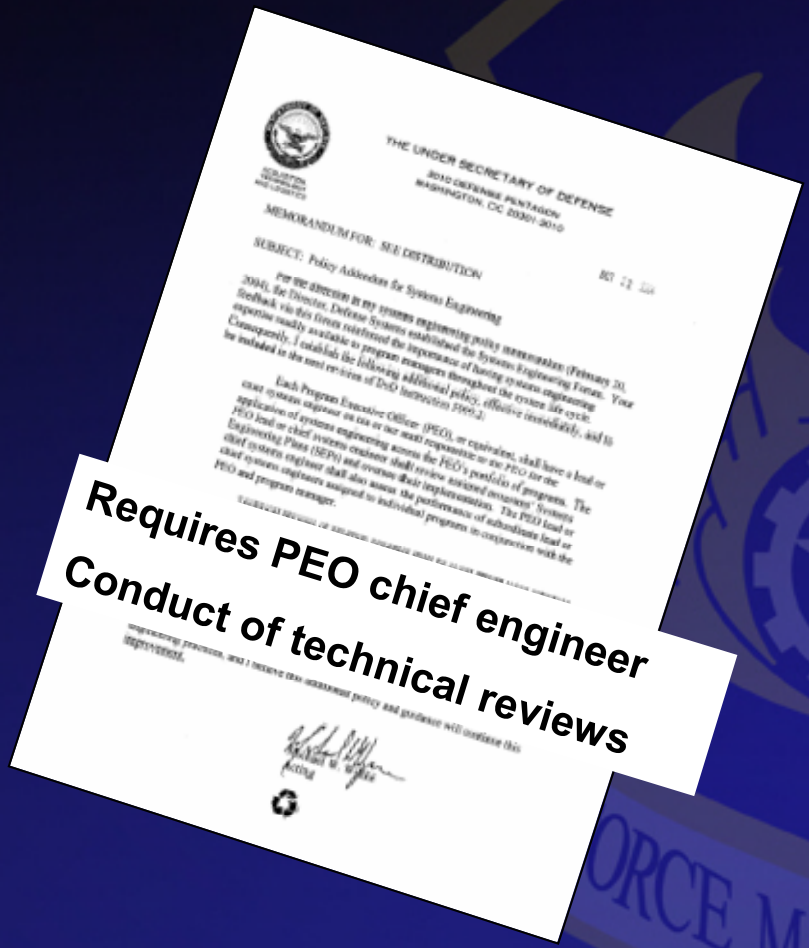
- OSS&E mandated 6 levels for certification
  - Included milestones, metrics, and entry/exit criteria for each level
- Implemented throughout the AF
  - Certification of Level 6 required by Oct 05
- Good effort, supported by most Chief Engineers
- However, OSS&E is a subset of systems engineering
- Over last 2 years, AF started releasing high-level policy regarding systems engineering

# AF and DoD Sys Eng Policy




Renewed emphasis on systems engineering

Implementation of SE Plans




Requires PEO chief engineer

Conduct of technical reviews

# SE Policy Addendum

## Signed by the Marvin R. Sambour, Asst. SecAF (Acquisition) Apr 03 & Jan 04

- Policy Memo 03A-005, 9 Apr 03
  - Subj: Incentivizing contractors for Better Systems Engineering
  - "An immediate transformation imperative for all our programs is to focus more attention on the application of Systems Engineering principles…"
  - Directing the following:
    - A. Assess ability to incentivize contractors to perform robust SE
    - B. Develop SE performance incentives
    - C. Include SE processes/practices during all program reviews
- Policy Memo 04A-001, 7 Jan 04
  - Subj: Revitalizing Air Force and Industry Systems Engineering (SE) – Increment 2
  - "…intended to institionalize key attributes of an acceptable SE approach and outcome…"
  - "…must focus on an end state…"

