AF Systems Engineering Assessment Model (AF SEAM)

Presented To:

International Council on Systems Engineering Finger Lakes Chapter

George Richard Freeman

Technical Director, US Air Force Center for Systems Engineering
937-255-3355 ext 3419

richard.freeman@afit.edu

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Agenda

- Background
- Development process
- AF SEAM construct
- AFSEAM process
- Results reporting
- Spiral 2 considerations / Lessons Learned

Why AF SEAM

Challenges:

- AF programs late, over cost, & do not provide the performance expected
- SECAF directed action to revitalize SE across the AF
- No standard tool/method for assessing SE processes

Goals:

- Promote consistent understanding of SE
- Ensure core SE processes are in place and being practiced
- Facilitate sharing “Best Practices”
- Provide “Brain Drain” insurance
- Improve AF leadership visibility into SE process maturity

Improved program performance & reduced technical risk

Defining the Methodology

- Hands Off
- Promulgate Policy
  - Directives
  - Instructions
  - Checklists
  - Guidance
- Expect Compliance

- AF SEAM
  - Collaborative & inclusive
  - Leanest possible best practices "Must Dos"
  - Clearly stated expectations
  - Program team & assessor team
  - Training
- Self-assessment of program with optional validation

- Hands On
- Comprehensive Continuous Process Improvement
  - Highly detailed process books
  - Training
- Independent Assessment
  - Deep dives

Assessment methods that balance time & depth to need

AFSEAM Development Team Members

Center	Members
AAC	Mr. Ian Talbot
AEDC	Mr. Neil Peery, Maj Mark Jenks
ASC	Mr. Gary Bailey
AF CSE	Mr. G. Richard Freeman & Mr. Randy Bullard
HQ AFMC	Mrs. Caroline Buckey
ESC	Mr. Bob Swarz & Mr. Bruce Allgood
OC-ALC	Mr. Cal Underwood & Mr. Bill Raphael
OO-ALC	Mr. Jim Belford & Ms. Mahnaz Maung
SMC	Ms. Linda Taylor
WR-ALC	Mr. Jim Jeter & Mr. Ronnie Rogers

Phenomenal Team Support !

Background

- Original task: AFMC EC Action Item
  - Objective: "Develop standard AF assessment model"
  - Tools were in place @ 4 Centers
- 12 On-Site Team Engagements
  - Representatives from EN Home Offices
    - 4 Product Centers, 3 ALCs, AEDC, HQ AFMC/EN, CSE
  - Met 9 times at 5 different locations in one year
  - Conducted 3 baseline assessments at 3 Centers
- 12 Briefings to Senior Leaders
  - AFMC Engineering Council Meetings (4)
  - ALC EN Meeting
  - SAF/AQR (2)
  - AF Tech Leaders Round Table
  - OSD (AT&L) & Boeing SE Advisory Group
  - National Research Council (National Academies)
  - Final to AFMC/EN – 5 Aug 08, & Final to SAFF/AQR – 11 Aug 08

Development Process

- **Environmental Scan Up Front**
  - **External Benchmarking**
  - **Existing Best Practices**
- **Collaborative Reviews/Inputs**
  - **Software Engineering Institute (CMMI)**
  - **NDIA**
  - **AF HSIO**
  - **LHA Development Team**
  - **TD 1-12**
  - **INCOSE**
  - **Industry Partners**

Collaborative build – Included greater SE community

AF SEAM Pedigree

- Several AF product Centers selected and tailored some version of the Software Engineering Institute (SEI) Capability Maturity Model Integration (CMMI®) to baseline process institutionalization
- SEI CMMI® is the Defense Industry-wide accepted method for process appraisal and improvement
- The SEI CMMI® incorporates principles and practices from recognized industry and US Government system engineering and related standards such as:
  - AFI 63-1201 — Life Cycle Systems Engineering, Defense Acquisition Guidebook, Chapter 4
  - MIL-STD 499B — System Engineering
  - ANSI/EIA 632 — Processes for Engineering a System
  - IEEE/EIA 731 — Systems Engineering Capability Model
  - ISO/IEEE 15288 — Systems Engineering-System Life Cycle Processes
  - INCOSE — System Engineering Standard
  - IEEE 1220 — Application and Management of the Systems Engineering Process

