

5th Annual CMMI Technology Conference & User Group

Space and Missile Systems Center



Process Improvement

14-17 November 2005

Los Angeles AFB, CA

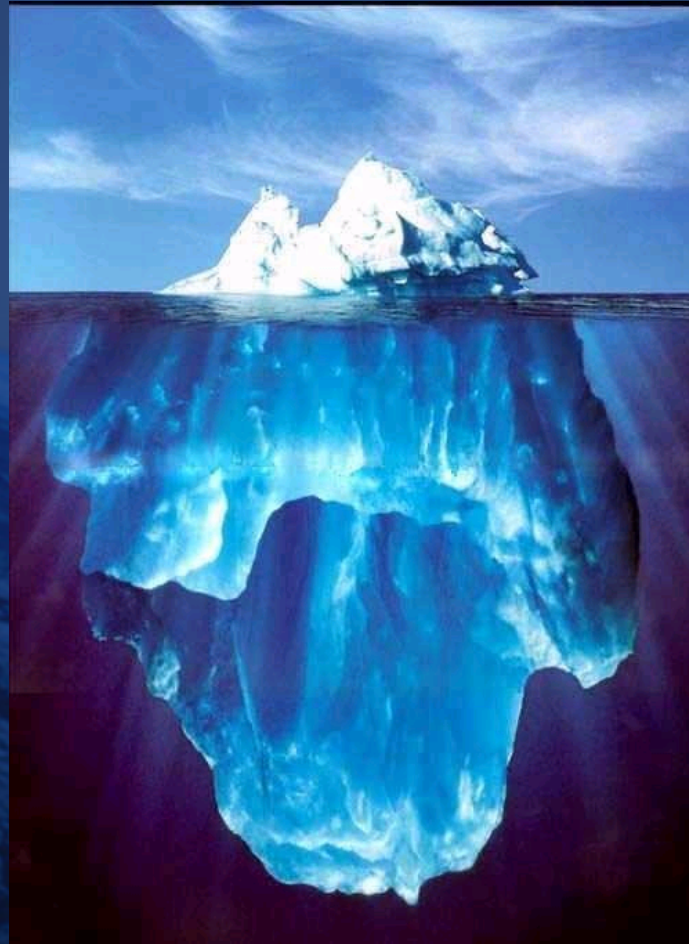
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Outline

- **Background – the Acquisition Problem**
- **Tailored CMMI® Model for Acquisition**
- **Appraisal Process for Benchmarking**
- **The NASA Experience**
- **Results and Process Improvements**
- **Lessons Learned**
- **Summary**

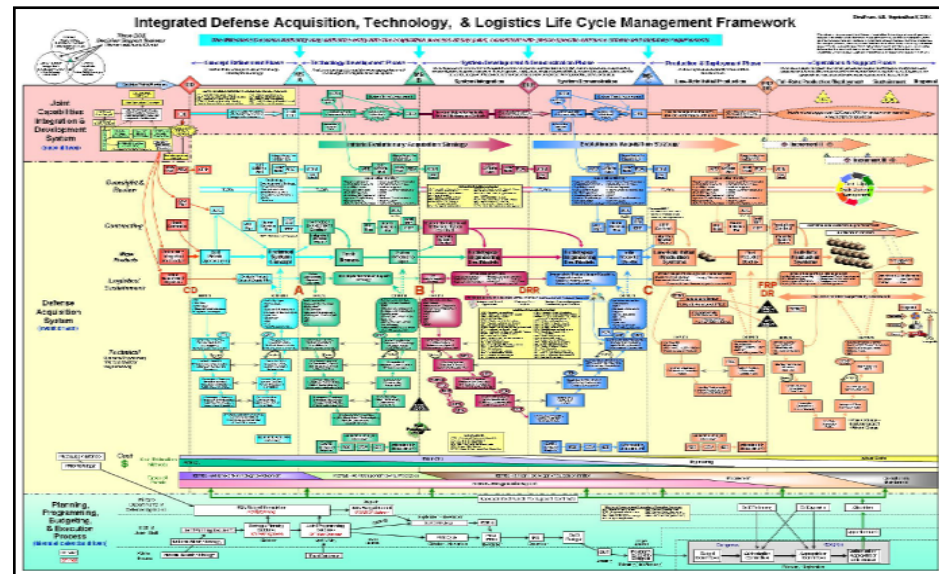
The Problem





Background – the Acquisition Problem

- In 2003 after a decade of DoD acquisition reform, space policy changes, and constrained budgets there were serious programmatic and technical issues in space acquisition
 - Reduced Air Force program office staffs
 - Shift of total system performance responsibility to prime contractors
 - Limited government programmatic insight and oversight
 - Increasingly more complex programs with cost/schedule growth
- The 2003 National Security Space Acquisition Policy 03-01
 - *“Robust SE is essential to the success of any program. Program offices must focus attention on the application of SE principles and practices throughout the system life cycle.”*





