Headquarters U.S. Air Force

Integrity - Service - Excellence

Systems Engineering Standard Practices: An AF Acquisition Improvement Initiative

2010 NDIA Systems Engineering Conference, 28 Oct 10

Chris Ptachik
SAF/AQRE Ctr
AF Departmental Standardization Office

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Topics

- Role, need, or value of standards for acquisition and engineering, especially SE
- State of SE standards, specs, handbooks in AF
- When to use DoD/MIL standards versus industry standards

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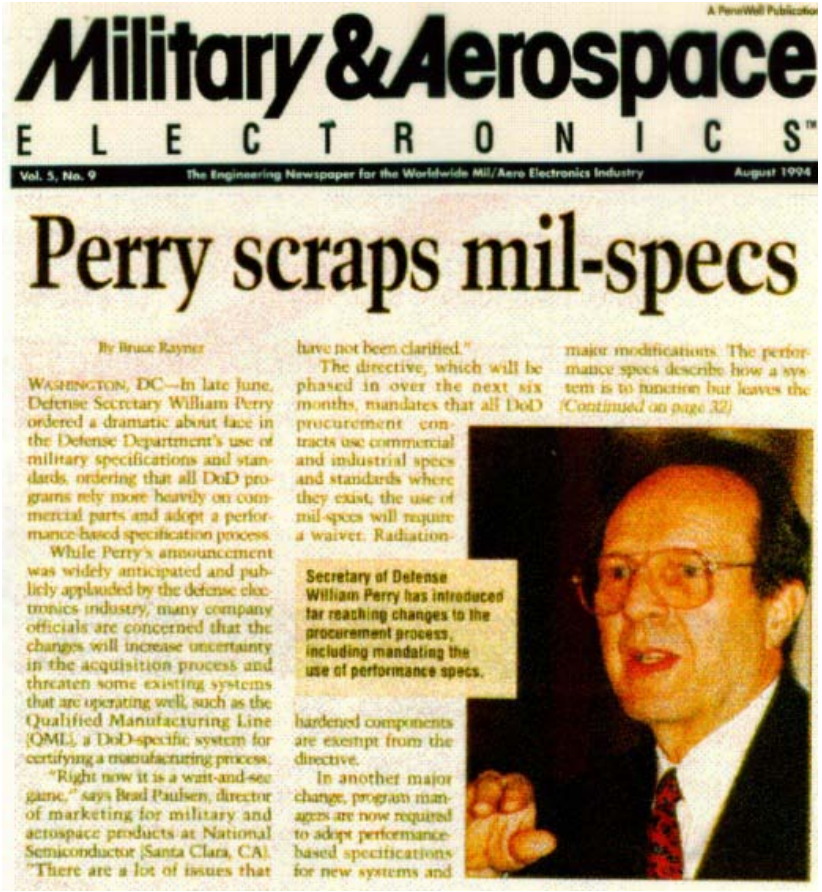
Need for SE Standards – Won Cold War, Shifted the Paradigm…



A PennWell Publication

Military & Aerospace ELECTRONICS™

Vol. 5, No. 9 — The Engineering Newspaper for the Worldwide Mil/Aero Electronics Industry — August 1994

Perry scraps mil-specs

By Bruce Rayner

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(Continued on page 32)

Secretary of Defense William Perry has introduced far reaching changes to the procurement process, including mandating the use of performance specs.

- Nuclear threat drove technology and systems
  - DOD a major consumer; defense industry set the pace
- Peace dividend diminished DOD influence, especially in electronics
  - Commercial market set the pace
  - DOD buying changed; adopted commercial practices
  - Prohibited or severely restricted use of all types of MIL SPECS & STDS

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Need for SE Standards – Types of Defense Standards*

- Interface standards: physical, functional, or military operational environment interface characteristics of systems, subsystems, equipment, assemblies, components, items, or parts.
- Design criteria standards: military-unique design or functional criteria (required) in the development of systems, subsystems, equipment, assemblies, components, items, or parts.
- Test method standards: the procedures or criteria for measuring, identifying, or evaluating qualities, characteristics, performance, and properties of a product or process.
- Manufacturing process standards: the desired outcome of a manufacturing process or specific procedures or criteria on how to perform a manufacturing process. (highly discouraged)
- Standard practices: procedures on how to conduct non-manufacturing functions that, at least some of the time, are obtained via contract from private sector firms.