# Systems Engineering Policy in DoD

## Signed by the Honorable Mike Wynne, USD(AT&L) (Acting) Feb 20, 2004

- All programs, regardless of ACAT shall:
  - Apply an SE approach
  - Develop a Systems Engineering Plan (SEP)
    - Describe technical approach, including processes, resources, and metrics
    - Detail timing and conduct of SE technical reviews
- Director, DS tasked to provide SEP guidance for DoDI 5000.2
  - Recommend changes in Defense SE
  - Establish a senior-level SE forum
  - Assess SEP and program readiness to proceed before each DAB and other USD(AT&L)-led acquisition reviews

# SEP Implementation Guidance

## Per OUSD(AT&L) Defense Systems Memo signed Mar 30, 2004

- **Submitted to MDA at each Milestone, SEP describes:**
  - **Systems engineering approach**
    - **Specific processes and their tailoring by phase**
    - **Both PMO and Contractor processes**
  - **Systems technical baseline approach**
    - **Use as control mechanism, including TPMs and metrics**
  - **Technical review criteria and outcomes**
    - **Event driven**
    - **Mechanism for assessing technical maturity and risk**
  - **Integration of SE with IPTs and schedules**
    - **Organization, tools, resources, staffing, metrics, mechanisms**
    - **Integrated schedules (e.g., IMP and IMS)**

# SE Policy Addendum

## Signed by the Honorable Mike Wynne, USD(AT&L) (Acting) Oct 22, 2004

- Each Program Executive Officer (PEO) shall have a lead or chief systems engineer
- The PEO lead or chief systems engineer shall:
  - Review assigned programs' SEPs and oversee their implementation
  - Assess the performance of subordinate lead or chief systems engineers
- Technical reviews shall:
  - Be event driven (vice schedule driven)
  - Conducted when the system under review meets review entrance criteria as documented in the SEP
  - Include participation by subject matter experts independent of the program, unless waived by SEP approval authority in the SEP

# *Defense Acquisition Guidebook*, Chapter 4, Section 4.2

- **SE terminology, models, and standards**
  - Technical Management Processes

| | |
|---|---|
| • Decision Analysis | • Risk Management |
| • Technical Planning | • Configuration Mgmt |
| • Technical Assessment | • Technical Data Mgmt |
| • Requirements Mgmt | • Interface Management |

  - Technical Processes

| | |
|---|---|
| • Requirements Development | • Integration |
| • Logical Analysis | • Verification |
| • Design Solution | • Validation |
| • Implementation | • Transition |

# So What is the Problem?

- High-level policy is a good and necessary first step, however, a more detailed direction is essential to turn the policy into a workable, grass-roots program

# So What Do We Do About It?

- Propose a step-by-step approach to begin implementing systems engineering throughout the organization
- Is a tangible approach that is:
  - Aimed at the working level
  - Affects all phases of a program's lifecycle
  - Applicable throughout entire organization
  - Accounts for organization's progress through metrics
- Approach is based on the OSS&E construct

# Summary of the OSS&E Construct

- Level 1 Criteria—Chief Engineer Assigned
- Level 2 Criteria—Configuration Control Processes Established
- Level 3 Criteria—Document Plan to Assure and Preserve OSS&E Baseline Characteristics
- Level 4 Criteria—OSS&E Baselines Developed and Coordinated with User
- Level 5 Criteria—OSS&E Assessment of Fielded Systems, Resolve Disconnects with Baseline
- Level 6 Criteria—Monitor and Maintain Full OSS&E Policy Compliance

# Notional Sys Eng Implementation Phases

- Phase 1: Awareness of Need
- Phase 2: Workforce Training/Education
- Phase 3: Identify Applicable Programs/Orgs
- Phase 4: Identify and Define Processes
- Phase 5: Incentivize Contractors/Partners
- Phase 6: Develop Library of Tools
- Phase 7: Track Progress via Metrics