SMC Process Assessment Strategy

- **Air Force Space and Missile Systems Center (SMC) at Los Angeles AFB, CA launched a proactive *Systems Engineering Revitalization (SER)* initiative to renew SMC’s commitment to world class systems engineering and restore program management excellence**
- **SMC Commander directed the Center to:**
 - “Establish status of process knowledge and implementation within various SMC SPOs (process baselining)”
 - Evaluate which processes need improvement and make suggestions for implementing process improvement
 - Support/complement with data from a variety of program reviews to achieve “revitalization” goals
- **The Capability Maturity Model Integration (CMMI®) framework was selected to baseline SMC processes**
 - A Defense Industry-wide accepted method for process appraisal and improvement



SMC Process Assessment Approach

- **Baseline the current process capabilities of program offices**
 - Appraisals to focus on **SPO process existence and use**
 - Not to be an appraisal of product quality
 - To assess status of process institutionalization
 - Not a report card on personnel
 - To identify strengths and weaknesses of processes compared to SMC-CMMI-A Model - **No numerical program ratings**
 - To capture the Center's **Best Practices**
 - Not to require significant program office resources
- **Formed an SMC Product Development and Appraisal Team of trained appraisers with extensive space program experience:**
 - Systems Acquisition Directorate (SMC/AX) – team leadership
 - Software Engineering Institute (SEI)
 - Aerospace Corporation
 - SETA Contractors



CMMI-A Complements Integrated Reviews



SMC-CMMI-A

An Early Acquisition Model



Process Improvement



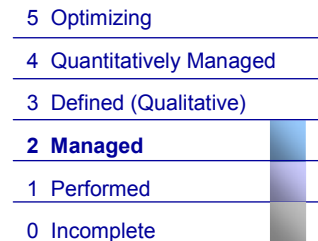
A CMMI[®] Acquisition Model Was Needed

- **No CMMI[®] acquisition model was available at the time**
- **CMMI[®] and SA-CMM[®] Models were adapted for SMC processes**
 - **CMMI[®] did not cover government acquisition sufficiently**
 - Selected Process Areas were adopted (11 of 25)
 - Practices were added from the Software Acquisition CMM[®] (SA-CMM[®]) for SE & PM
 - **Some terminology was changed to more recognizable language**
 - E.g., “project” to “program”, “supplier” to “contractor / vendor”
 - **Simplified the generic practices**
- **“Specialty engineering” disciplines critical to space systems were added to supplement what the model didn’t address**

EMI / EMC	Manufacturing	Safety
Human Factors Engineering	Parts, Materials, Processes	Software Engineering
Integrated Logistics Support	Quality Assurance	Survivability
Mass Properties	Rel/Maint/Avail	Test & Evaluation

- **Adapted CMMI[®] Class B Appraisal Requirements for the acquisition organization**

- **Four levels of practice implementation (FI, PI, NI, NA)**
- **A Managed (Level 2) organization was targeted** 





Additions from SA-CMM®

Augmented CMMI® Process Areas

- **Project Planning**
- **Project Monitoring and Control**
- **Contractor / Vendor Management
(Supplier Agreement Management)
(Integrated Supplier Management)**
- **Requirements Development**
- **Requirements Management**
- **Risk Management**

Activity Additions from SA-CMM®

- **Acquisition Strategy**
- **Operations and Sustainment**
- **Solicitation**
- **Contract Tracking and Oversight**
- **Develop Verification Requirements**
- **Baseline Requirements and Analyze Changes for Impacts**
- **Report Status of Identified Risks**



The SMC CMMI-A Model

- **Began with 101 specific practices across 11 Process Areas**
 - Program Planning (16)
 - Program Management (11)
 - Risk Management (8)
 - Contractor / Vendor Management (16)
 - Solicitation preparation and evaluation
 - Contract tracking and oversight
 - Requirements Development (13)
 - Requirements Management (6)
 - Verification (6) *(of SPO products)*
 - Validation (5)
 - Configuration Management (7) *(of SPO products)*
 - Decision Analysis and Resolution (6)
 - Organizational Training (7)
 - **Integrated Teaming (7)**
 - **Technical Solution (2)**
 - **Product Integration (6)**
 - **Causal Analysis & Resolution (5)**

