Disclaimer

The Opinions Expressed by the Speaker

Are His Own

and

Do Not Necessarily Reflect Anyone Else's

..although

They Might!

The Power of the Spec:

The Many and Diverse Roles of Specifications & Standards in Systems Engineering

Robert B. “Scott” Kuhnen

HQ AFMC Command Stdzn Office

Wright-Patterson AFB OH

28 October 2009

First…some table setting…

déjà vu for any of you?

Any of you here in 2007?

Any of you remember…

..this outfit?

How to Paint a Room

The Role of Specs & Standards in the Systems Engineering… ..Business!

Robert B. “Scott” Kuhnen

ASC/AFRL Eng Stds Office

Wright-Patterson AFB OH

24 October 2007

Shall We Get Started?

Not so fast!!!

- “Proper interior paint preparation of your walls and ceilings before painting will often encompass more work than the actual painting. Up to 75% of the work can be getting a surface ready for painting.”

- Karl Crowder
- http://www.house-painting-info.com/index.html

Tools for Prepping Walls

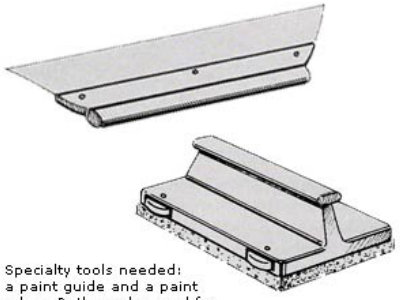
- Safety glasses or goggles
- Respirator or face mask
- Ear protectors
- Rubber gloves
- Pry bar
- Paint scraper
- Wallpaper steamer (rent if needed)
- Can opener or widening tool
- Fan
- Hand sanding block
- Orbital sander
- Screwdriver
- Putty knife
- Sponge
- Cap or scarf
- Old clothes

Materials for Prepping Walls

- Spackle (compound)
- Fine-grit sandpaper
  - (100 - 120-grit silicon carbide)
- Detergent and ammonia or tri-sodium phosphate (TSP)
- Self-adhesive drywall tape
- Primer or adhesive pad
- Sizing (for wallpapering)

Tools for Painting

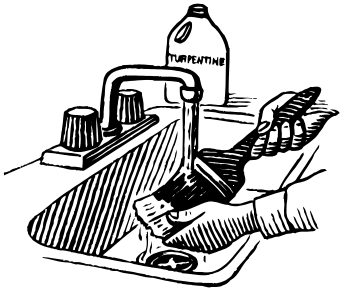
- Drop cloths
- Ladders
- Buckets
- Paint edger
- Brushes, 4", 3", and 11/2"
- Angled sash brushes, 1 1/2" and 2"
- Roller pan with screen
- Roller covers with appropriate naps
- Roller handle
- Roller extender
- Paint guide

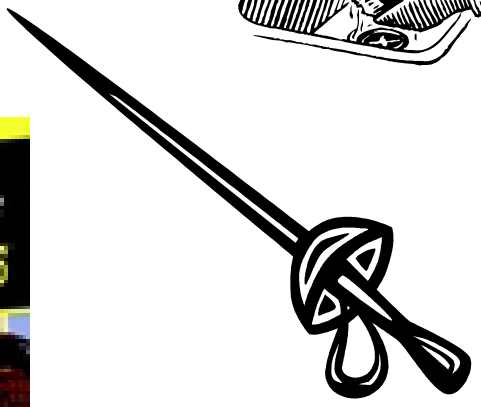


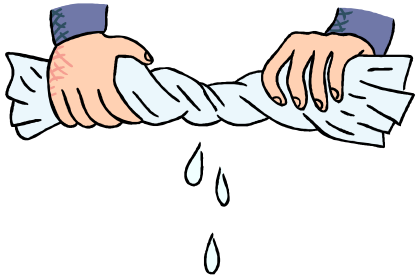
Specialty tools needed: a paint guide and a paint edger. Both can be used for "cutting in."

Materials for Painting

- Masking tape, 2" wide
- Newspaper
- Adhesive pad or primer
- Paint thinner (with oil-based paints)
- Aluminum foil
- Rags





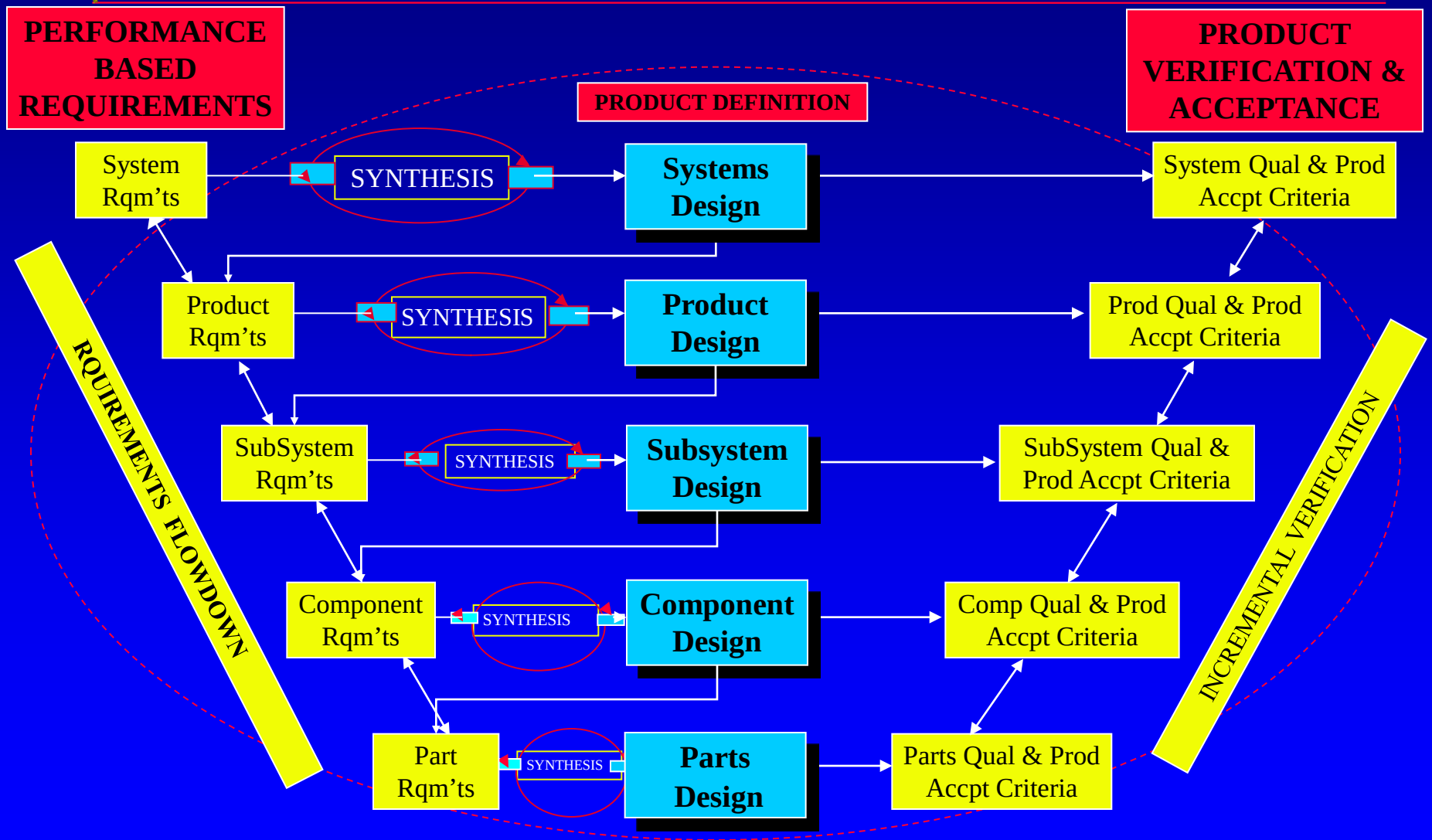


What the experts say…

- Most people think they know how to paint, and usually the results are pretty good. But for painting contractor John Dee, "pretty good" isn't good enough. After nearly three decades of rolling, brushing, and spraying paint he knows the subtle tricks for applying smooth, even coats to walls, ceilings, and woodwork, and for creating crisp boundaries between colors.