Formula For Change

C fn[N, V, M]>C of C

- C = Change
- N = Need
  - Leaders Create the need to change
- V = Vision
  - Leaders provide a Vision of a better future
- M = Means
  - Leaders manage the charge process
- C of C = Cost of Change
  - Must be less than the benefit anticipated

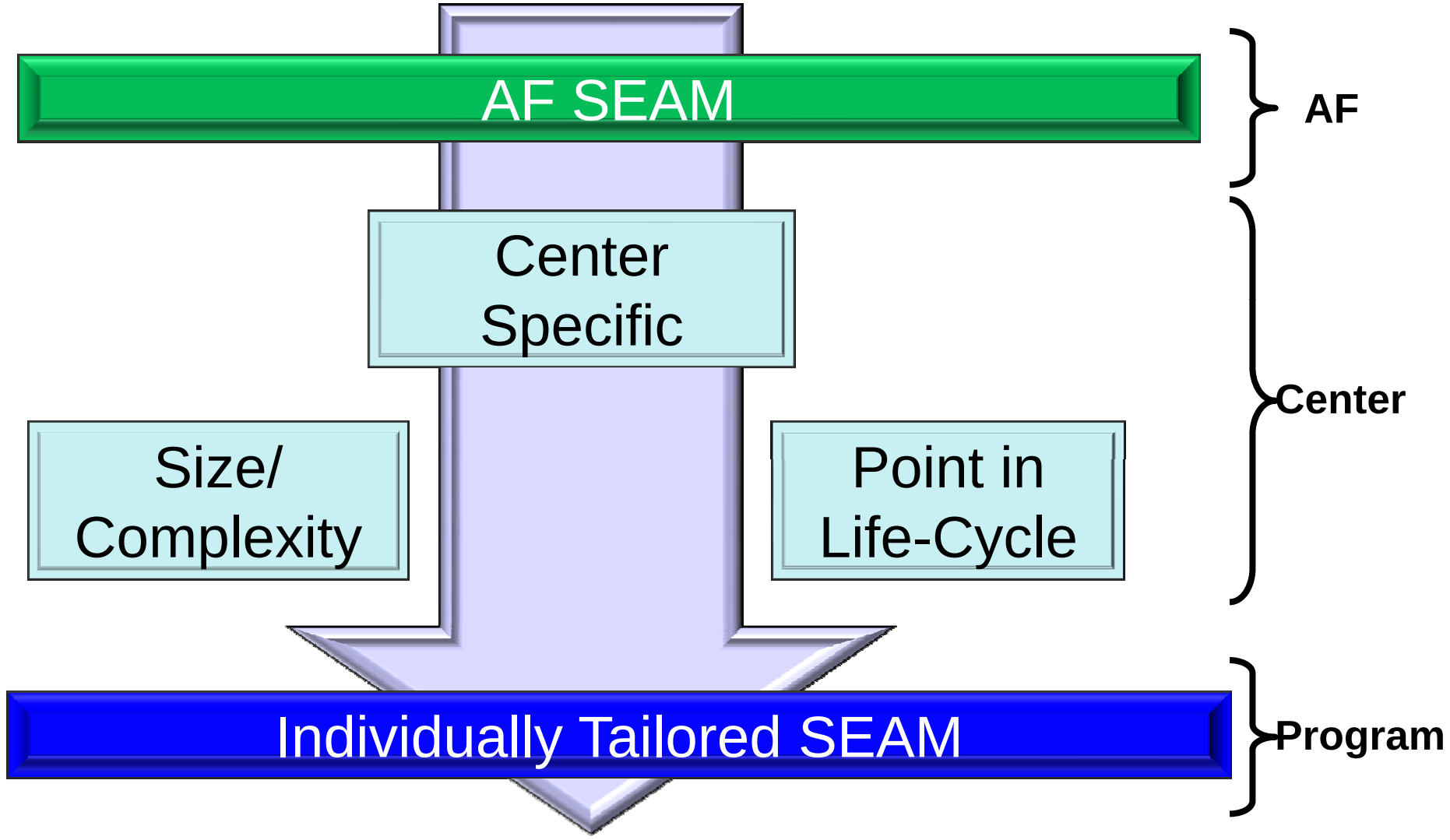
Environment Sensitivity

- **Sustaining Change Over Time**

Unfreeze	>	Changes	>	Refreeze
1 to 24 months		12 to 36		24 to 48
Case for Change		Early wins		Irreversible momentum

Ref: Lewin's Freeze Phases,
http://changingminds.org/disciplines/change_management/lewin_change/lewin_change.htm

AF SEAM Construct



AF SEAM - CMMI-ACQ v1.2

AF SEAM Processes

- Requirements
- Design
- V&V
- Decision Analysis
- Configuration Mgmt
- Risk Mgmt
- Project Planning
- Sustainment
- Manufacturing
- Tech Mgmt & Ctrl
- Generic Practices

CMMI Color Legend: Green = Covered, Yellow = Partially, Red = Not Covered

CMMI-ACQ Processes v1.2

REQM – Requirements Management (RM)	2
MA – Measurements & Analysis	
PMC – Project Monitoring & Control	
PP – Project Planning	
PPQA – Process and Product Quality Assurance	
SSAD – Solicitation & Supplier Agreement Dev	
CM – Configuration Management	
DAR – Decision Analysis and Resolution	3
AM – Agreement Management	
ARD – Acq Requirements Development	
ATM – Acq Technical Management	
VAL – Acq Validation	
VER – Acq Verification	
OPD – Organizational Process Definition	