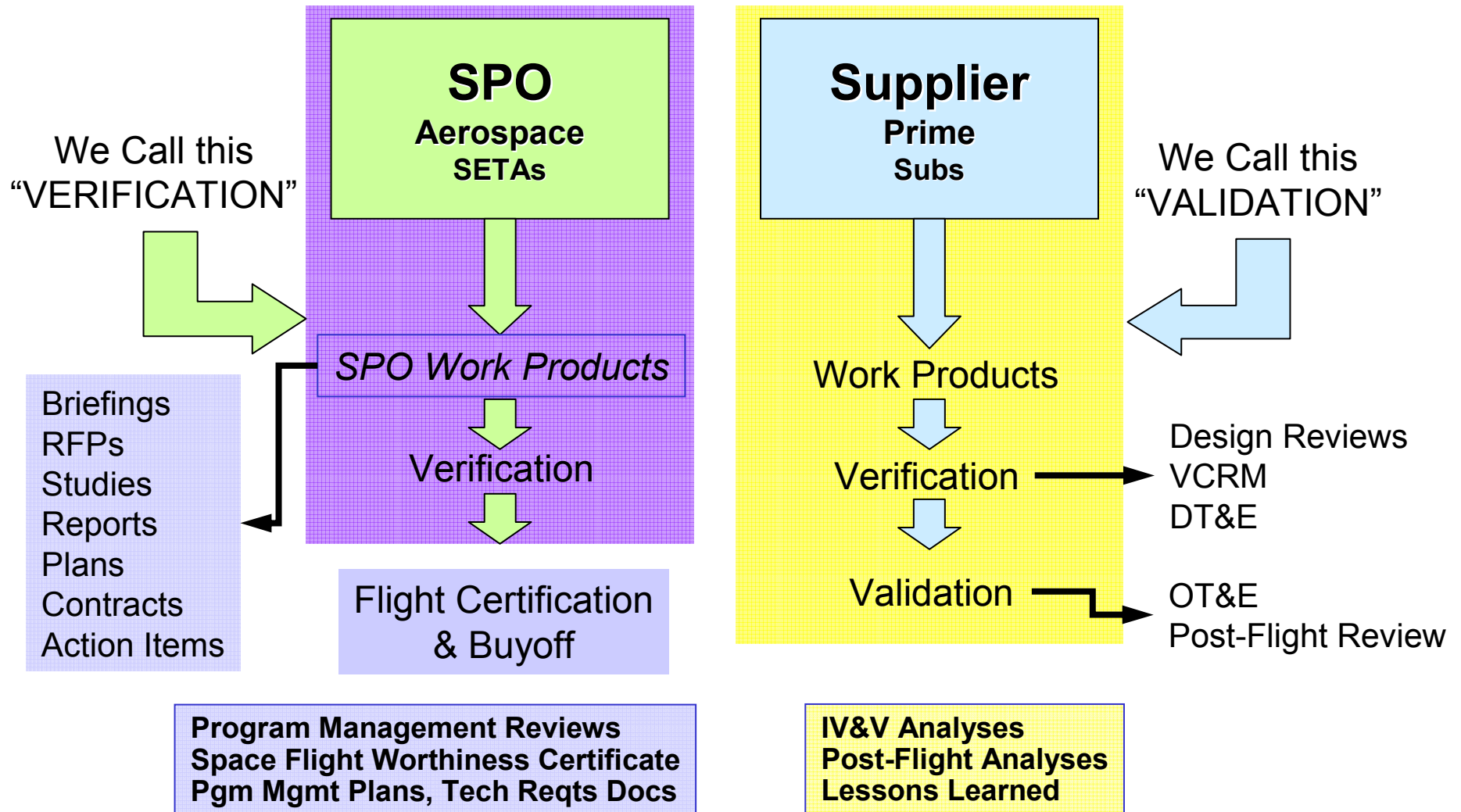
*Process Areas added
for NASA appraisals*



Verification and Validation – A Distinction

Government

Contractor





Process Implementation Characteristics*

- **Do processes exist?**
- **Are they used?**
- **Are they documented?**
- **Do others know about them?**
- **Are they reviewed by management?**
- **Are there adequate resources to perform the processes?**
- **Is there process training?**