# Phase 1: Awareness of Need

- **Phase 1 Taskings:**
  - Identify Focal Point for SE policy, practice and implementation
  - Brief senior leaders on SE Defintion, SE policy, and SE "reinvigoration" plan
  - Develop "Road Show" for subordinate offices and/or programs
- **Exit Criteria:**
  - Focal Point identified and appointed
  - Senior leaders briefed with documented support/concurrence
  - Road show presented to all applicable offices/programs

# Phase 2: Workforce Training/Education

- **Phase 2 Taskings:**
  - Define minimum training/certification requirements
  - Train working level engineers
  - Train program managers
  - Train Lead/Chief Engineers and Directors of Engineering
- **Exit Criteria:**
  - 80% of working level engineers trained
  - 95% of program managers trained
  - 100% of Lead/Chief Engineers, and Directors of Engineering trained

# Phase 3: Identify Applicable Programs/Orgs

- Phase 3 Taskings:
  - List all applicable Programs/Organizations, such as:
    - All OSS&E identified programs
    - Other major progams and projects
    - Engineering Contracts
    - Technology Insertion Projects
    - Relevant functional offices (Engineering, Logistics…)
  - Notify each affected program and organization
  - May do incrementally, but if so, build schedule
- Exit Criteria:
  - Documented process to identify programs/orgs
  - Clear, comprehensive list
  - Schedule phase due dates for all programs/organizations

# Phase 4: Identify and Define Processes

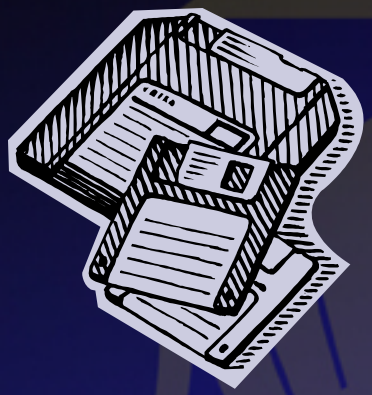
- **Phase 4 Taskings:**
  - Develop list of applicable common processes
    - At a minimum include:
      - Requirements Management
      - Risk Management
      - Configuration Management
      - Test Management
      - Life Cycle Cost/Robustness
  - Define/standardize each process
    - Use best practices
    - Clearly document each process
  - Systems Engineering Plan (SEP)
- **Exit Criteria:**
  - List of common, documented processes

# Phase 5: Incentivize Contractors/Partners

- **Phase 5 Taskings:**
  - Devise selection criteria
  - List applicable contracts
  - Develop tailorable “template”
  - Ensure language in contracts
  - Determine how to verify SE compliance
- **Exit Criteria:**
  - List of all targeted contracts
  - SE an incentivized factor in all applicable contracts
    - Given the nature of contracts, this can be a sliding scale, e.g 25% in FY06, 50% by 2007, etc…

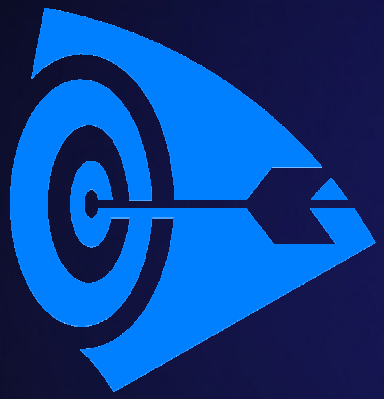
# Phase 6: Develop Library of Tools

- Phase 6 Taskings
  - Define "How To" and examples for:
    - Risk Management
    - Requirement Management
    - Configuration Management
    - Designing for Life Cycle Cost
    - Others
      - M&S - Best Practices
      - Tech Perf Measurement - Paredo Charts
      - Trade Studies - Case studies
      - Fishbone Analysis - Lessons Learned
      - Peer Reviews - Trend Analysis
      - Test Management - Etc
  - Exit Criteria
    - Documented, advertised, dynamic, and accessible library of tools/techniques

