

Converting High-Level Systems Engineering Policy to a Workable Program



26 Oct 05

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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

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010
FEB 21 2010

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Policy for Systems Engineering in 2010

Application of rigorous systems engineering discipline is paramount to the Department's ability to meet the challenge of developing and maintaining needed warfighting capability. This is especially true as we serve to integrate, sustain, and modernize complex systems in a family-of-systems, system-of-systems, networked warfare context. Systems engineering provides the integrating technical processes to define and balance system performance, cost, schedule, and risk. It must be embedded in program planning and performed across the entire acquisition life cycle.

Toward that end, I am establishing the following policy, effective immediately and to be included in the next revision of the DoD SEI series acquisition documents:

Systems Engineering (SE). All programs responding to a capability or requirements document, regardless of acquisition category, shall apply a systems engineering approach that ensures total system performance and total ownership costs within the family-of-systems, systems-of-systems context. Programs shall develop a formal Systems Engineering Plan (SEP) that shall be included in the next revision of the DoD SEI series acquisition documents.

h. Assess the adequacy of current Department-level SE related policies, processes, practices, guidance, tools, and education and training and recommend to the necessary changes.

Renewed emphasis on systems engineering
Implementation of SE Plans

THE UNDER SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-3010
SEP 22 2009

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Policy Addendum for Systems Engineering

For the direction in my systems engineering policy memorandum (February 20, 2010), the Director, Defense Systems established the Systems Engineering Forum. Your feedback via this forum reinforced the importance of having systems engineering expertise readily available to program managers throughout the system life cycle. Consequently, I establish the following additional policy, effective immediately, and to be included in the next revision of DoD Instruction 5160.2.

Each Program Executive Officer (PEO), or equivalent, shall have a lead or chief systems engineer on his or her staff responsible to the PEO for the application of systems engineering across the PEO's portfolio of programs. The PEO lead or chief systems engineer shall review and approve customer Systems Engineering Plans (SEPs) and ensure their implementation. The PEO lead or chief systems engineer shall also assess the performance of subordinate lead or PEO and program manager.

Additional details of program management shall be derived from the DoD SEI series acquisition documents.

Implementation, processes, and I reserve the management policy and guidance will outline this

Requires PEO chief engineer
Conduct of technical reviews

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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 institutionalize 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**

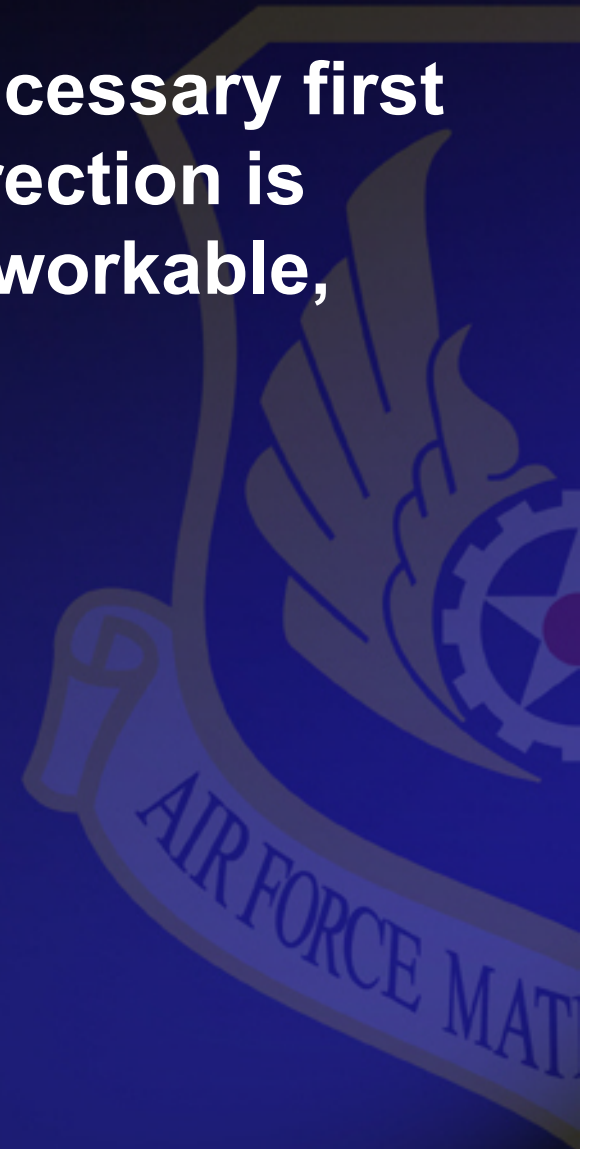
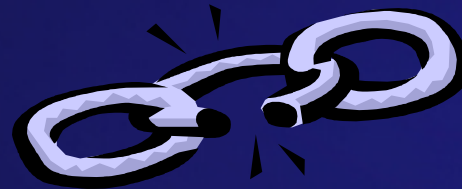
- | | |
|---|---|
| <ul style="list-style-type: none">• Decision Analysis• Technical Planning• Technical Assessment• Requirements Mgmt | <ul style="list-style-type: none">• Risk Management• Configuration Mgmt• Technical Data Mgmt• Interface Management |
|---|---|