* MIL-STD-962D(C1)

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Need for SE Standards – Core SE Standard Practices Cancelled

APPENDIX B
FINAL DISPOSITIONS OF THE TOP 110 COST DRIVER MILITARY SPECIFICATION AND STANDARDS

Canceled Without Replacement

MIL-STD-337	Design to Cost
MIL-STD-415	Test Provisions for Electronic Systems and Associated Equipment, Design Criteria For
MIL-STD-499	Engineering Management
MIL-STD-680	Standardization Program Requirements for Defense Acquisition
MIL-STD-785	Reliability Program for Systems Equipment Development and Production
MIL-STD-804	Formats and Coding of Aperture, Camera, Copy, and Tabulating Cards
MIL-STD-973	Configuration Management (CM)
MIL-STD-980	Foreign Object Damage Prevention in Aerospace Products
MIL-STD-1345	Test Requirements Document, Preparation of
MIL-STD-1367	Packaging, Handling, Storage, and Transportability Program Requirements
MIL-STD-1421	Breathing Apparatus (Self-Contained)
MIL-STD-1519	Test Requirements Document, Preparation of
MIL-STD-1520	Corrective Action and Disposition System for Nonconforming Material
MIL-STD-1521	Technical Review and Audits for Systems, Equipments, & Computer
MIL-STD-1528	Manufacturing Management Program
MIL-STD-1535	Supplier Quality Assurance Program Requirements
MIL-STD-1543	Reliability Program Requirements for Space and Launch Vehicle
MIL-STD-1556	Government/Industry Data Exchange Program, Contractor Participation Requirements
MIL-STD-1567	Work Measurement
MIL-STD-1629	Procedures for Performing a Failure Mode, Effects and Criticality Analysis
MIL-STD-1785	System Security Engineering Program Management Requirements
MIL-STD-1803	Software Development Integrity Program
MIL-STD-1806	Marking Technical Data Prepared by or for the DoD
MIL-STD-2000	Standard Requirements for Soldered Electrical & Electronic Assemblies
MIL-STD-2077	General Requirements, Test Program Sets
DOD-STD-2168	Defense System Software Quality Program
MIL-HDBK-51	Evaluation of a Contractor's Inspection System
MIL-Q-9858	Quality Program Requirements
MIL-E-21981	Electronics Type Designations, Identification Plates & Markings, Requirements for
MIL-C-28809	Circuit Card Assemblies, Rigid, Flexible, Rigid Flex
MIL-M-38784	Manuals, Technical: General Style and Format Requirements
MIL-I-45208	Inspection System Requirements
MIL-S-45743	Soldering, Manual Type, High Reliability Electrical and Electronic Equipment
MIL-P-46843	Printed Wiring Assemblies, Production of
MIL-T-62314	Test Equipment (Simplified) for Internal Combustion Engine (STE/ICE)