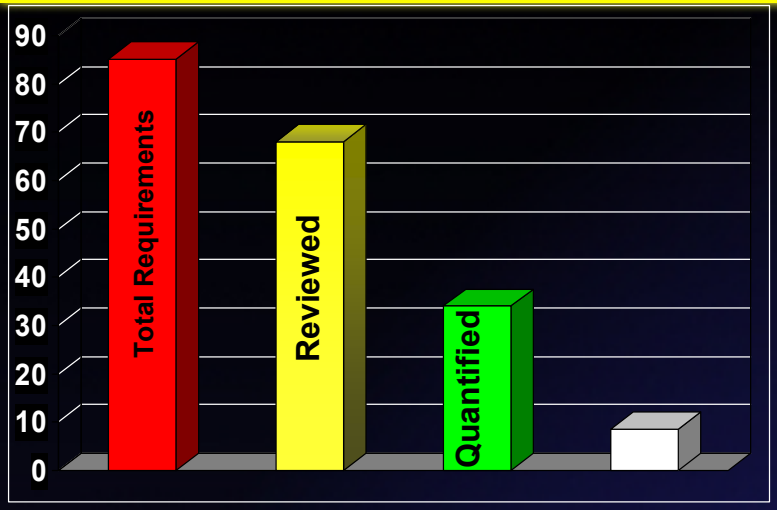


# Phase 7: Track Progress via Metrics

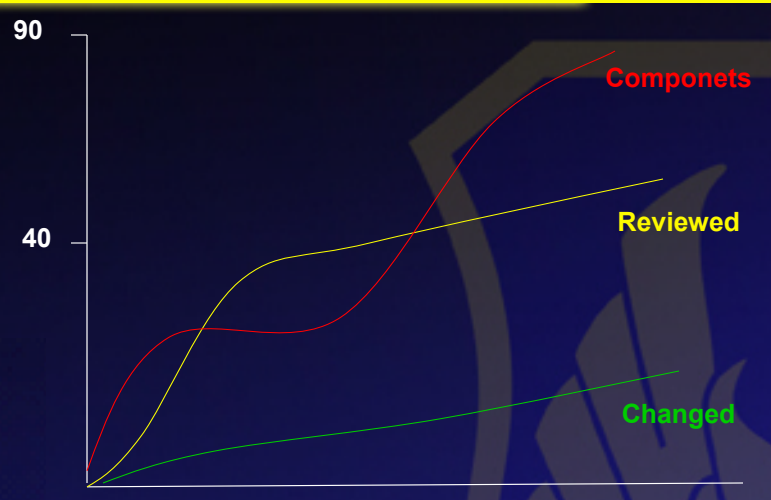
- Phase 7 Taskings
  - Develop a set metrics
  - Determine when and at what level(s) they will be regularly briefed
- Exit Criteria
  - Developed set of metrics
  - Metrics displayed regularly at staff meetings