- **Technical Processes**

- | | |
|--|--|
| <ul style="list-style-type: none">• Requirements Development• Logical Analysis• Design Solution• Implementation | <ul style="list-style-type: none">• Integration• Verification• Validation• 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**

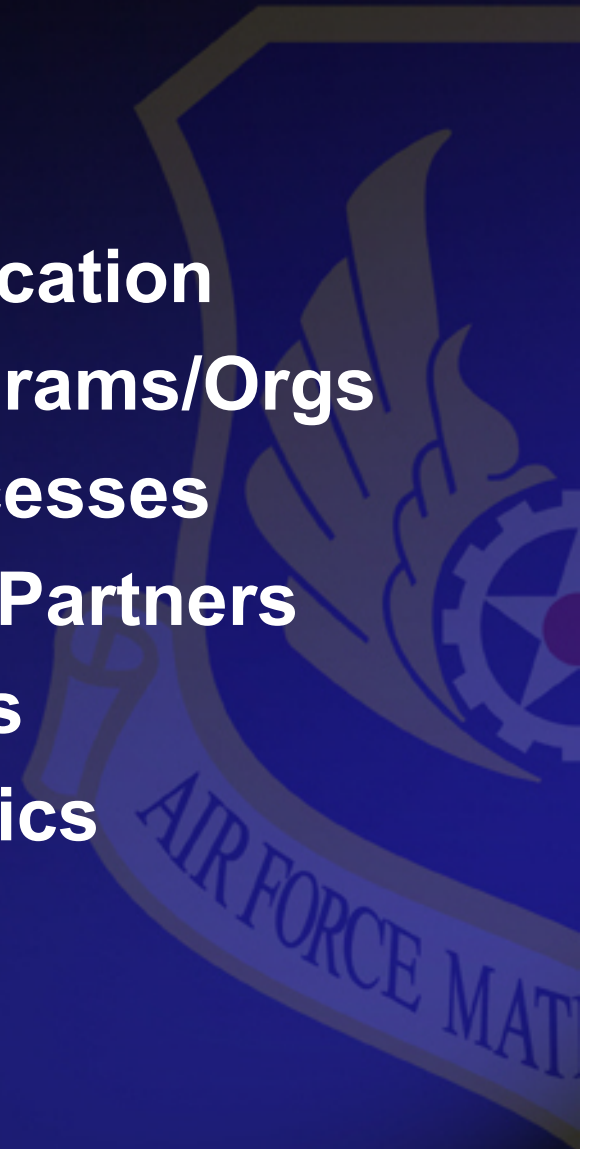


Summary of the OSS&E Construct

- **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 Definition, 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 programs 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...