1

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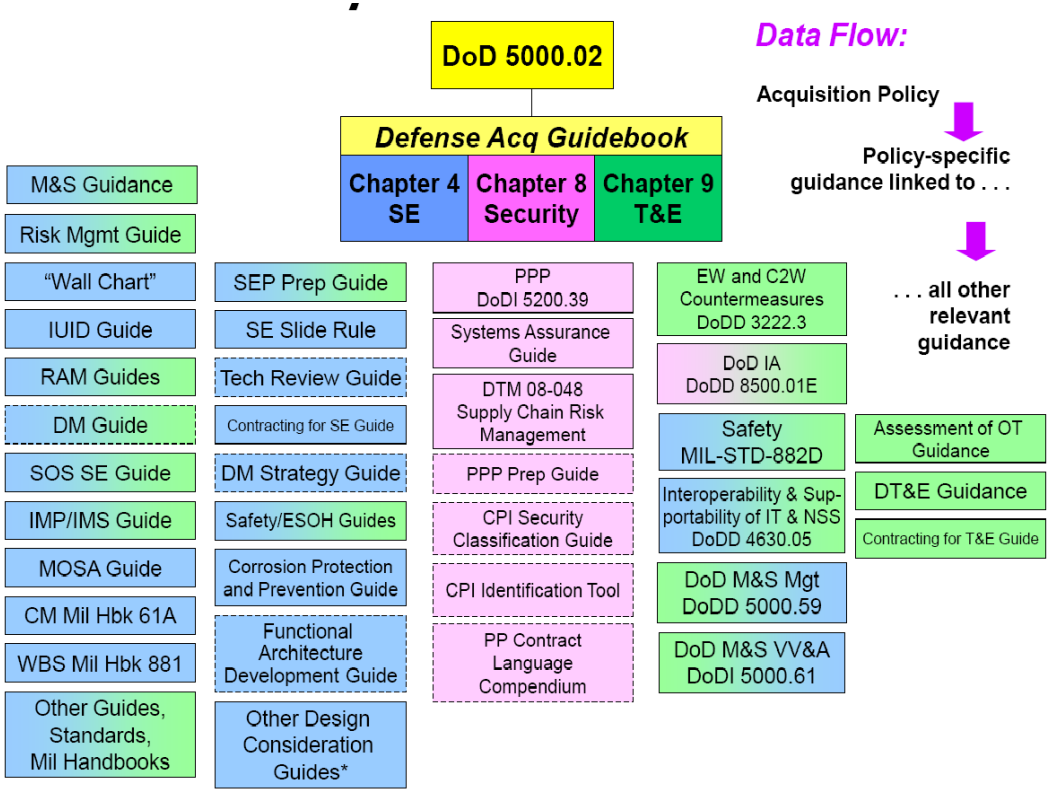
Need for SE Standards – Consistency in Practices & Training

- Performance-based specifications allow for design innovation
  - Evaluated against warfighter requirements & technology readiness
- Objective-based statements of work (SOO) allow for company best practices
  - Evaluated against…?
  - Bidder's SOWs & practices not common in a competitive environment
- Guidance useful; inconsistently applied across AF



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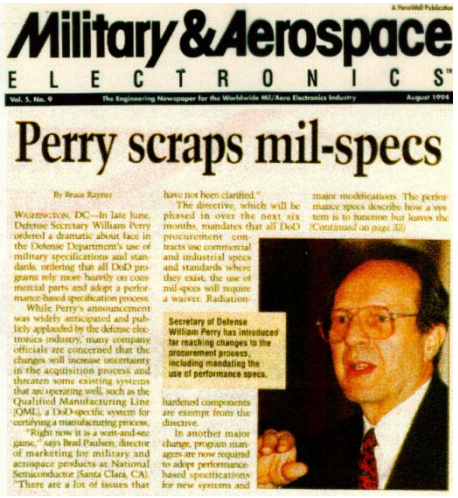
Need for SE Standards - SMC / Space Experience



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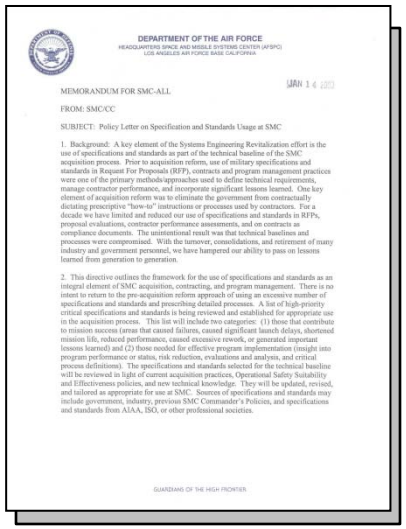


DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER (AFSPC)
LOS ANGELES AIR FORCE BASE CALIFORNIA

MEMORANDUM FOR SMC-ALL

JAN 14 2010

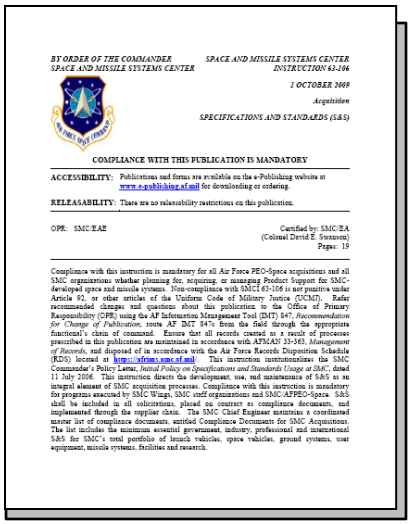
FROM: SMC/CC

SUBJECT: Policy Letter on Specification and Standards Usage at SMC

1. Background: A key element of the Systems Engineering Revitalization effort is the use of specifications and standards as part of the technical baseline of the SMC acquisition process. Prior to acquisition reform, use of military specifications and standards in Request For Proposals (RFP), contracts and program management practices were one of the primary methods/approaches used to define technical requirements, manage contractor performance, and incorporate significant lessons learned. One key element of acquisition reform was to eliminate the government from contractually dictating prescriptive "how-to" instructions or processes used by contractors. For a decade we have limited and reduced our use of specifications and standards in RFPs, proposal evaluations, contractor performance assessments, and on contracts as compliance documents. The unintentional result was that technical baselines and processes were compromised. With the turnover, consolidations, and retirement of many industry and government personnel, we have hampered our ability to pass on lessons learned from generation to generation.

2. This directive outlines the framework for the use of specifications and standards as an integral element of SMC acquisition, contracting, and program management. There is no intent to return to the pre-acquisition reform approach of using an excessive number of specifications and standards and prescribing detailed processes. A list of high-priority critical specifications and standards is being reviewed and established for appropriate use in the acquisition process. This list will include two categories: (1) those that contribute to mission success (areas that caused failures, caused significant launch delays, shortened mission life, reduced performance, caused excessive rework, or generated important lessons learned) and (2) those needed for effective program implementation (insight into program performance or status, risk reduction, evaluations and analysis, and critical process definitions). The specifications and standards selected for the technical baseline will be reviewed in light of current acquisition practices, Operational Safety Suitability and Effectiveness policies, and new technical knowledge. They will be updated, revised, and tailored as appropriate for use at SMC. Sources of specifications and standards may include government, industry, previous SMC Commander's Policies, and specifications and standards from AIAA, ISO, or other professional societies.

GUARDIANS OF THE HIGH FRONTIER



BY ORDER OF THE COMMANDER
SPACE AND MISSILE SYSTEMS CENTER

SPACE AND MISSILE SYSTEMS CENTER
INSTRUCTION 63-106

1 OCTOBER 2009

Acquisition

SPECIFICATIONS AND STANDARDS (S&S)

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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RELEASABILITY: There are no releasability restrictions on this publication.

OPR: SMC/EAE

Certified by: SMC/EA
(Colonel David E. Swanson)
Pages: 19

Compliance with this instruction is mandatory for all Air Force PEO-Space acquisitions and all SMC organizations whether planning for, requiring, or managing Product Support for SMC-developed space and missile systems. Non-compliance with SMCI 63-106 is not punitive under Article 92, or other articles of the Uniform Code of Military Justice (UCMJ). Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Information Management Tool (IMT) 847, *Recommendation for Change of Publication*, route AF IMT 847s from the field through the appropriate functional's chain of command. Ensure that all records created as a result of processes prescribed in this publication are maintained in accordance with AFMAN 33-363, *Management of Records*, and disposed of in accordance with the Air Force Records Disposition Schedule (RDS) located at https://afrims.amc.af.mil/. This instruction institutionalizes the SMC Commander's Policy Letter, *Initial Policy on Specifications and Standards Usage at SMC*, dated 11 July 2006. This instruction directs the development, use, and maintenance of S&S as an integral element of SMC acquisition processes. Compliance with this instruction is mandatory for programs executed by SMC Wings, SMC staff organizations and SMC/AFPEO-Space. S&S shall be included in all solicitations, placed on contract as compliance documents, and implemented through the supplier chain. The SMC Chief Engineer maintains a coordinated master list of compliance documents, entitled Compliance Documents for SMC Acquisitions. The list includes the minimum essential government, industry, professional and international S&S for SMC's total portfolio of launch vehicles, space vehicles, ground systems, user equipment, missile systems, facilities and research.