OPF – Organizational Process Focus	
IPM – Integrated Project Management (IPPD)	
RSKM – Risk Management	
OT – Organizational Training	
OPP – Organizational Process Performance	4
QPM – Quantitative Project Management	
OID – Organizational Innovation & Deployment	5
CAR – Causal Analysis & Resolution	

CMMI Maturity Levels:
1 Initial, 2 Managed, 3 Defined, 4 Quantitatively Managed, 5 Optimizing

AF SEAM - CMMI-DEV v1.2

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CMMI Maturity Levels:
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Process Area	*Maturity Level*
Causal Analysis and Resolution	5
Configuration Management	2
Decision Analysis and Resolution	3
Integrated Project Management +IPPD	3
Measurement and Analysis	2
Organizational Innovation and Deployment	5
Organizational Process Definition +IPPD	3
Organizational Process Focus	3
Organizational Process Performance	4
Organizational Training	3
Product Integration	3
Project Monitoring and Control	2
Project Planning	2
Process and Product Quality Assurance	2
Quantitative Project Management	4
Requirements Development	3
Requirements Management	2
Risk Management	3
Supplier Agreement Management	2
Technical Solution	3
Validation	3
Verification	3

AF SEAM Content

- **Process Areas (PAs)**
- **Goals**
- **Practices**
- **Informative Material**
  - **Description**
  - **Typical Work Products**
  - **Reference Material**
  - **Other Considerations**