  According to Dee, there's no magic to getting professional-looking results. Practice helps, and thorough surface preparation is essential. But the key, he says, is to paint in an orderly, systematic way. So whether he's painting a multi-paneled door or a flat expanse of wall, he proceeds almost scientifically from one step to the next, with no shortcuts. "Your approach to the task, the order in which you do things, can speed the work or slow you down," Dee says. "Here's the approach that works best for me."

ENGINEERING DESIGN PROCESS



A Theory to Live By…

- Preparing the surface is the most important part of any painting project. If the paint doesn't have a smooth, clean surface to adhere to, the result will be a poor-quality job that doesn't last very long. "You should spend at least as much time on surface prep as you will be painting," advises Horst.

- If it's worth doing, it's worth doing right the first time. And proper preparation is the key. Few of us really realize this, or even like to admit it, since it leads to more work. It is a step that is all too often left out, and the final job reflects its omission. It is too easy just to start painting and not go through the necessary prep steps. Indeed, for a while the paint job may even look pretty good. But sooner or later the poor quality will show up.

Talking about painting or…SE?

FIGURE 3. The Systems Engineering Process

- **Defense Specifications**
- **Defense Standards**
- **Qualified Products Lists**
- **Non-Gov't Standards**
- **Int'l Standards**
- **etc.**

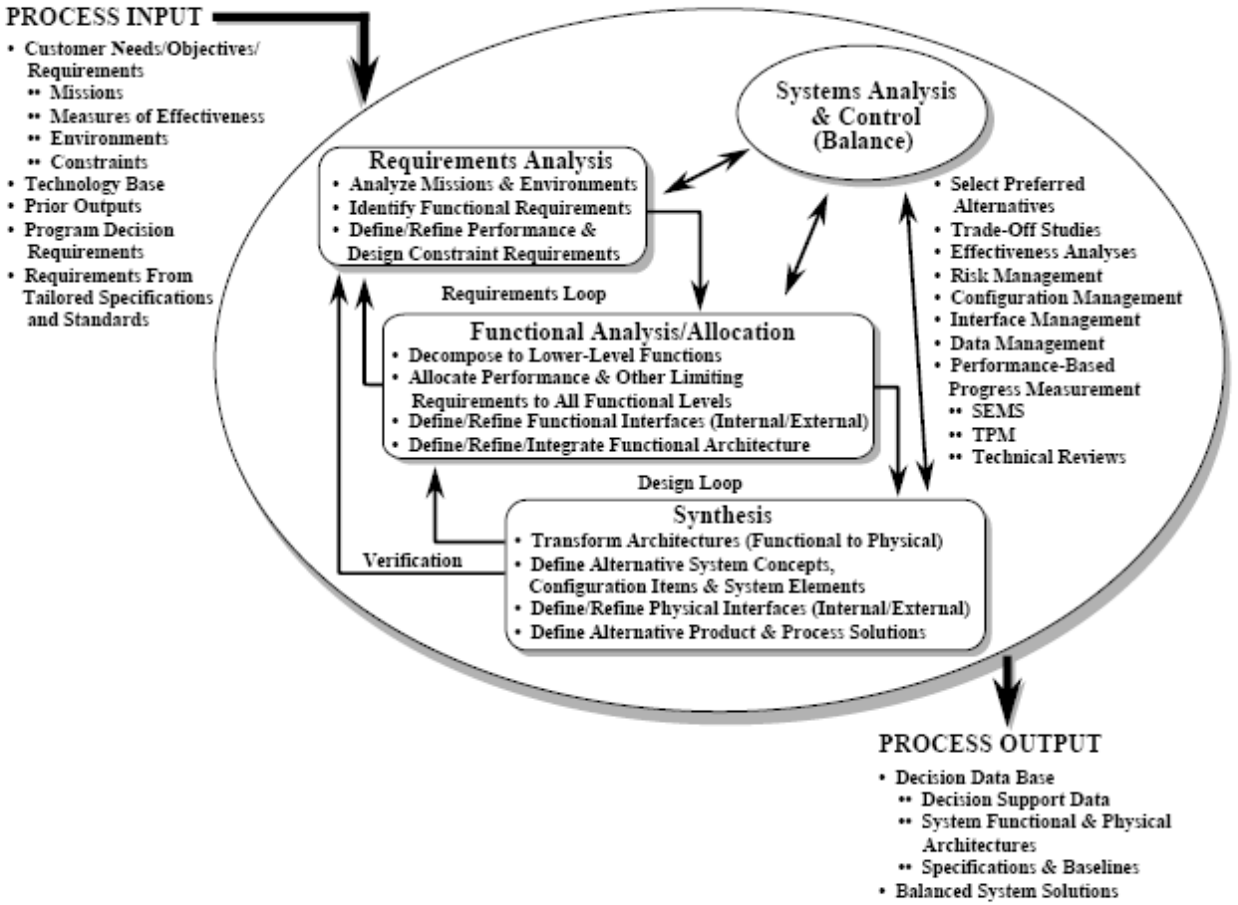


FIGURE 3. The Systems Engineering Process

DoD Systems Engineering Shortfalls*

- Root cause of failures on programs include:
  - Inadequate understanding of requirements
  - Lack of systems engineering discipline, authority, and resources
  - Lack of technical planning and oversight
  - Stovepipe developments with late integration
  - Lack of subject matter expertise
  - Availability of systems integration facilities
  - Low visibility of software risk
  - Technology maturity overestimated

Major contributors to poor program performance

* DoD-directed Studies/Reviews

Could the problem be…?

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

WASHINGTON, DC—In late June, Defense Secretary William Perry ordered a dramatic about face in the Defense Department's use of military specifications and standards, ordering that all DoD programs rely more heavily on commercial parts and adopt a performance-based specification process.

While Perry's announcement was widely anticipated and publicly applauded by the defense electronics industry, many company officials are concerned that the changes will increase uncertainty in the acquisition process and threaten some existing systems that are operating well, such as the Qualified Manufacturing Line (QML), a DoD-specific system for certifying a manufacturing process.

"Right now it is a wait-and-see game," says Brad Paulsen, director of marketing for military and aerospace products at National Semiconductor (Santa Clara, CA). "There are a lot of issues that have not been clarified."

The directive, which will be phased in over the next six months, mandates that all DoD procurement contracts use commercial and industrial specs and standards where they exist; the use of mil-specs will require a waiver. Radiation-hardened components are exempt from the directive.

In another major change, program managers are now required to adopt performance-based specifications for new systems and major modifications. The performance specs describe how a system is to function but leaves the

(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.