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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

- Tech Perf Measurement

- Trade Studies

- Fishbone Analysis

- Peer Reviews

- Test Management

- Best Practices

- Pareto Charts

- Case studies

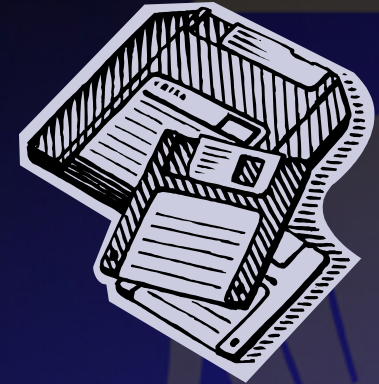
- Lessons Learned

- Trend Analysis

- Etc

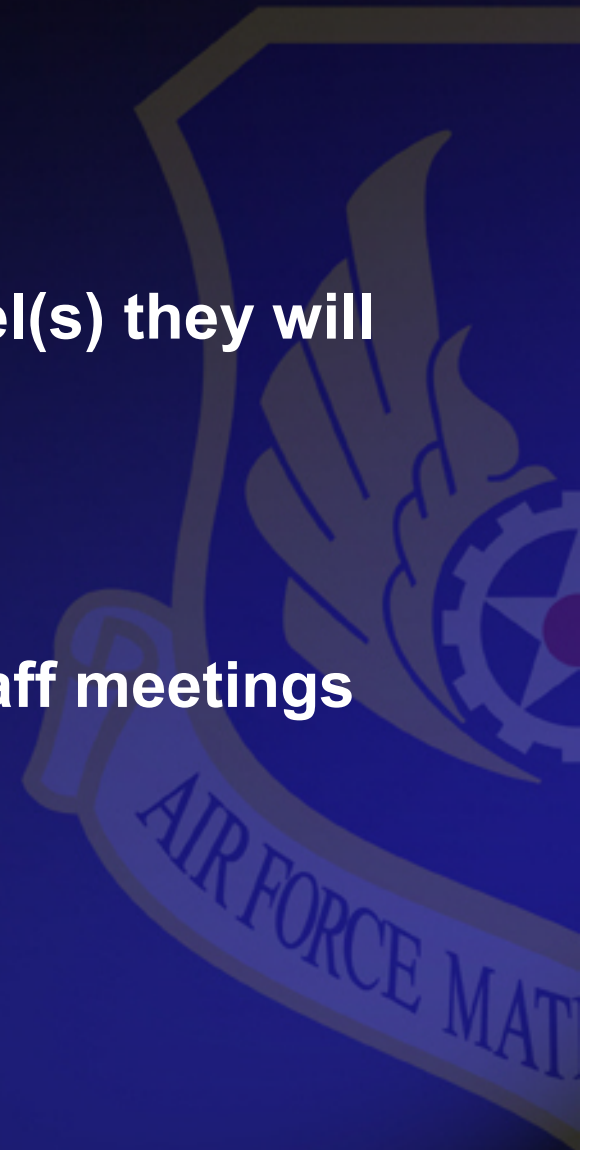
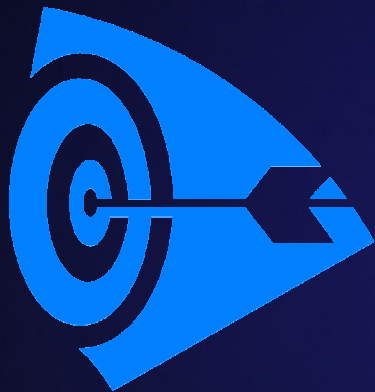
- Exit Criteria