**** SMC Adaptation of SEI CMMI® Generic Goals and Practices***

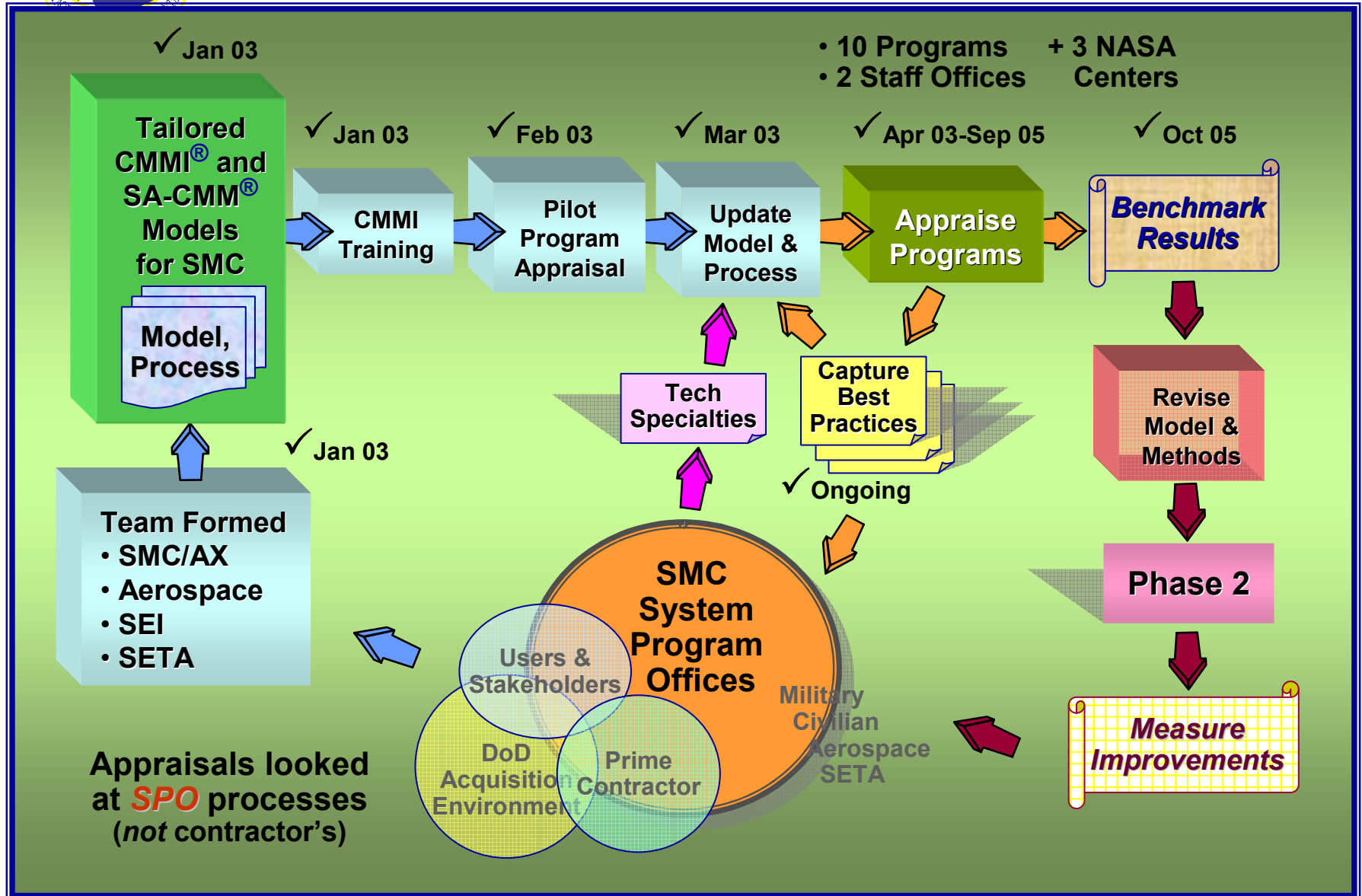
The Appraisal Process



Process Improvement



SMC Appraisal Process

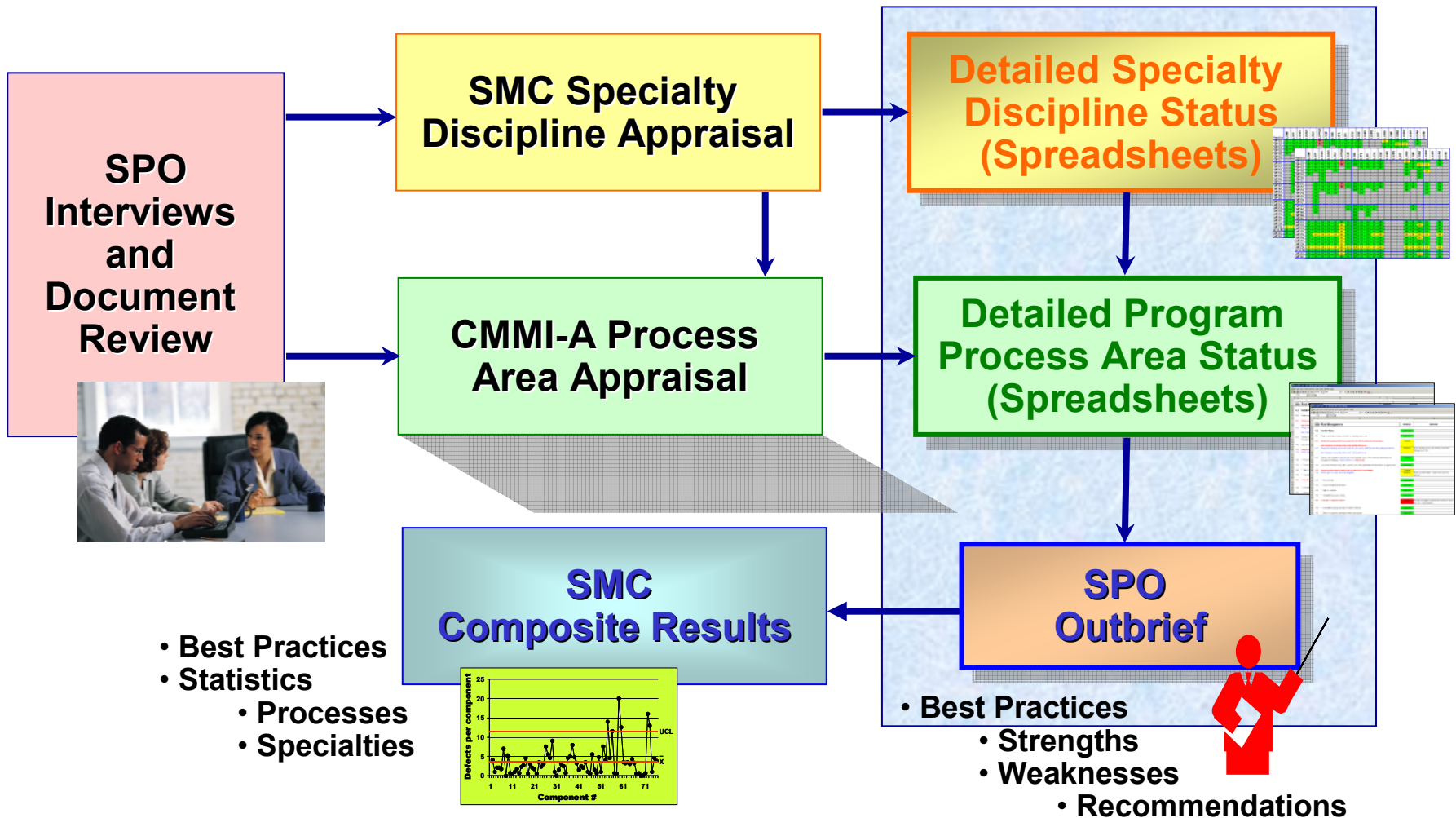




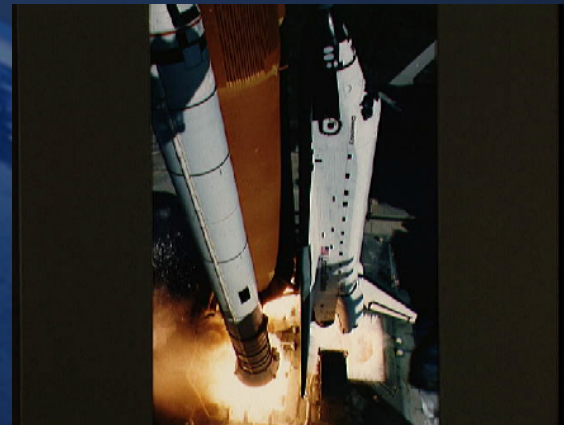
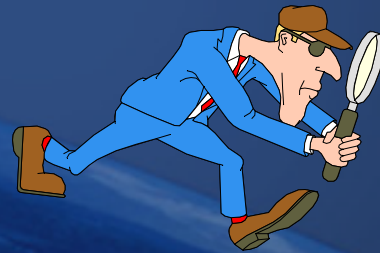
Appraisal Products

Process

Products



The NASA Experience





NASA Return to Flight Support

- **Columbia Accident Investigation Board (CAIB) Report cites the Aerospace Corporation’s Launch Verification Process as an independent safety program that should be considered**
- **NASA requests appraisals of the JSC, KSC, and MSFC centers’ Systems Engineering & Integration Office similar to the appraisals for SMC**
 - Added key AF appraisal team members to an Aerospace team
 - Modified and used the SMC CMMI-A model to be more “operational”
 - Added Integrated Teaming, Technical Solution, Product Integration, Causal Analysis & Resolution
- **NASA asks for *process improvement recommendations***



Lessons Learned

- **Best Practices were shared between the two organizations**
- **The NASA appraisals reinforced SMC's original thought to include these PAs in its model:**
 - Technical Solutions
 - Product Integration
 - Integrated Teaming
- **Improvement recommendations became a standard appraisal product**
 - They are prioritized and actionable
 - Sample documented processes are provided

AF Results and Process Improvements



Process Improvement



Processes Appraised

Process Categories and Areas:

Engineering

- Requirements Development (RD)
- Requirements Management (RM)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (of SPO products) (VER)
- Validation (of system) (VAL)

Support

- Configuration Management (CM)
- Decision Analysis & Resolution (DAR)

Process Categories and Areas:

Project Management

- Program Planning (PP)*
- Program Management (PM)*
- Contractor / Vendor Management (CVM)*
- Risk Management (RiM)
- Integrated Teaming (IT)

Organizational Process Management

- Organizational Training (OT)

116 practices across 14 process areas

SMC Technical Specialties Surveyed

EMI / EMC	Quality Assurance
Human Factors Engineering	RMA
Integrated Logistics Support	Safety
Mass Properties	Software Engineering
Manufacturing	Survivability
Parts, Materials, & Processes	Test & Evaluation