- Unintended Consequences - <u>reduced effectiveness of acquisition practices</u>…
- Significant Lost Space Assets during the 1990s/early 2000's
- ✓ Re-applied specs & standards as element of acquisition practices and toolset
- ✓ Established "Select" list of 65 space systems standards
- ✓ Established Organizational Policy
- ✓ Specify critical standards in RFP

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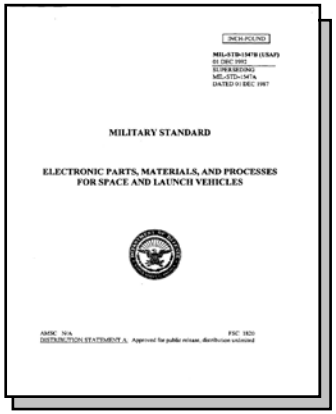
Need for SE Standards - SMC / NRO Space Experience

- **Commander SMC & Director NRO requests**
  - **Reinstate two MIL-STDs**
    - **MIL-STD-1546* (AF only)**
    - **MIL-STD-1547** (Full Coord)**
  - **Standard Practices needed for effective program execution**
- **Actions approved in 2008**
  - ✓ **AF Standardization Exec w/HQ AF coordination (-1546)**
  - ✓ **Defense Standardization Council (-1547)**


MIL-STD-1546B (USAF)
27 JUL 1992

MILITARY STANDARD

PARTS, MATERIALS, AND PROCESSES
CONTROL PROGRAM
FOR
SPACE AND LAUNCH VEHICLES


MIL-STD-1547B (USAF)

MILITARY STANDARD

ELECTRONIC PARTS, MATERIALS, AND PROCESSES
FOR SPACE AND LAUNCH VEHICLES

* *Parts, Materials and Processes Engineering, Management and Control Program for Space and Launch Vehicles*

** *Electronic Parts, Materials and Processes for Space and Launch Vehicles (HOT 110 std)*

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Need for SE Standards - AFMC / ASC Mfg Experience

ASC Study of GAO Reports & Root Causes

- **Industry message: AF does not specify right …**
  - **"Deliverables"**
  - **"Mfg/QA contractual requirements"**
- **Create Air Force Policies and Instructions (AFPDs, AFIs)**
  - **Flow Mfg & QA reqmts down to Centers**
- **Policy should:**
  - **Put "transition to production" tasks back in SOO/SOW**
- **Convert MIL-HDBK-896* to MIL-STD**
  - **Enable consistent application of proven best practices**

*** Manufacturing & Quality Program**

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Need for SE Standards - AFMC / AAC RFP Experience

Summary of Industry Panel Findings

- **Acquisition Reform, Competitive Pressures, and Industry Over-Reliance on Modeling/Analysis, parented a Loss of Critical Systems Engineering Fundamentals:**
  - Government Standards Lost to Acquisition Reform
  - Insufficiently Defined Requirements in Government RFP's to Assure Complete Design Maturation
  - Lack of Detailed Technical Planning Being Provided In Industry Proposals
    - For Government Technical Evaluation
    - For Program Funding Development and Contract Pricing
- **Consensus Opinion on SE**
  - If the Government Doesn't Require Definition of the Core Practices to Mature a Product Design……then,
  - Technical Activities (ie Fundamental Systems Engineering Practices) Are Within Industry's "Trade Space" and Can Be Eliminated Unilaterally-
    - Very Likely to Occur With Pressures of Competition In Today's Acquisitions