Summary of the Weapon Systems Acquisition Reform Act of 2009:

- **Section 101. Systems Engineering Capabilities. The Defense Science Board Task Force on Developmental Test and Evaluation reported in May 2008 that "the single most important step necessary" to address high rates of failure on defense acquisition programs is "a viable systems engineering strategy from the beginning." The Government Accountability Office has reached similar conclusions. Unfortunately, the Committee on Pre-Milestone A and Early-Phase Systems Engineering of Air Force Studies Board of the National Research Council reported in February 2008 that the Air Force has systematically dismantled its systems engineering organizations and capabilities over the last twenty years. The other services have done the same. Section 101 would address this problem by requiring DOD to: (1) assess the extent to which the Department has in place the systems engineering capabilities needed to ensure that key acquisition decisions are supported by a rigorous systems analysis and systems engineering process; and (2) establish organizations and develop skilled employees needed to fill any gaps in such capabilities.**

Summary of the Weapon Systems Acquisition Reform Act of 2009:

- **Section 103. Technological Maturity Assessments.** For years now, the Government Accountability Office (GAO) has reported that successful commercial firms use a "knowledge-based" product development process to introduce new products. Although DOD acquisition policy embraces this concept, requiring that technologies be demonstrated in a relevant environment prior to program initiation, the Department continues to fall short of this goal. Last Spring, GAO reviewed 72 of DOD's 95 major defense acquisition programs (MDAPs) and reported that 64 of the 72 fell short of the required level of product knowledge. According to GAO, 164 of the 356 critical technologies on these programs failed to meet even the minimum requirements for technological maturity. Section 103 would address this problem by making it the responsibility of the Director of Defense Research and Engineering (DDR&E) to periodically review and assess the technological maturity of critical technologies used in MDAPs. The DDR&E's determinations would serve as a basis for determining whether a program is ready to enter the acquisition process.

Summary of the Weapon Systems Acquisition Reform Act of 2009:

- **Section 206. Acquisition Excellence.** The Department of Defense will need an infusion of highly skilled and capable acquisition specialists to carry out the requirements of this bill and address the problems in the defense acquisition system. The Committee has already established an acquisition workforce development fund to provide the resources needed to hire and retain new workers.
- However, positive motivation is needed as much as money. Section 206 would address this issue by establishing an annual awards program – modeled on the Department's successful environmental awards program – to recognize individuals and teams who make significant contributions to the improved cost, schedule, and performance of defense acquisition programs.

Bring me the head of a systems engineer!

Let's Give Awards!

Systems Engineering Fundamentals from Past Programs

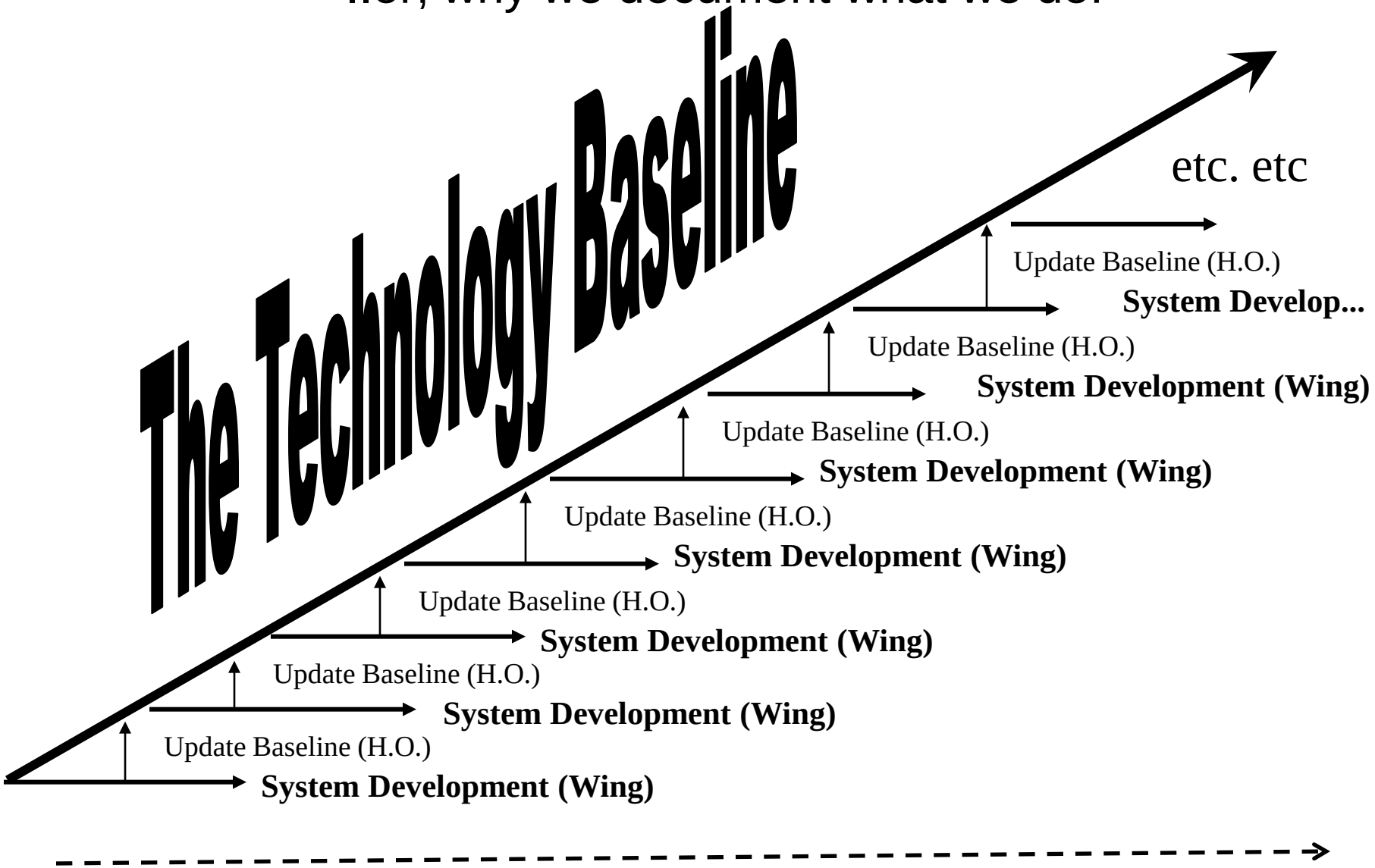
- SE was conducted by the design team
  - Systemic to the design process
  - Product of many designs by the same teammates over many programs and many years
- Common Characteristics: yesterday and today
  - Small, efficient systems engineering staff
    - Previous design engineers
      - Knack for requirements
      - Appreciated the larger challenge at the system level
  - Not always collocated and not always the same company

We don't "infuse" them; We GROW Them!

Source: Mr. John Griffin, former ASC/EN Director

How Knowledge Works…

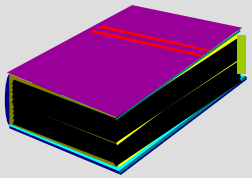
..or, why we document what we do!



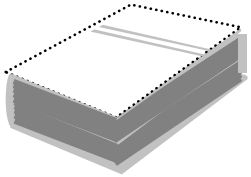
Technical Wisdom From Our Past . . .

...Technical Leadership For Our Future

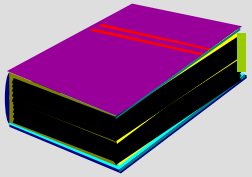
Joint Service Specification Guides



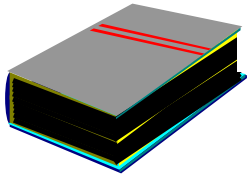
JSSG-2000
Air System



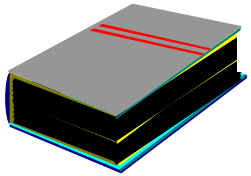
JSSG-2004
Weapons



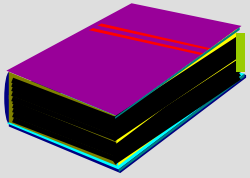
JSSG-2001
Air Vehicle



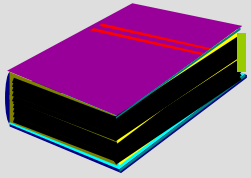
JSSG-2002
Training



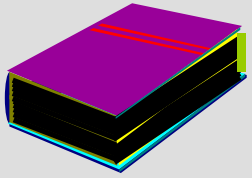
JSSG-2003
Support Sys



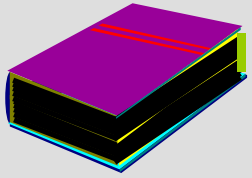
JSSG-2005
Avionics



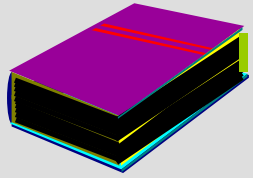
JSSG-2006
Structures



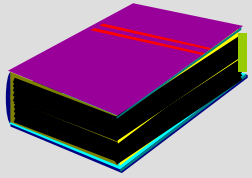
JSSG-2007
Engines



JSSG-2008
Vehicle Control
& Mgmt



JSSG-2009
Vehicle
Subsystems



JSSG-2010
Crew
Systems

Unintended consequences?