* Revised names



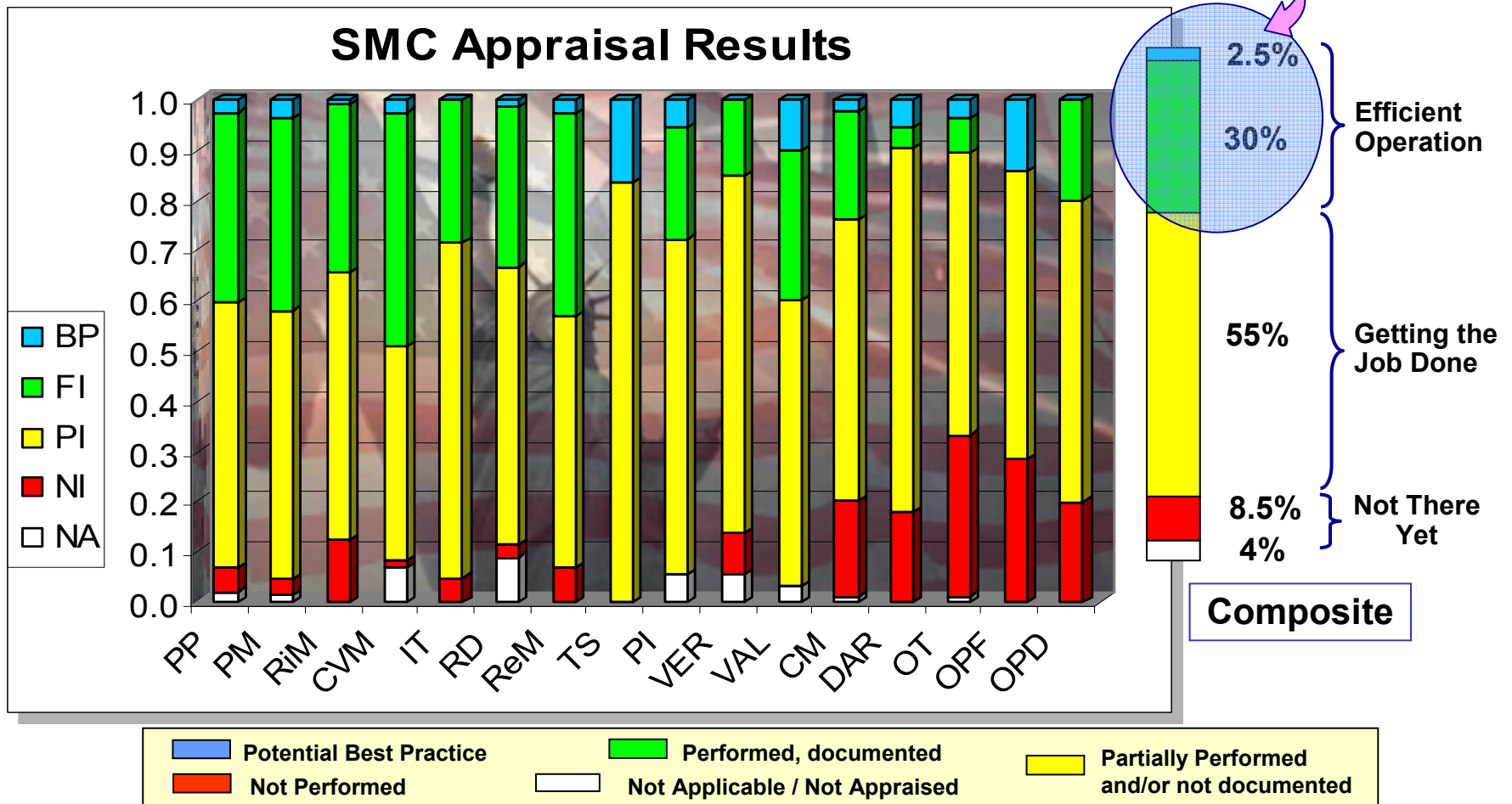
Rules for Practice Implementation

- **Best Practice (BP)**
 - Potential for SMC-wide sharing
- **Fully Implemented (FI)**
 1. The practice is performed with **no substantial weaknesses**
 2. The practice **must be documented, used and known**
 3. At least **two** pieces of objective evidence exist (documents and/or interviews)
- **Partially Implemented (PI) - (weaknesses found)**
 - The practice is at least minimally performed but not sufficiently documented or known
- **Not Implemented (NI) - (weaknesses found)**
 - No significant aspect(s) of the practice is/are implemented
- **Not Applicable (NA)**
 - The practice does not apply to this (phase of the) program



Results to Date

- 12 Programs and Staff Offices Have Been Appraised
- Nearly 40 “Best Practices” Identified
- About One-Third of Practices are Fully Performed





Results Are Provided to and Owned by the Program Managers

- **Actionable results**
 - Owned by the SPD/PM
 - Observations not attributed
 - Recommendations
- **Process area findings**
 - Best Practices
 - Strengths & Weaknesses
- **Personnel feedback**

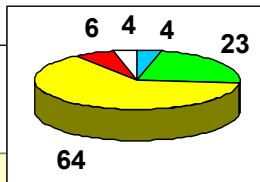
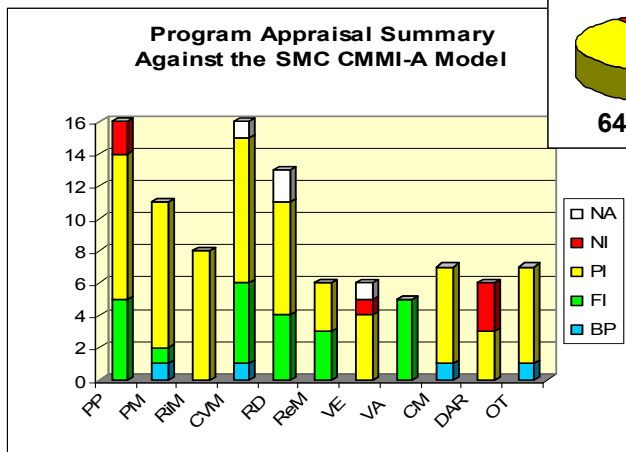
CMMI Process Area	Process Exists?	Is It Used?	Documented?	Others Know & Use?	Mgmt Aware & Review?	Resources ?	Training ?
Program Planning							
Program Management							
Risk Management							
Contractor Management							
Requirements Development							
Requirements Management							
Verification							
Validation							
Configuration Management							
Decision Analysis & Resolution							
Organizational Training							