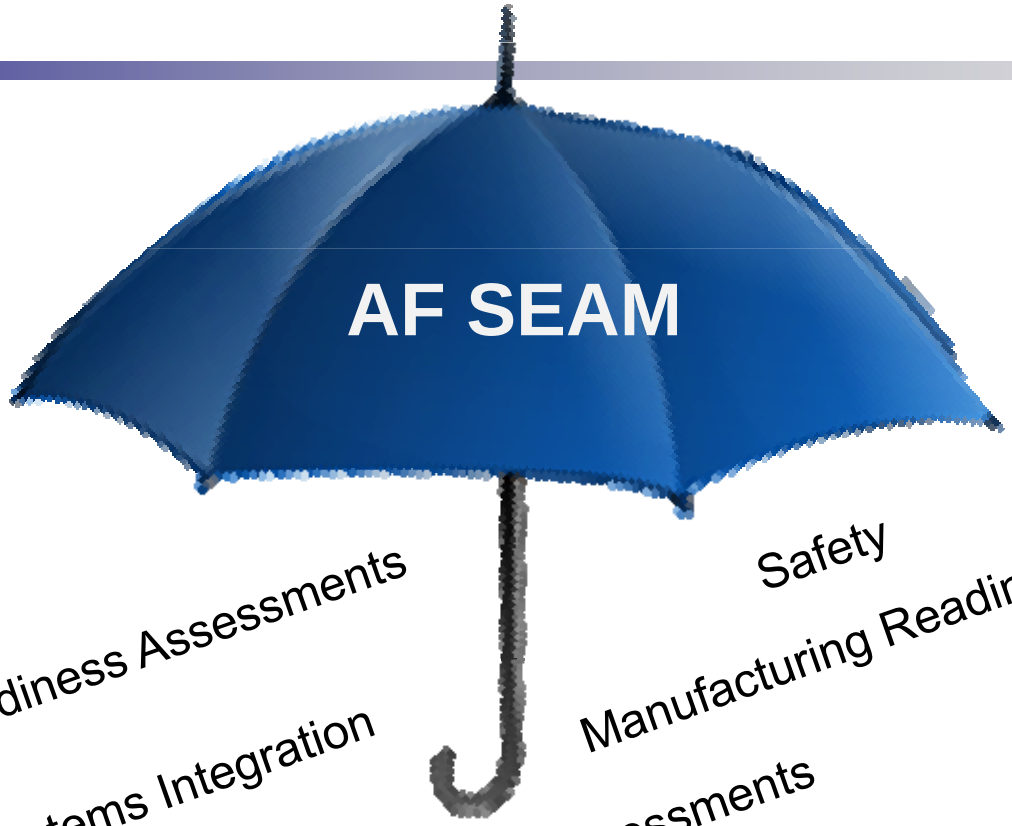
Process Areas

#	Symbol	Process
1	CM	Configuration Management
2	DA	Decision Analysis
3	D	Design
4	M	Manufacturing
5	PP	Project Planning
6	R	Requirements
7	RM	Risk Management
8	S	Sustainment
9	TMC	Technical Management & Control
10	V	Verification & Validation

Generic Practices

#	Practice Description
GP1	Description of process
GP2	Plans for performing the process
GP3	Adequate resources for performing the process
GP4	Responsibility & authority for performing the process
GP5	Train the people performing the process
GP6	Monitor & control the process
GP7	Review activities, status, & results of the process

AF SEAM Umbrella



Technology Readiness Assessments

Human Systems Integration

Risk Assessments

Logistics Health Assessments

And More…….

Safety

Manufacturing Readiness Assessments

Where They Intersect

AF SEAM

- Determines existence of defined SE practices
  - Ten “classical SE” process areas
- Validates documented processes are being followed
  - A self-inspection or independent-inspection tool

What to Do

Risk ID

- Enhances existing TRA process to:
  - Address issues wrt integration and ‘ilities of new technologies
  - Forecast cost/sched/risk of moving to next TRL level
- Develops TRA & MRA courses to train workforce
  - Reduce ambiguities on interpreting TRLs
  - Ensure understanding of TRLs & MRLs
  - Prepare teams to conduct TRAs & MRAs
- Enables Acq & S&T communities to communicate on desired levels of tech maturity

How to Do It

AF SEAM Process Descriptions

8.3 Design (D)

- ***DG3: Assemble the design/development prototype(s) in accordance with the detailed design and integration strategy.***
  - ***DG3P2 Establish and maintain procedures and criteria for integration of the product-components***

Description: Procedures for the integration of the product-components can include such things as details of the expected tests and other evaluations to be carried out at each stage. Criteria can indicate the readiness of a product-component for integration or its acceptability. Assure component compatibility with the integration environment. Provide sufficient data to support certifications.