A PennWell Publication

Military & Aerospace ELECTRONICS™

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

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(Continued on page 32)

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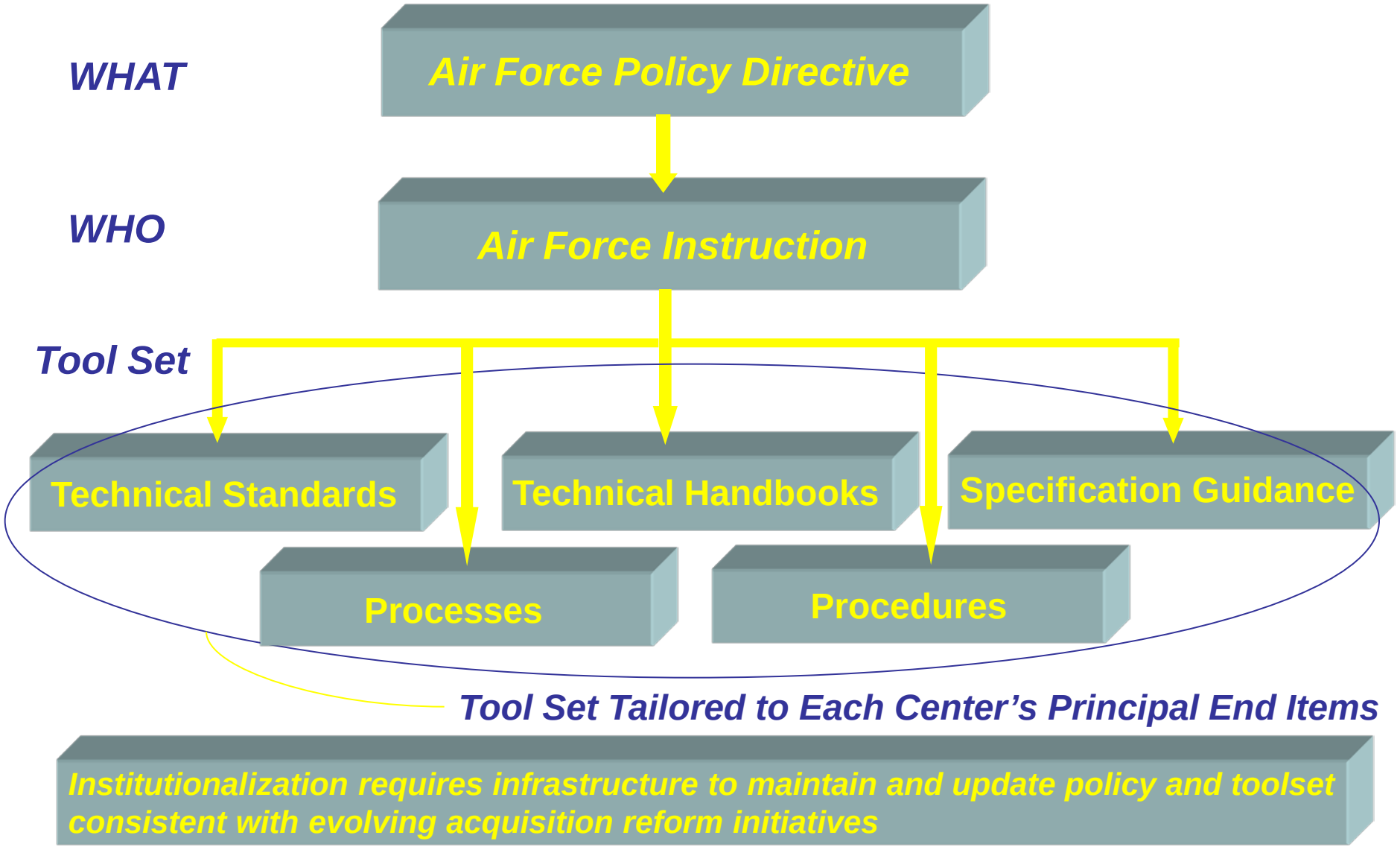
Truth is…we noticed issues almost immediately!