Gulf Coast Chapter NDIA

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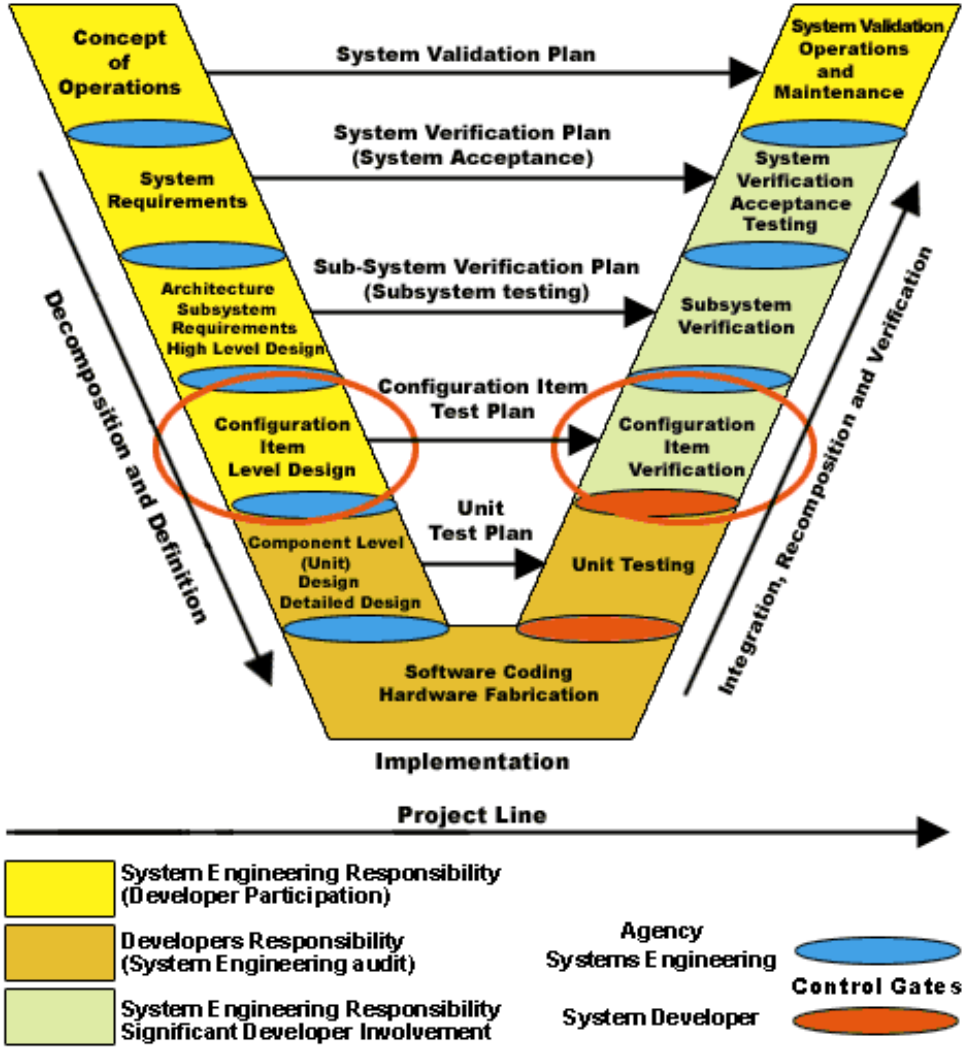
Role of SE Standards – Make SE "V" Work in DOD Acquisitions



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State of Standards in AF - Current Status

- **AF Acquisition Improvement Plan (AIP) Task – Reinstating Standards**
  - ✓ **Action Plan established to track implementation**
    - **Internal AF actions on documents, policy, and resources**
    - **Enabling activities by OSD**
- **Collaborating with DDR&E/SE and DOD Components**
  - ✓ **Through Defense Standardization Council (DSC)**
  - ✓ **AF recommendations vetted and supported**
  - ✓ **Standards needs identified**
  - ✓ **Working Group prioritized for DSC decision**
    - **Initial focus : standard practices for core Systems Engineering process and functional disciplines**
- **8 Nov - DSC meeting**