Typical Work Products:

- ❑ Product and product-component certifications
- ❑ Integration and test documents

Reference Material: AFI 99-103, AFI 63-107

AF SEAM Process Descriptions

– ***DG3P3 Manage internal and external interface definitions, designs, and changes for products and product-components***

Description: Periodically review all interface descriptions for coverage and completeness. Effective management of product-component interface requirements, specifications, and designs helps ensure that implemented interfaces will support integration.

Typical Work Products:

- ❑ Assembly procedures and sequences
- ❑ Interface drawings and documents
- ❑ Integration and test documents
- ❑ TCTO (Time Compliance Technical Orders)
- ❑ Digital System Models

- **Reference Material:** AFI 99-103, AFI 63-107
- **Other Considerations:** Many product integration problems arise from unknown or uncontrolled aspects of both internal and external interfaces. Participation in all relevant interface control working groups (ICWGs) helps ensure that implemented interfaces will support integration.

AF SEAM Process Descriptions

8.10 Verification and Validation (V)

- ***VG1 Prepare for verification***
  - ***VG1P1 Establish and maintain the overall verification strategy and plan, including integrated testing approach***

Description: Address, in the verification strategy, the technical approach to product verification and the specific approaches that will be used to verify that work products meet their specified requirements. Establish verification criteria and methods for each requirement. Proactively seek opportunities for combined testing with the operational test agencies and oversight offices and form an Integrated Test Team.

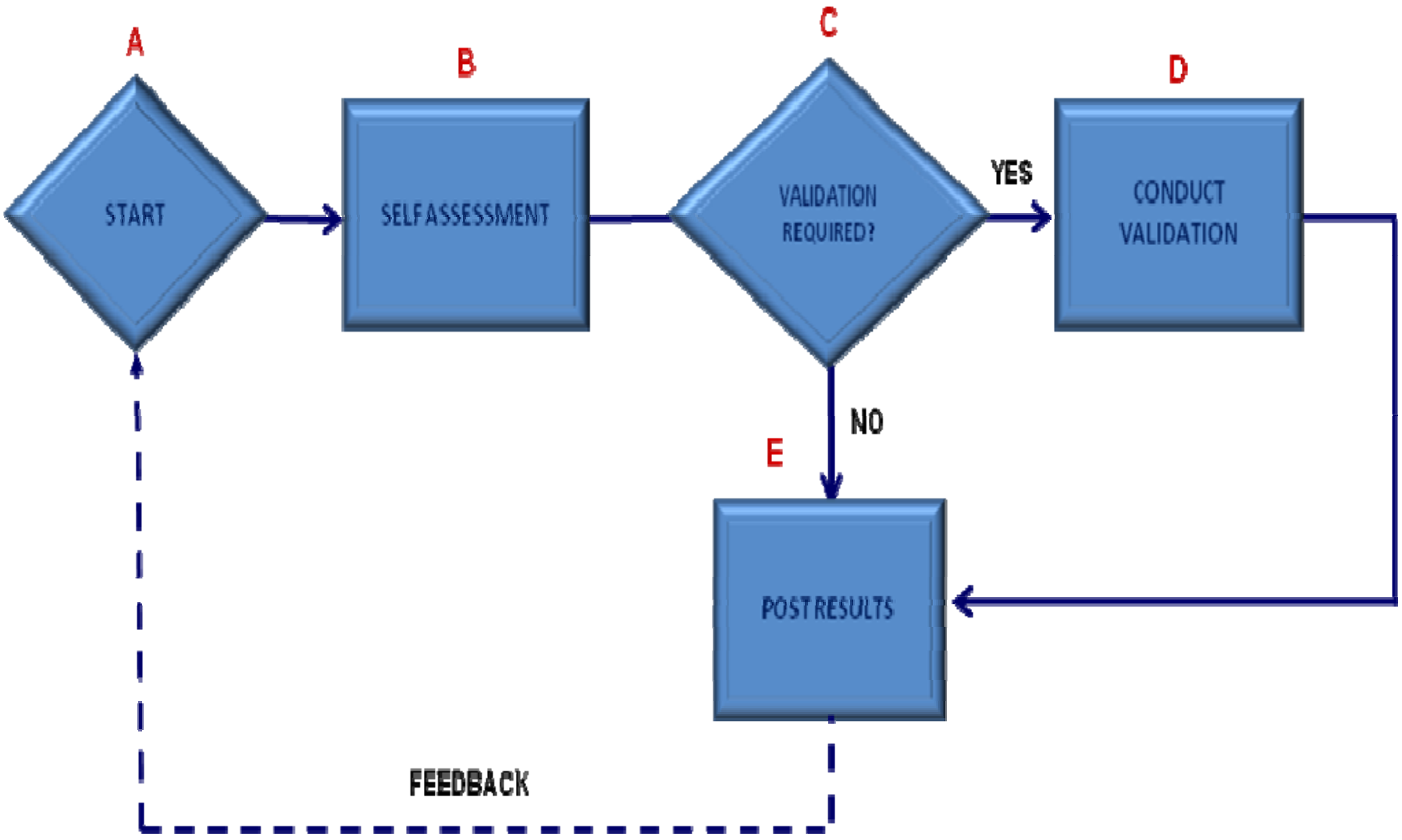
Typical Work Products:

- ❑ Document modeling, simulation, ground and flight test activities planned for product verification in the Test and Evaluation Master Plan (TEMP) or similar document if a TEMP does not exist.
- ❑ Use Cases are used to define test requirements.

Reference Material: AFI 99-103, AFI 16-1001, AFI 16-1002

Other Considerations: Work products can be developed by either the acquirer or suppliers. They should be selected based on their contribution to meeting project objectives and requirements, and to addressing project risks.

AFSEAM Process



Specific Practices Summary

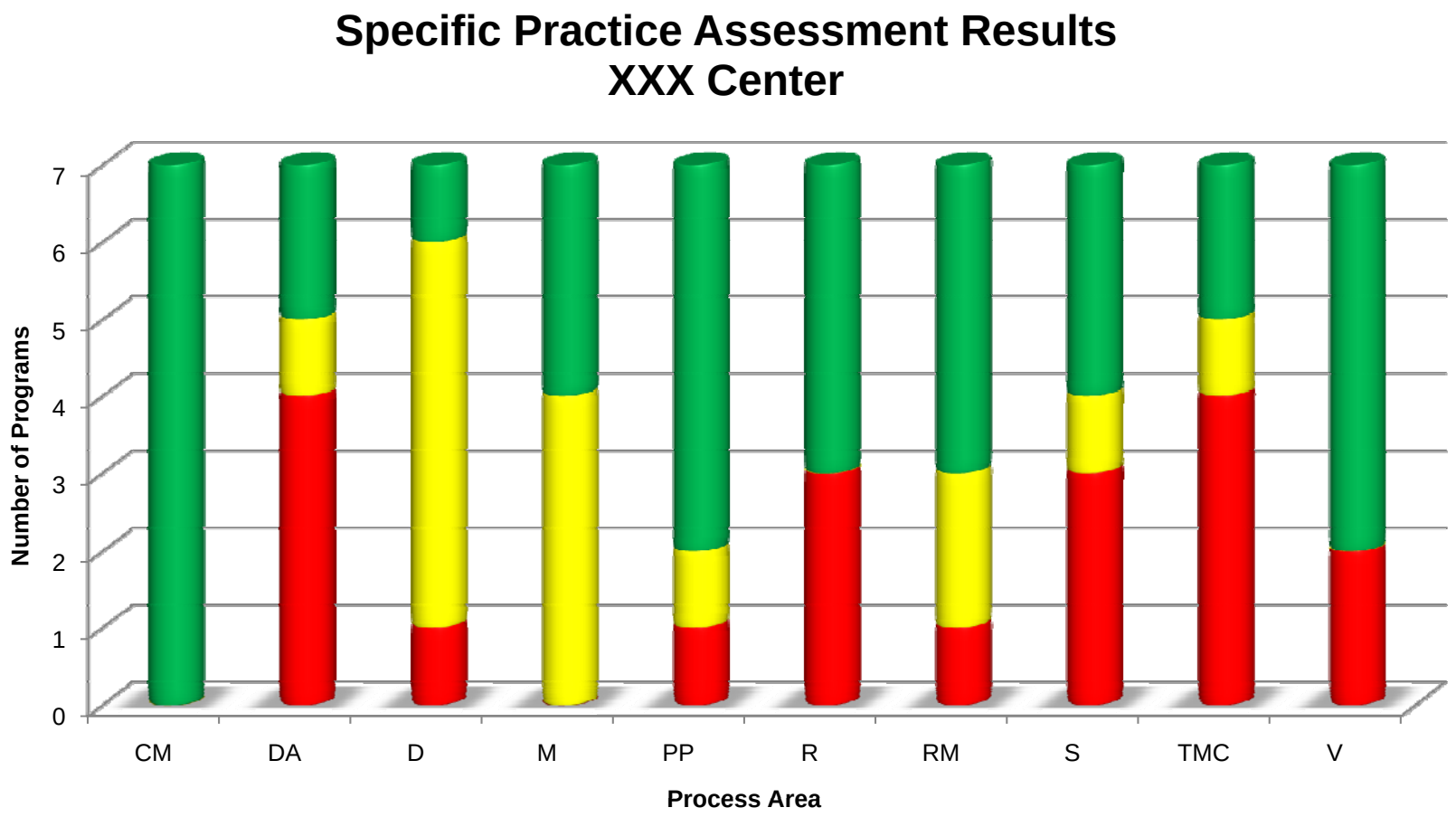
PA LEGEND
90-100%
65-89%
0-64%

SP LEGEND
1
0
Not Applicable

Percentage *(of those practices scored)*	75%	50%	79%	73%	87%	86%	100%	67%	83%	93%
	CM	DA	D	M	PP	R	RM	S	TMC	V
Specific Goal 1										
SP 1.1	1	1	1	0	1	1	1	1	1	1
SP 1.2	1	1	1	1	1	1	1	1	1	1
SP 1.3		0	1	1	1	1	1	1	1	1
SP 1.4		N/A	0		1	1			1	1
SP 1.5		0	0						1	
Specific Goal 2										
SP 2.1	1		1	1	0	1	1	0	1	1
SP 2.2	1		0	1	0	1	1	0	1	1
SP 2.3	0		1		1	1		0	1	
SP 2.4	0		1		1			0		
SP 2.5	N/A				1			0		
SP 2.6					1					
SP 2.7					1					
SP 2.8					1					
Specfic Goal 3										
SP 3.1	1		1	1	1	1	1	1	0	1
SP 3.2	1		1	1	1	0	1	1	0	1
SP 3.3			1	1	1	0			1	0
SP 3.4			1						1	
SP 3.5			1							
Specific Goal 4										
SP 4.1				1		1		1		1
SP 4.2				0		1		1		1
SP 4.3				0		1		1		1
SP 4.4						1		1		1
SP 4.5								1		1
Specific Goal 5										
SP 5.1										N/A
SP 5.2										N/A