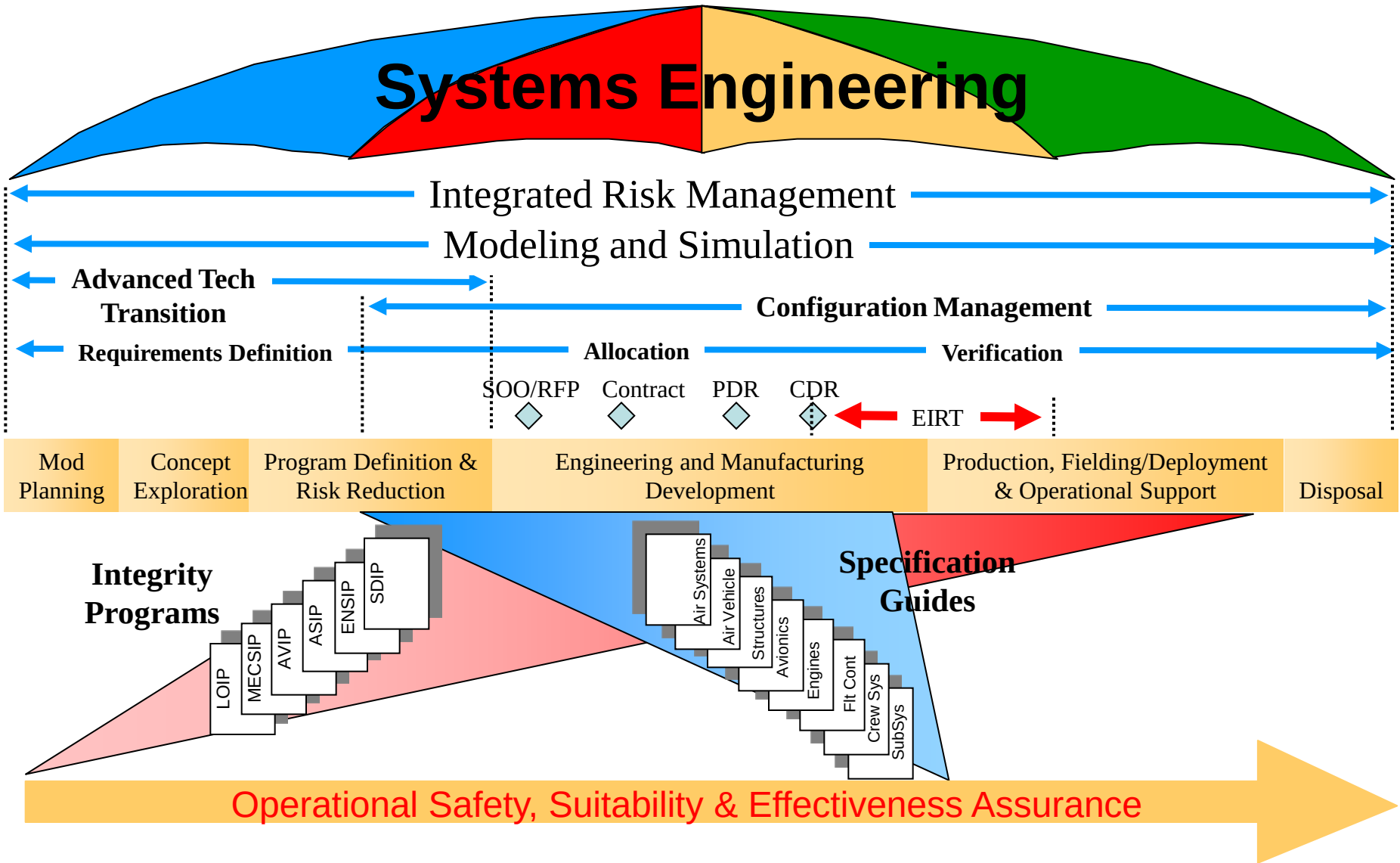
The Great Challenge

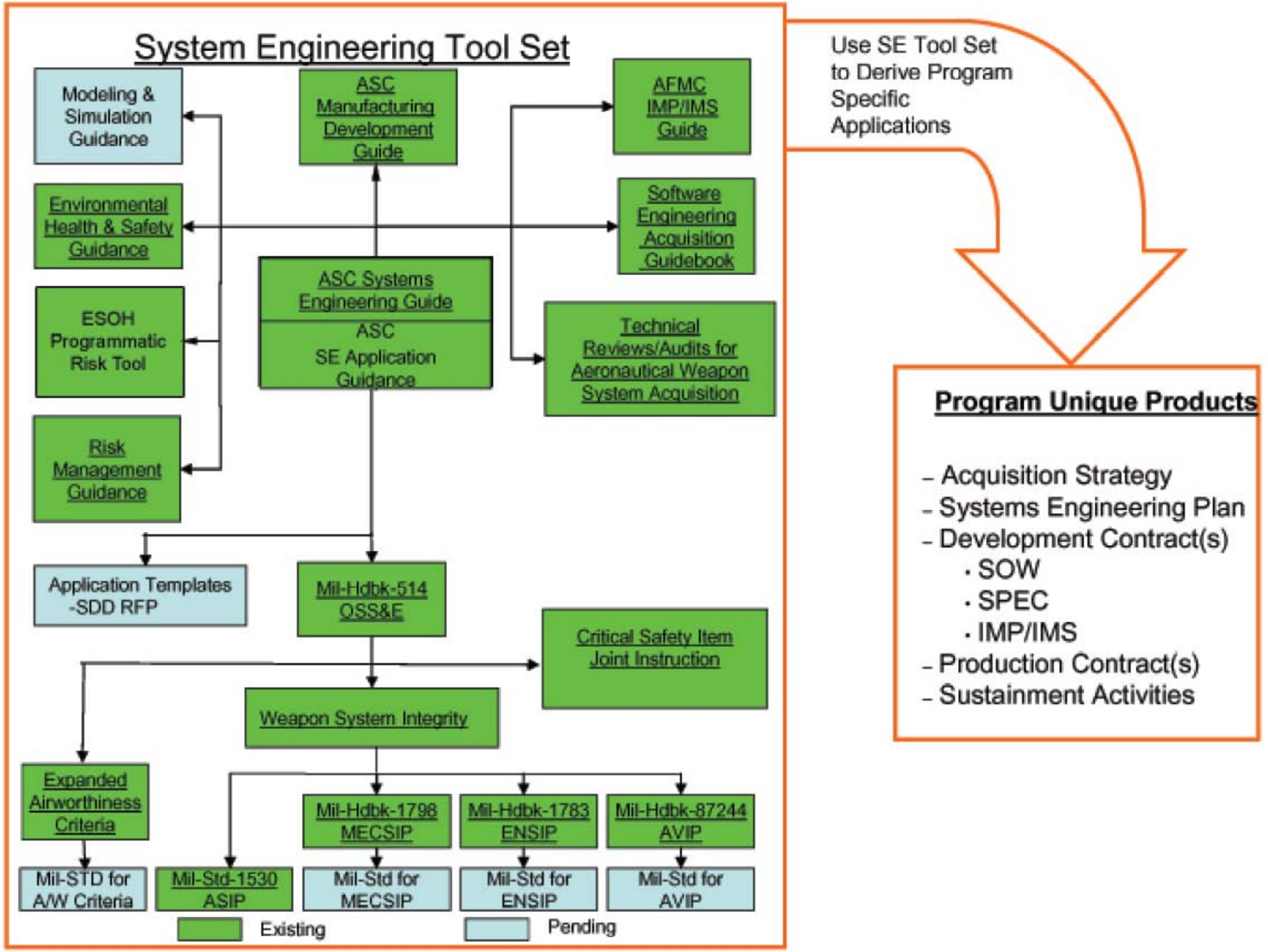
Humpty Dumpty sat on a wall,
Humpty Dumpty had a great fall.
All the king's horses,
And all the king's men,
Couldn't put Humpty together again.

Institutionalizing OSS&E Through Regulatory Products



EN Technical Processes




System Engineering Tool Set
Modeling & Simulation Guidance
ASC Manufacturing Development Guide
AFMC IMP/IMS Guide
Environmental Health & Safety Guidance
Software Engineering Acquisition Guidebook
ASC Systems Engineering Guide
ASC SE Application Guidance
ESOH Programmatic Risk Tool
Technical Reviews/Audits for Aeronautical Weapon System Acquisition
Risk Management Guidance
Application Templates -SDD RFP
Mil-Hdbk-514 OSS&E
Critical Safety Item Joint Instruction
Weapon System Integrity
Expanded Airworthiness Criteria
Mil-Hdbk-1798 MECSIP
Mil-Hdbk-1783 ENSIP
Mil-Hdbk-87244 AVIP
Mil-STD for A/W Criteria
Mil-Std-1530 ASIP
Mil-Std for MECSIP
Mil-Std for ENSIP
Mil-Std for AVIP
Existing
Pending
Use SE Tool Set to Derive Program Specific Applications
Program Unique Products
- Acquisition Strategy
- Systems Engineering Plan
- Development Contract(s)
  - SOW
  - SPEC
  - IMP/IMS
- Production Contract(s)
- Sustainment Activities

Excerpts from:
Pre-Milestone A and Early-Phase Systems Engineering

A Retrospective Review and Benefits for Future Air Force Systems Acquisition

"Two critical factors in the success or failure of programs that fall in the latter category are the need for high-quality systems engineering and the related issue of the need for a high-quality systems engineering workforce."

"On a more technical level, the NRO, in cooperation with its industry team members, has reinstituted a minimum essential set of specifications and standards on such diverse topics as systems engineering (SE) and the qualification of key components."

"But in one respect the complexity of most large systems today seems to be much greater, and that is in the complexity of the missions that the systems are asked to serve and in the number and diversity of users, supporters, and administrators of the systems. Indeed, it is often the increased complexity of external interfaces, more than internal system design complexity, that is the cause of extended development times and costs."

Space & Missile Center (SMC) ..took the first concrete steps… circa 2003!