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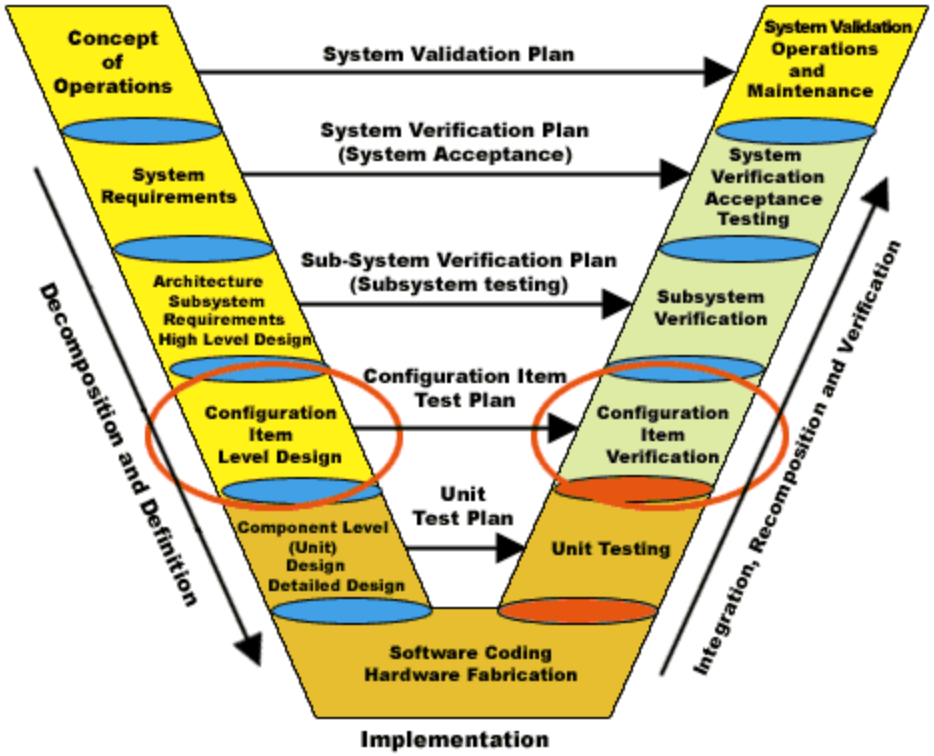
State of Standards in AF – Current Status



KEY TO STANDARD NUMBER COLORS:
RED – "cost driver' standard; cancelled during Mil Spec & Std Reform by DSC
BLACK – active document or one approved for reinstatement

RELIABILITY	MAINTAINABILITY	LSA	MFG/QA
✓ MIL-STD-785 MIL-STD-1629 MIL-STD-781 ANSI/EIA 0009	MIL-STD-470	✓ MIL-STD-1388 ANSI/EIA 0007	✓ MIL-STD-1528 MIL-STD-1535 MIL-HDBK-896

WORK BREAKDOWN STRUCTURE
MIL-STD-881

TEST REQUIREMENTS DOCUMENTS
MIL-STD-1345/1519

TECHNICAL REVIEWS AND AUDITS
✓ **MIL-STD-1521**

CONFIGURATION MANAGEMENT
✓ **MIL-STD-973; ANSI/EIA-649**

SPECIFICATION PRACTICES
MIL-STD-490; MIL-STD-961

SE PROCESS
✓ **MIL-STD-499; ANSI/EIA 632; ISO/IEC 15288**

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State of Standards in AF – Current Status

- Space & Missile Systems Center (SMC)
  - Uses 65 select standards in 29 technical areas
    - 20 – SMC developed w/ Aerospace Corp
    - 19 – Industry developed (10 from AIA)
    - Preparing Activity for MIL-STD-1521
- AF Materiel Command (AFMC)
  - Survey identified 40 standards for action
    - 31 – "Cost driver" list; require DSC approval
    - 21 – AF is the Preparing Activity
    - AFMC committed to resourcing for development & maintenance

- *Program Management*
- *Systems Engineering*
- *Risk Management*
- *Configuration Management*
- *Design Reviews*
- *Product Assurance*
- Electrical Power
- Electrical Power, Batteries
- Electrical Power, Solar
- EMI / EMC
- *Environmental Engineering*
- *Human Factors*
- *Interoperability*
- *Logistics*
- *Parts Management/Engr*
- Ordnance
- Pressure Vessels
- *Reliability*
- *Maintainability*
- *Manufacturing / Producibility*
- *Mass Properties*
- *Safety*
- *Security*
- *Software Development*
- Structures
- *Survivability*
- Moving Mechanical Assemblies (MMAs)
- *Test, Ground*
- *Test, Space*