# Sample Program Sys Eng "Dashboard"




Requirements

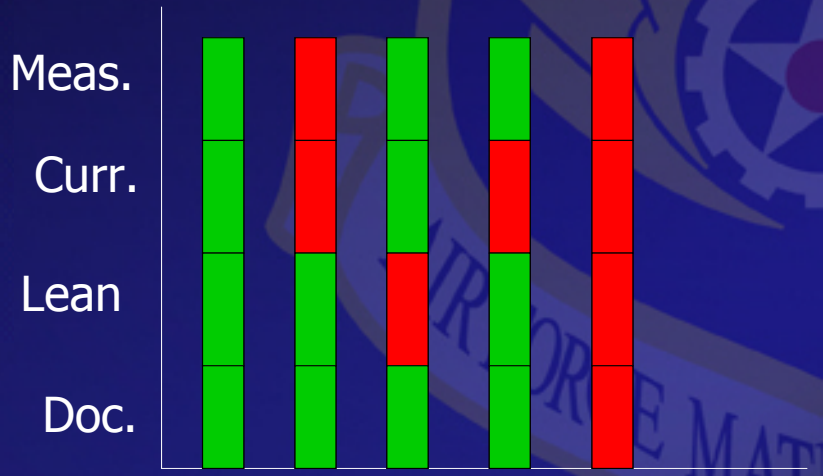



LCC/Robust


Contracts

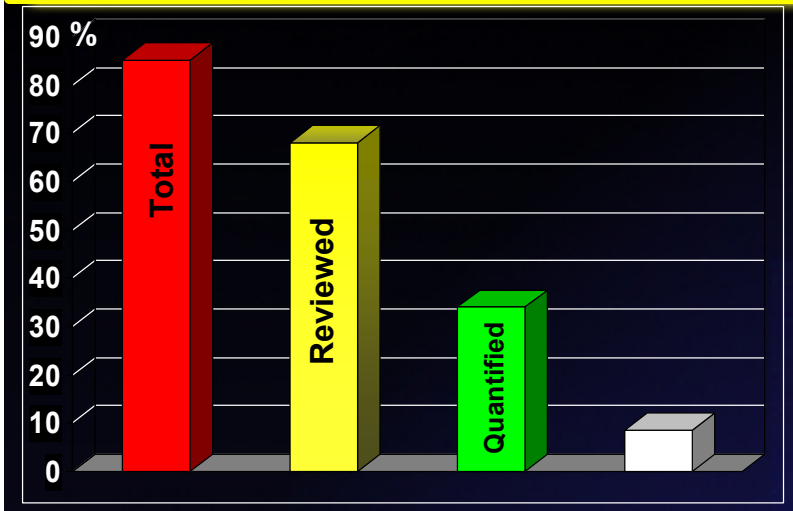
| | Low | Med. | High |
|---|---|---|---|
| High | 0 | 2/4 | 1/2 |
| Med. | 1/6 | 0/1 | 3/4 |
| Low | 1/3 | 2/4 | 2/3 |

Risk

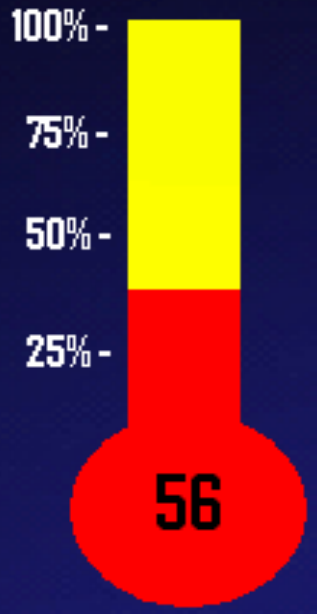



Processes

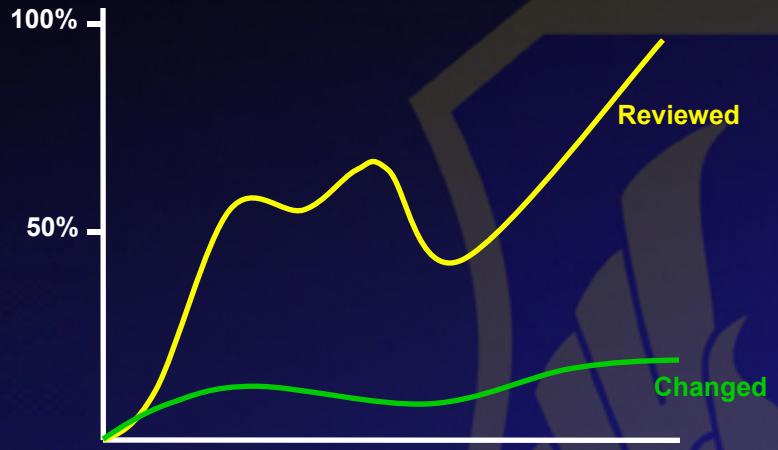
# Sample Organization Sys Eng "Dashboard"