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

JAN 14 2003

MEMORANDUM FOR SMC-ALL

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

Specs & Standards

Initiative

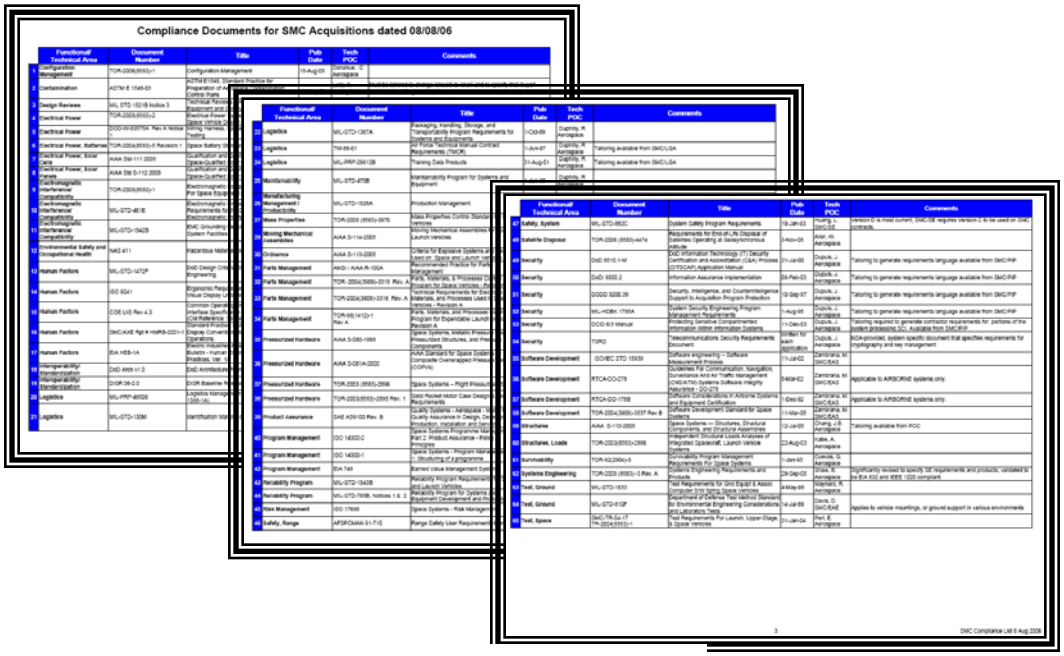
THE AEROSPACE CORPORATION

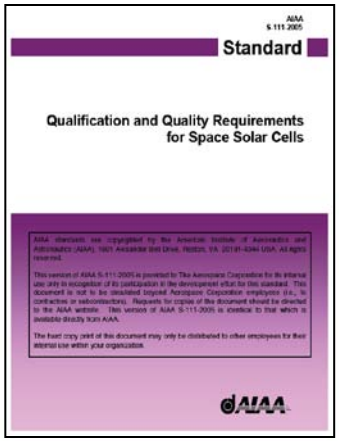
Specs & Standards Initiative

- Apply specs & standards as element of acquisition practices and toolset
  - Define technical practices and expectations by government
    - Define the “what” – and not the “how to”
- Establish “Select” list of space systems standards
  - Establish baseline set of common specs and standards
  - Include military and industry (e.g., AIAA, ISO) standards
- Establish Organizational Policy
- Specify critical standards in RFP
  - Compliance Documents
  - Baseline contractually

SMC S&S List

- **Revised SMC S&S List published 8/9/2006**
  - **65 essential documents**
    - **Entire SMC System Portfolio**
  - **Military, International, and Industry Standards, and Aerospace TORs**
  - **Updated standards to reflect current best practices**
  - **Additional updates to current document versions**





Standards Technical/Functional Areas

- 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

New SMC S&S Policy

- Issued by Lt.Gen. Hamel 11 July
- Establishes specifications and standards as an integral element of SMC acquisition processes
- Applies to all new development, acquisition and sustainment contracts, including new contracts for legacy programs
- Contractual compliance through the supplier chain, as appropriate
- SMC Chief Engineer (CE) responsible for master list of compliance documents
- SPO's, with CE, generate tailored set of specs and standards and recommend to PEO for implementation
- SMC/CC/AFPEO – Space resolves issues

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

JUL 11 2006

MEMORANDUM FOR SMC-ALL

FROM: SMC/CC

SUBJECT: Initial Policy on Specifications and Standards Usage at SMC

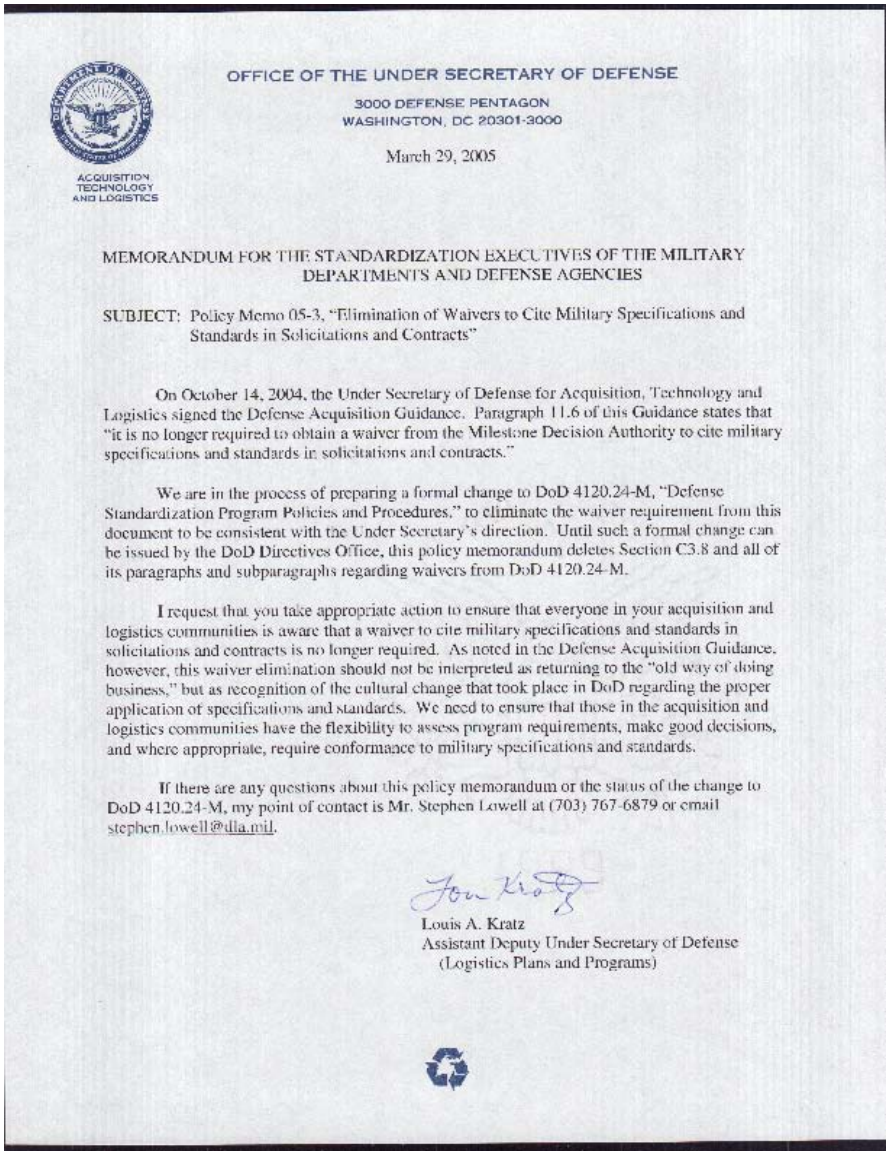
1. This policy establishes the use of specifications and standards as an integral element of SMC acquisition processes. Programs executed by SMC/AFPEO-Space shall include specifications and standards in all solicitations and shall place them on contract as compliance documents through the supplier chain, as appropriate.