- Documented, advertised, dynamic, and accessible library of tools/techniques

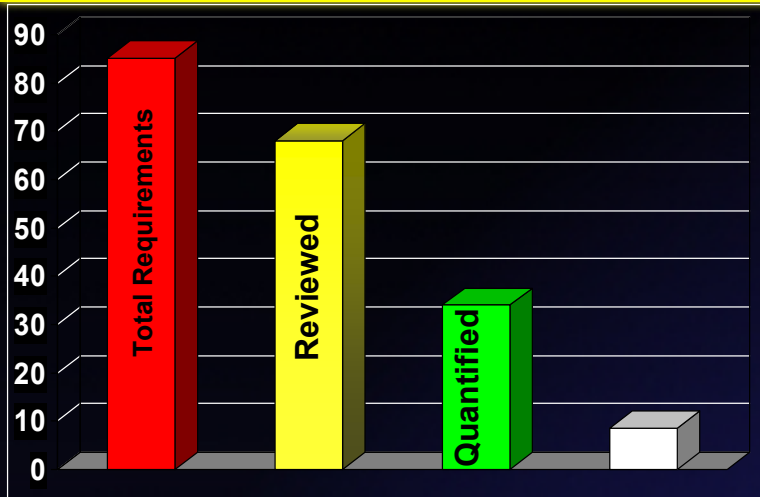


Phase 7: Track Progress via Metrics

- **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



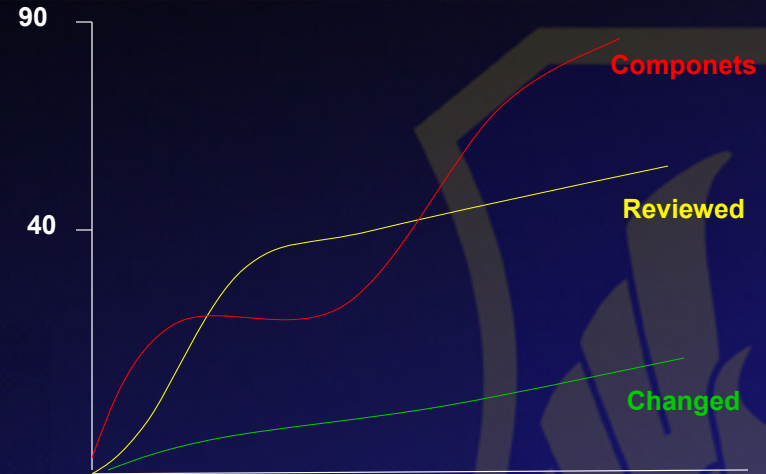
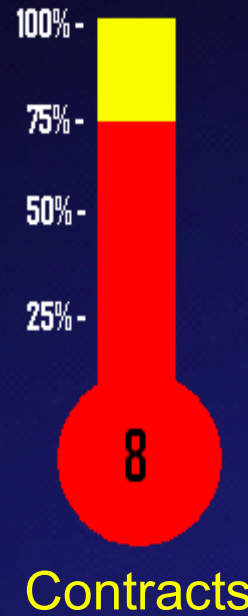
Sample Program Sys Eng "Dashboard"



Requirements

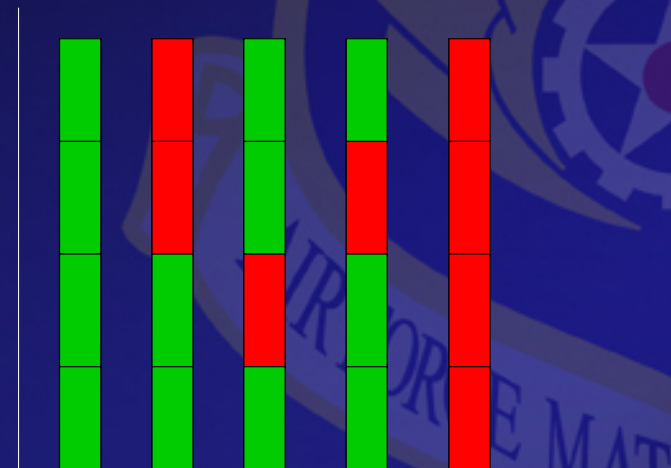
High	0	2/4	1/2
Med.	1/6	0/1	3/4
Low	1/3	2/4	2/3
	Low	Med.	High