Requirements (%)



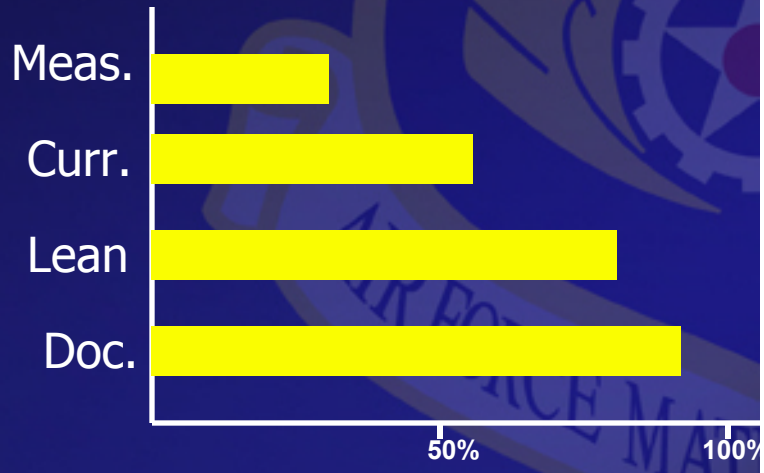

Contracts




LCC/Robust (%)

| | Low | Med. | High |
|---|---|---|---|
| High | 20 | 40 | 80 |
| Med. | 5 | 50 | 60 |
| Low | 10 | 5 | 40 |

Risk (%)




Processes (%)

# Summary

- AF is releasing necessary high-level policy regarding SE
- Need a workable grass-roots means to implement SE
- Developed a notional 7 phase approach
  - Similar to OSS&E construct
  - Aimed at the working level
  - Affects entire lifecycle
  - Applicable to whole organization
  - Accounts for progress

- Provides a concrete, tangible starting point to help first line supervisors and working engineers begin implementing systems engineering

# Questions?

# OSS&E- Level 1

- Level 1 Criteria—Chief Engineer Assigned
- Exit Criteria
  - System/End-Item (S&EI) on OSS&E S&EI List
  - Chief Engineer identified on OSS&E S&EI list
  - Process is in place to update S&EI list (1.1.1 a)

# OSS&E- Level 2

- Level 2 Criteria—Configuration Control Processes Established
- Exit Criteria
  - Configuration control processes identified and documented at the program level
  - Configuration control process training requirements identified
  - Configuration control processes are in-place and operating
  - Delegated authority identified and documented

# OSS&E- Level 3

- Level 3 Criteria—Plan to Assure and Preserve OSS&E Documented
- Exit Criteria
  - Plan shall include strategies/approach for:
    - Identifying, reconciling, and preserving OSS&E baseline characteristics
    - Achieving and/or maintaining required certifications
    - Establishing OSS&E program level and product line metrics
    - Identifying data system feedback mechanisms
  - OSS&E Execution Plan coordinated with:
    - Appropriate Product, Logistic, Test, and Specialty Centers

# OSS&E- Level 4

- Level 4 Criteria—OSS&E Baselines Developed and Coordinated with User
- Exit Criteria
  - OSS&E baseline characteristics identified
  - Critical Characteristics for measuring safety, suitability, and effectiveness selected
  - OSS&E baseline characteristics and metrics coordinated with users

# OSS&E- Level 5

- Level 5 Criteria—OSS&E Assessment of Fielded Systems/End-Items
- Exit Criteria
  - Fielded system/end-item data gathered
  - OSS&E baseline characteristics assessment completed
  - OSS&E baseline disconnects identified
  - Recommended corrective actions to users

# OSS&E- Level 6

- Level 6 Criteria—Full OSS&E Policy Compliance
- Exit Criteria
  - Level 5 corrective actions completed
  - All required certifications in place and maintained
  - Metrics and feedback systems monitoring OSS&E health
  - Processes established and in place to maintain OSS&E baseline characteristics