2. The SMC Chief Engineer shall be responsible for defining, coordinating, maintaining, updating and reporting the master list of compliance documents. The list includes the minimum essential government, industry, professional and international specifications and standards for SMC's total portfolio of launch vehicles, space vehicles, ground systems, user equipment, missile systems, facilities and research. This policy applies to all new SMC/AFPEO-Space development, acquisition and sustainment contracts, including new contracts for legacy programs. For existing programs and contracts, the SPO's, with the SMC Chief Engineer, will assess the program, status, requirements, technical baseline and risks to generate a tailored subset of specifications and standards. This subset will be recommended to SMC/CC/AFPEO-Space for implementation. The necessary specifications and standards will be placed on contract, as part of the program's baseline and the Program Office shall enforce them. Any issues on specifications, standards or implementation that arise between SMC/EA and SPD's will be brought forward to SMC/CC/AFPEO-Space for resolution.

3. The Chief Engineer shall prepare an SMC OI to institutionalize the practice and intent of this policy.

MICHAEL A. HAMEL
Lieutenant General, USAF
Commander

Recent Actions



OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

March 29, 2005

MEMORANDUM FOR THE STANDARDIZATION EXECUTIVES OF THE MILITARY DEPARTMENTS AND DEFENSE AGENCIES

SUBJECT: Policy Memo 05-3, "Elimination of Waivers to Cite Military Specifications and Standards in Solicitations and Contracts"

On October 14, 2004, the Under Secretary of Defense for Acquisition, Technology and Logistics signed the Defense Acquisition Guidance. Paragraph 11.6 of this Guidance states that "it is no longer required to obtain a waiver from the Milestone Decision Authority to cite military specifications and standards in solicitations and contracts."

We are in the process of preparing a formal change to DoD 4120.24-M, "Defense Standardization Program Policies and Procedures," to eliminate the waiver requirement from this document to be consistent with the Under Secretary's direction. Until such a formal change can be issued by the DoD Directives Office, this policy memorandum deletes Section C3.8 and all of its paragraphs and subparagraphs regarding waivers from DoD 4120.24-M.

I request that you take appropriate action to ensure that everyone in your acquisition and logistics communities is aware that a waiver to cite military specifications and standards in solicitations and contracts is no longer required. As noted in the Defense Acquisition Guidance, however, this waiver elimination should not be interpreted as returning to the "old way of doing business," but as recognition of the cultural change that took place in DoD regarding the proper application of specifications and standards. We need to ensure that those in the acquisition and logistics communities have the flexibility to assess program requirements, make good decisions, and where appropriate, require conformance to military specifications and standards.

If there are any questions about this policy memorandum or the status of the change to DoD 4120.24-M, my point of contact is Mr. Stephen Lowell at (703) 767-6879 or email stephen.lowell@dla.mil.

Louis A. Kratz
Assistant Deputy Under Secretary of Defense
(Logistics Plans and Programs)

OUSD/AT&L Policy Memo 05-3, "Elimination of Waivers to Cite Military Specifications and Standards in Solicitations and Contracts"

Translation: "You are now free to use the right tool for the job!"

ASC SE Road Show - 2005

U.S. AIR FORCE

Rapidly delivering war-winning capability

- Overview - Gary Van Oss
- SE Tool Set
  - SE Toolset Foundation – Charles Gebhard
  - Modeling and Simulation – Pat Montanaro
  - Product Integrity – Bill Kinzig, Rich Stepler

    --- Break ---
  - Airworthiness – Bob Fitzharris
  - Software – Mike Nicol
  - Environmental – Alex Briskin
  - Specs and Standards – Scott Kuhnen
- SE Plans – Gary Van Oss
- Wrap up / Q & A – Gary Van Oss

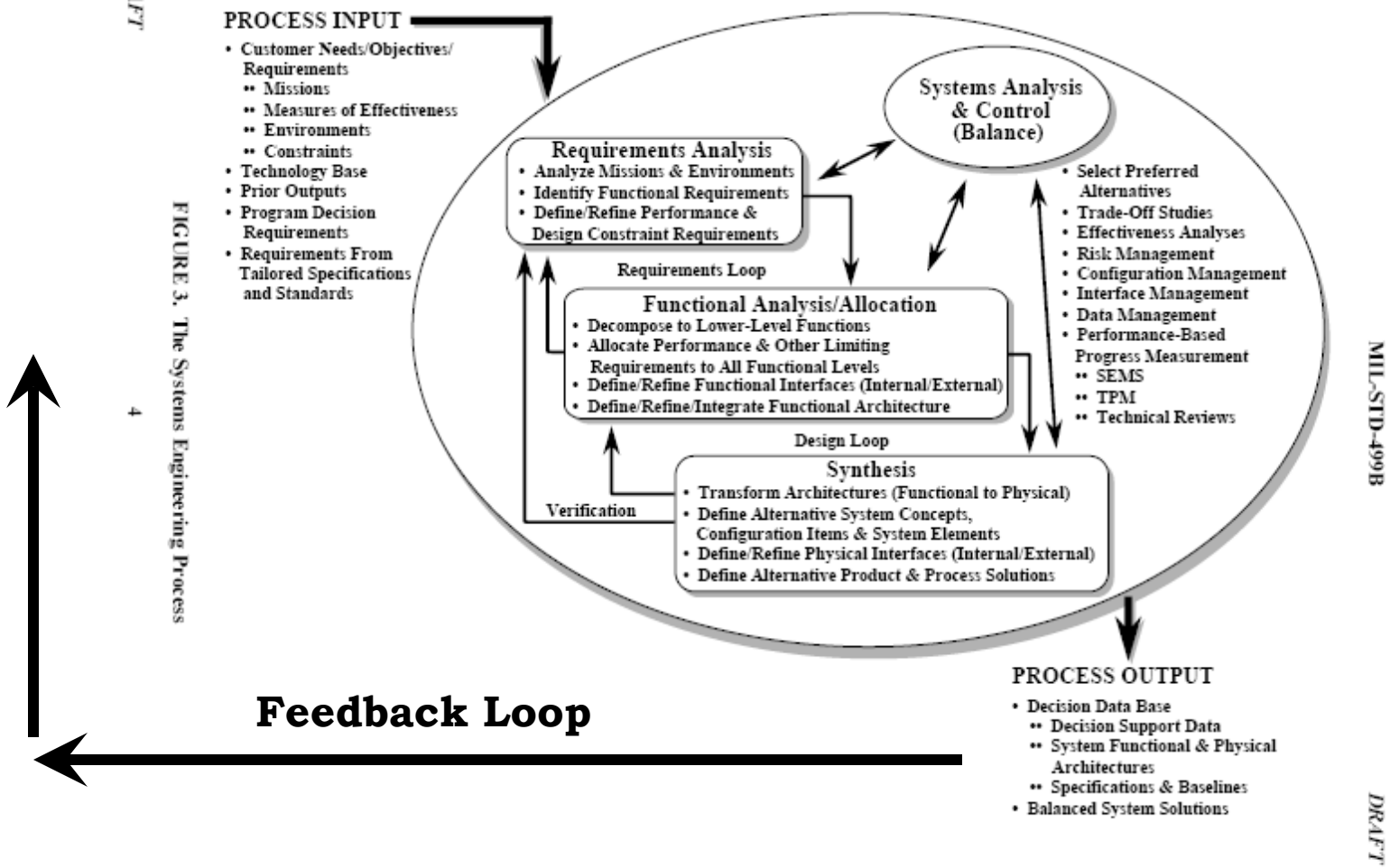
Defense Standardization Program

- ASC/EN is responsible for development and maintenance of Engineering Standards under Defense Standardization Program (DSP)
  - Mandated by Public Law 82-436; DoD 5000.1&2; DoDD 4120.24; DoD 4120.3-M; AFPD 60-1; AFI 60-101
- Wing engineering tailors and applies standards
  - Responsible for application feedback to ASC/EN
- Industry design teams also use MIL specs and standards

It's part of your day job!