• *Red Italics = Standard Practice implemented via SOW*

When MIL vs Industry Standards – Commercial vs DOD Business Process

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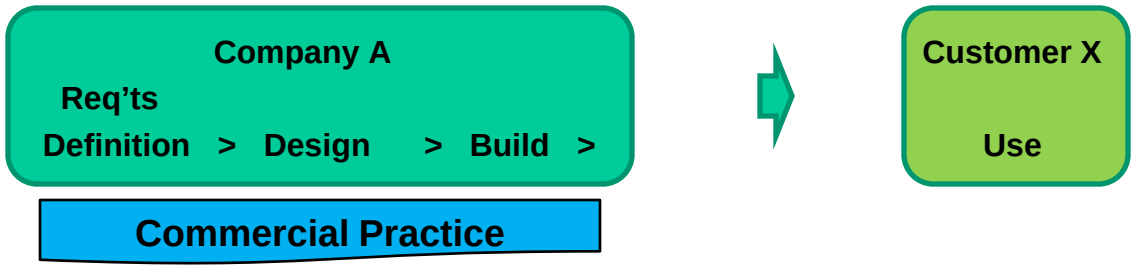
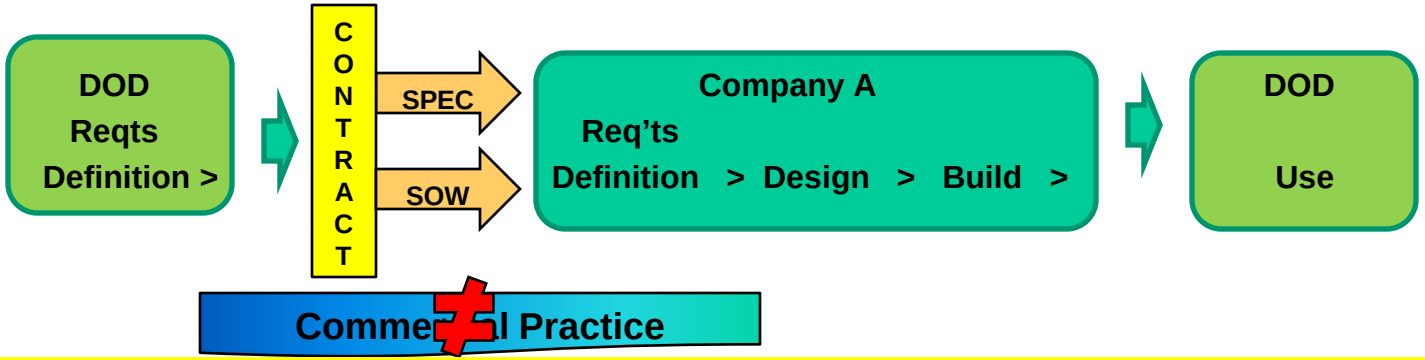
- Every product goes thru life cycle phases of:

  1. Define (requirements) > 2. Design > 3. Build > 4. Use.

- Commercial Business Model to execute this life cycle:



- Typical DOD Business Model to execute this life cycle:



POINT OF VIEW IS NOT THE SAME – ESPECIALLY IN COST PLUS CONTRACTS

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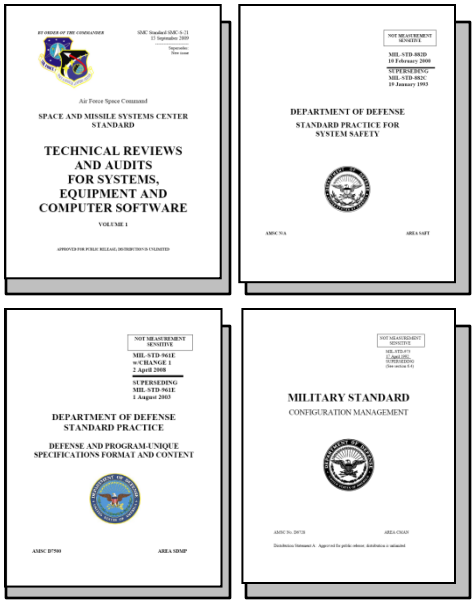
When MIL vs Industry Standards – Standard Practices Decision Criteria



- **Use MIL-STD when:**
  - **Practice is military unique: e.g. *Technical Reviews and Audits, System Safety***
  - **Practice must be standardized for integration with other core & interrelated processes: e.g. *Specification Practices, Configuration Management***
  - **Industry practice does not meet DOD requirements or not structured for use on DOD contracts w/o excessive tailoring**
- **Use industry standard when:**
  - **Practice meets DOD requirements and is suitable for use on contract, e.g. GEIA STD-0007, *Logistics Product Data***

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QUESTIONS?