Process Results

Appraisal Summary Findings							
Specialty Disciplines	Process Exists?	Is It Used?	Documented?	Others Know & Use?	Mgmt Aware & Review?	Resources?	Training?
EMC/EMI							
Human Factors							
ILS							
Manufacturing							
Mass Prop							
PMP							
QA							
RMA							
Software							
System Safety							
Survivability							
T&E							

Technical Specialties

Statistics



Detailed Data

SP1.1-1 Determine Risk Sources and Categories		
Determine risk sources and categories.		
Risk sources are categorized as technical performance, cost, or schedule.	(A)	g
The contractor has a Risk Management Plan (RMP) that identifies sources and categories, that the government monitors.	(A)	g
Each IPT has its own Risk Management process, there is no Risk Management plan formally tracked.	(A)	y
There is a Risk Management Plan in coordination that was reviewed and signed off.	(A, DA)	g
There is a Risk Management process described in the..... Narrative, the.....	(A, DA)	g
Not aware of anything written for Program Office or risk process.	(A)	r
A Risk Management Plan was developed dated 06 January 2003, together with training dated January 13, 2003.	(A, DA)	g
Risk Management charts (1/13/03) show risks are being identified	(DA)	g
SP1.1-1 Finding		
Determination of risk sources and categories is defined in the..... Risk Management Plan (RMP).		
FI	<----Practice Finding	FI
Mini-Team Recommendation ---->		

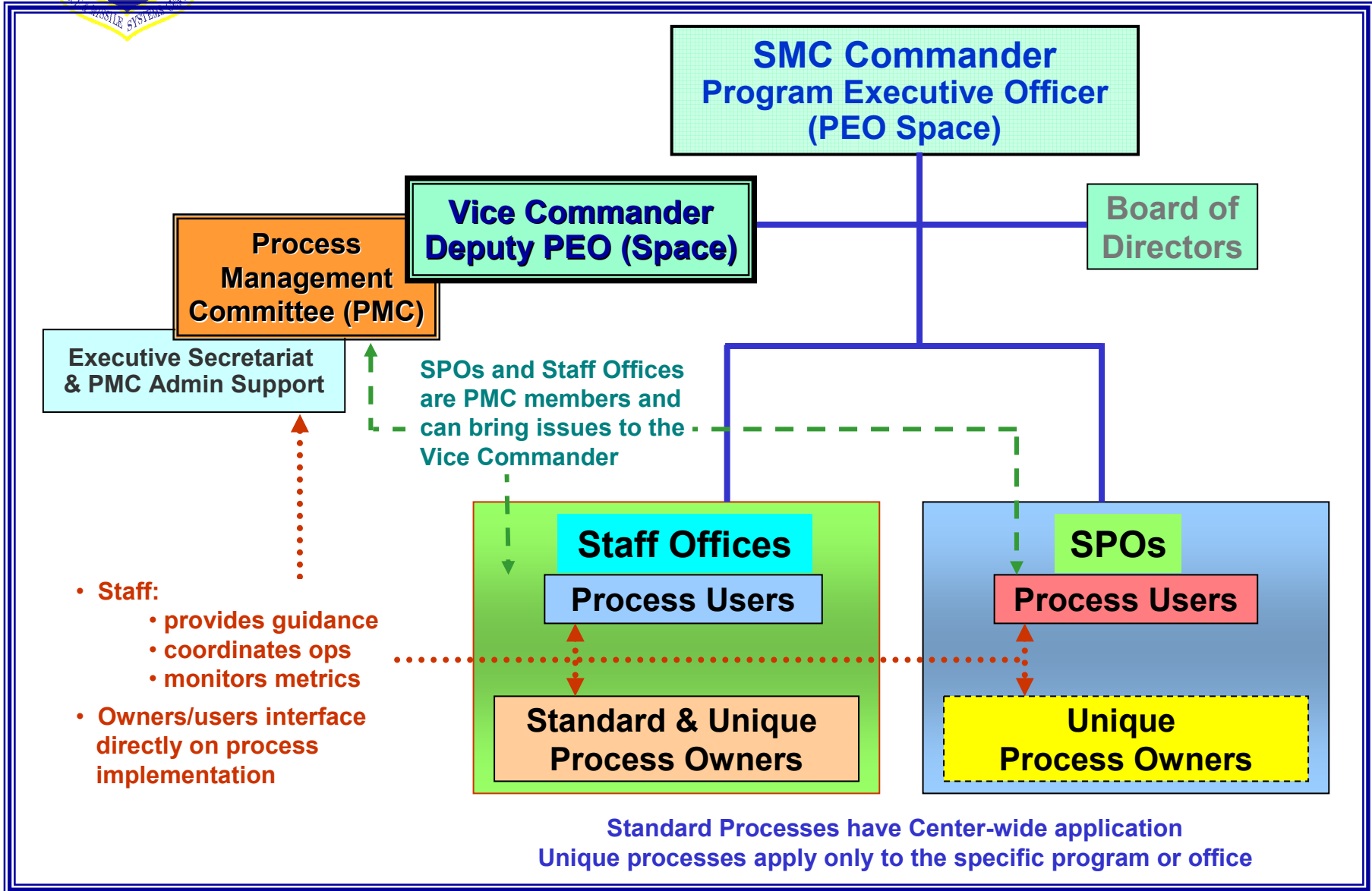


SMC Process Policy Guidance Established

- ***SMC Vision*** – continue as the Center of Excellence for space and missile systems acquisition by producing quality products and capabilities for our warfighters and nation on time and at cost
- **A Commander's Policy** was published that directs process improvement implementation
 - Effective use of ***documented processes*** is key
- **Established a *Process Management Committee*** to ensure smooth transformation of the Center to process centric operations
 - Chaired by the Deputy Commander
 - All programs and staff offices are members
 - Center Best Practices are being captured and made available