- **Defense Specifications**
- **Defense Standards**
- **Qualified Products Lists**
- **Non-Gov't Standards**
- **Int'l Standards**
- **etc.**

Systems Engineering "Engine"



Feedback Loop

My Assertion…

- Specs & Standards are not gone!
  - We are “down to” only 12,000 in the aero sector

- Spec & Standards, and all the work it takes to create them, coordinate them, update them, understand them, use them, is “foundational” to the execution of the SE process (not a “crutch!”)

- Development of, use of, translation of technical requirements is the heart of the technical portion of the SE process… ..as we revitalize SE, consider the role that specifications and standards play in the overall “business” of systems engineering.

Benefits of the DSP

- Standards are “foundational” to all that we do
  - Measuring program execution, success and/or failure
  - Moving both the State-of-the-Art and managing the Tried-and-the-True
  - Reducing risks in programs and in the SE process
  - Providing “confidence” to those who actually execute the SE process
  - Documenting & Communicating Lessons Learned
  - “Mentoring” the Next Generation (“Here kid, read this!”)
  - Communicating technologies and strategies across entire sectors…forming a common understanding
  - ..Shall I continue…?

AFRL Contracted Study

- AFRL RX (formerly ML) contracted an analysis of their specs & stds workload in 2008-09.
- Draft report in works…(excerpt):

"Military specifications and standards served as:

a. Procurement documents.

b. A record of experiences and lessons learned.

c. Benchmarks in system acquisition.

d. A resource for subject matter experts.

e. A tool for mentoring and transferring knowledge.

f. An aid in developing and transitioning new R & D programs and transitioning technology. "

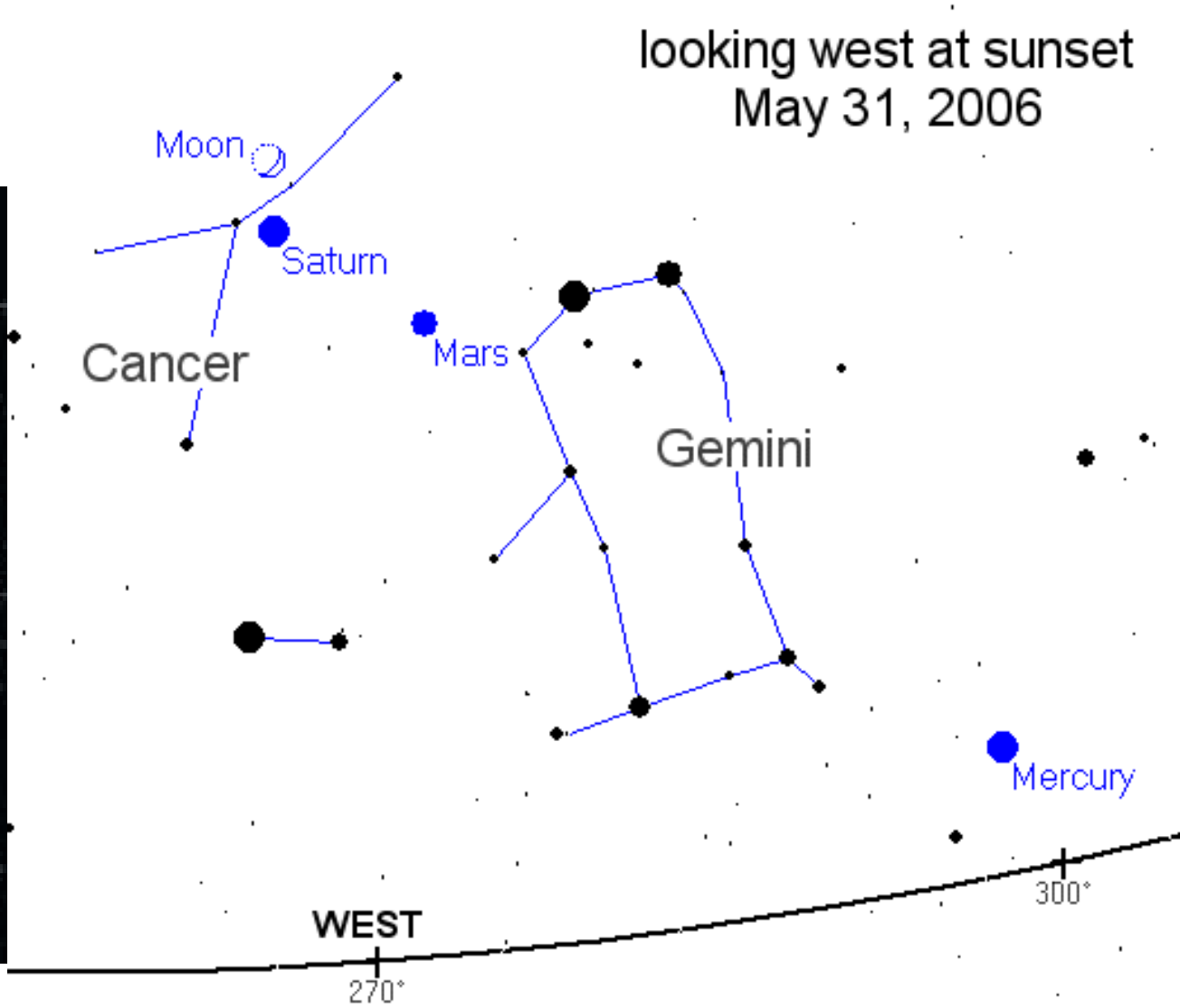
HQ AFMC/ENS Stdzn Study

- Request of AFMC Centers for “key” specifications, standards, or handbooks which they would like to see returned to their SE Toolset?
- Initial/Raw Results: 104 different documents requested for possible re-instatement.
- Approximately 25 of these were requested by multiple organizations…covering such topics as: Reliability, SE, Config Mgt, Corrosion, Software, Materials, Reviews & Audits, FMECA…many being related to what we call standard practices.

What can you expect from AF?

- **AFMC D&SWS Council** has endorsed a continued study of reinstating and using key stdzn docs.
  - Planning timeline due in June of 2010
- **SAF/AQRE** appreciates that certain "standard practices" (rather than "guides") would be useful to restoring both common understanding and discipline back into acquisition.
- Industry involvement is critical…again this time!
- We solicit your interest & support
  - The stars may be aligning…again…

No, seriously…



Contact

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Back Ups

Standards Live!

DoD Document Summary (Active & Inactive)

– ***Specifications***	**18,834**
– ***Standards***	**864**
– ***Handbooks***	**406**
– ***CIDs***	**4,941**
– ***DIDs***	**1,019**
– ***QPL's***	**758**
– ***Non Gov't Standards***	**9,223**
– ***International Standards***	**1,961**

..in all the Services/Agencies

Preparing Activity by Service (Active & Inactive)

- ***Air Force*** **2,610**
- ***Army*** **8,891**
- ***Navy*** **10,321**
- ***DLA*** **13,908**

Which Standards Matter to ASC?

- Def. Stdzn documents:

	Military	NGS	Total
Preparing Activity (speaks for DoD)	371	363	734
AF Custodian (speaks for AF)	6356	2742	9098
AF Review Activity (reviews for ASC)	1140	265	1405
	7867	**3370**	**11,207**

- Design Handbooks (17)
  - Shipping only 1- and 2-series documents today - on CD
- AF Characteristics Guides (6)
  - Shipping only - have only begun migration to CD
- Misc. support to other technical docs & publications
- Bottom Line: Each of the sectors (Space, Aeronautical Maritime)…all have a body of knowledge…standards.