Risk



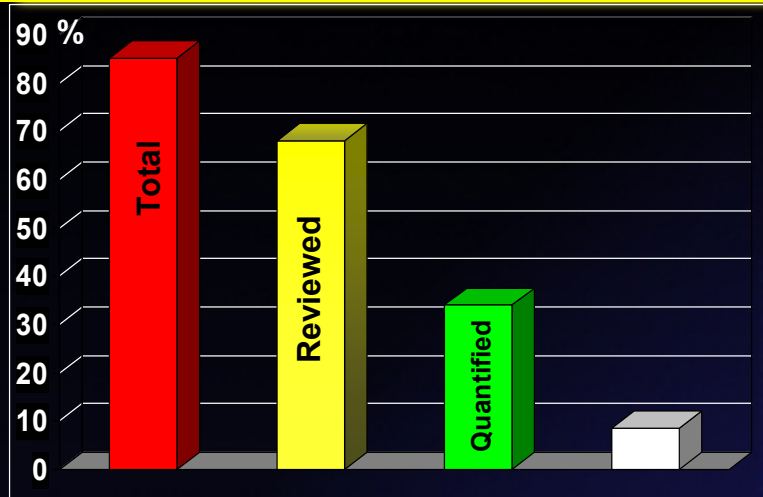
LCC/Robust

Meas.
Curr.
Lean
Doc.



Processes

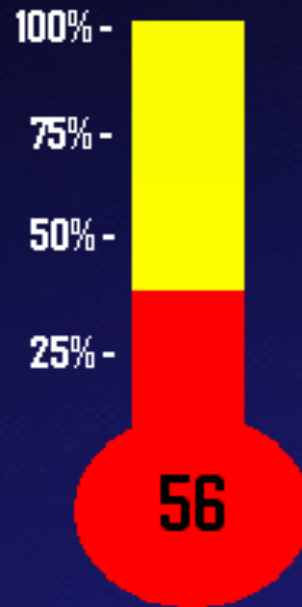
Sample Organization Sys Eng “Dashboard”



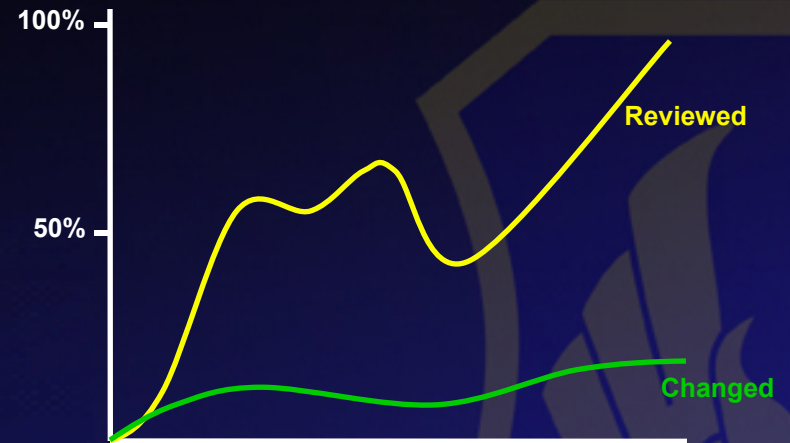
Requirements (%)

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

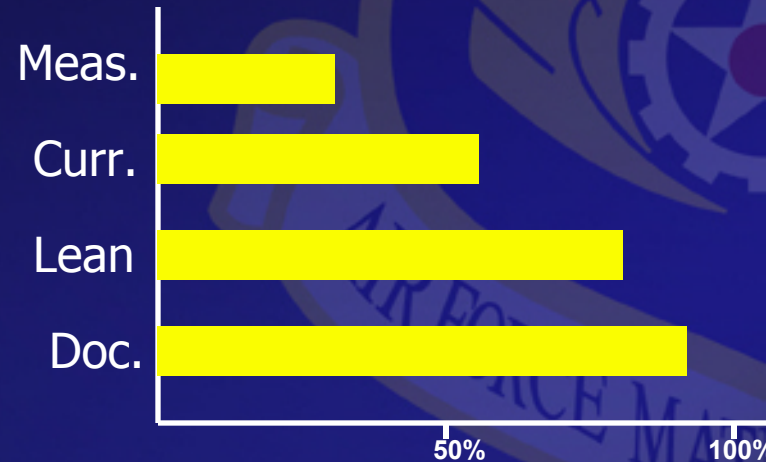
Risk (%)



Contracts



LCC/Robust (%)



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
- 
- The logo of the Air Force Materiel Command is visible in the background on the right side of the slide. It features a stylized hand holding a gear, with a banner below it that reads "AIR FORCE MATERIEL".

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