Process Improvement Structure



Lessons Learned



Process Improvement



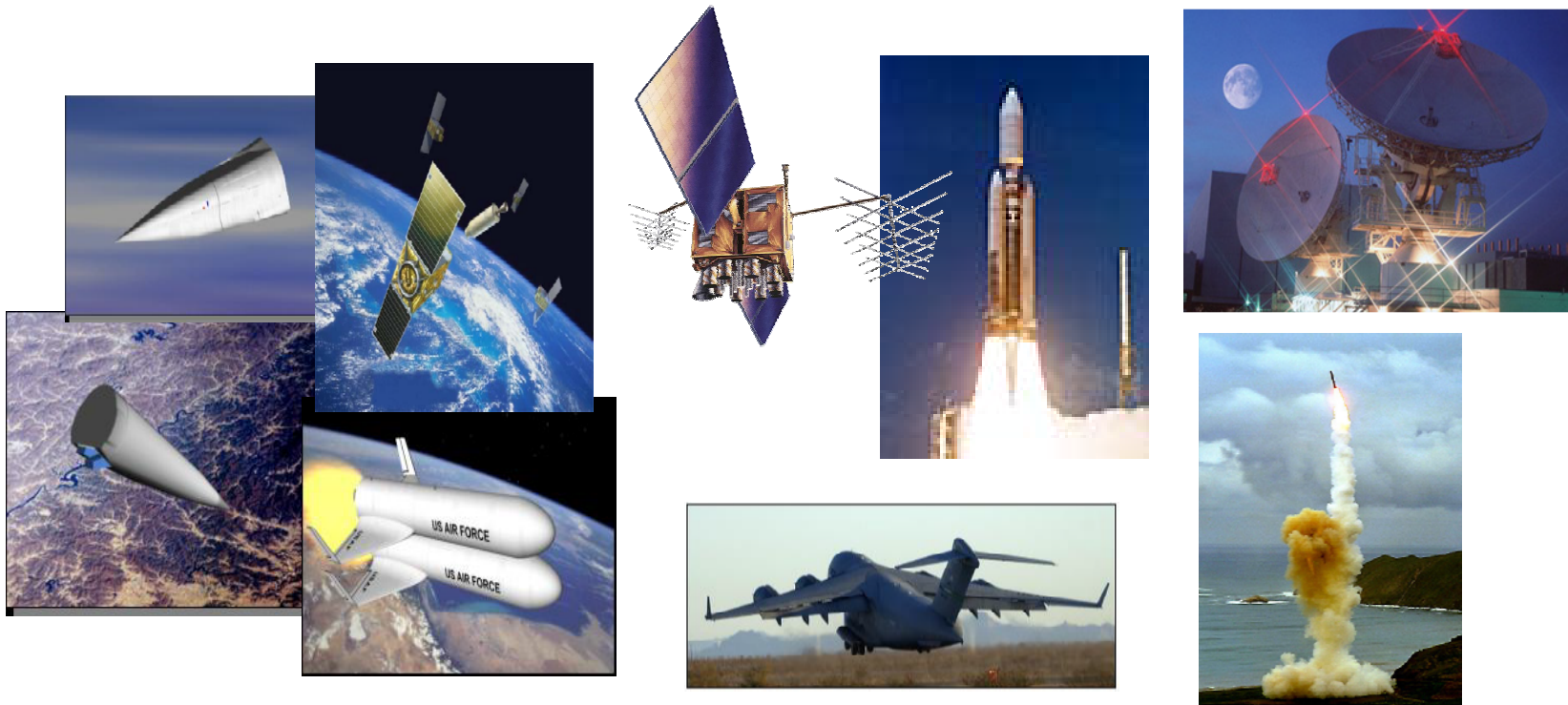
Lessons Learned

- **Expectations (2003)**
 - SPOs would be skeptical
 - SPOs would be uncooperative
 - 24 appraisals in 18 months
 - We could get direct artifacts to review well in advance
- **Reality (2005)**
 - Skepticism became enthusiasm
 - SPOs requested appraisals
 - 12 appraisals in 30 months
 - Discovery was how we had to do it (and it was tough)
- **It is essential to have a knowledgeable SPO point of contact to:**
 - Coordinate and schedule interviews
 - Help locate documentation
 - Be a process improvement “owner” inside the organization when it’s over
- **Making improvement recommendations along with appraisal results provides immediate, useful feedback**



Summary

- Programs were benchmarked and improvements observed
- An infrastructure is now in place to manage process improvement



Appraisals yielded positive results that are shared Center-wide

Questions?