Spreadsheet tool provides this output

Scoring Roll-Up



Generic Practices Summary

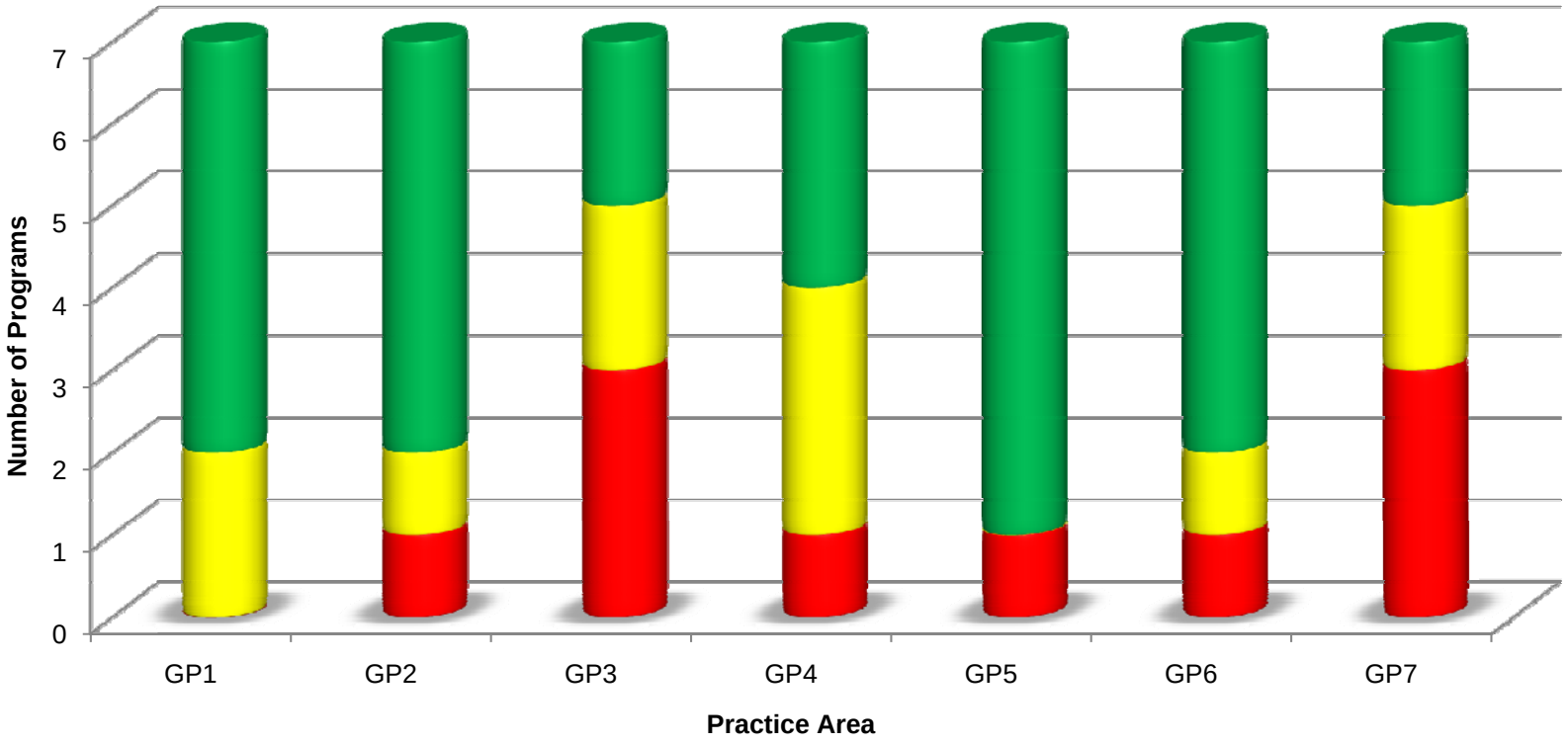
PA/GP	GP1	GP2	GP3	GP4	GP5	GP6	GP7	GP Overall
CM	1	1	1	1	1	1	1	7
DA			1	1	1	1	1	5
D	1	1	1	1	1	1	1	7
M	1	1	1	1	1	1	1	7
PP		1	1		1		1	4
R	1	1	1	1	1	1	1	7
RM	1	1	1	1	1	1		6
S	1	1	1	1	1	1	1	7
TMC		1	1	1	1	1	1	6
V	1	1	1	1	1	1	1	7

[redacted]

[redacted]

Spreadsheet tool provides this output

Scoring Roll-Up

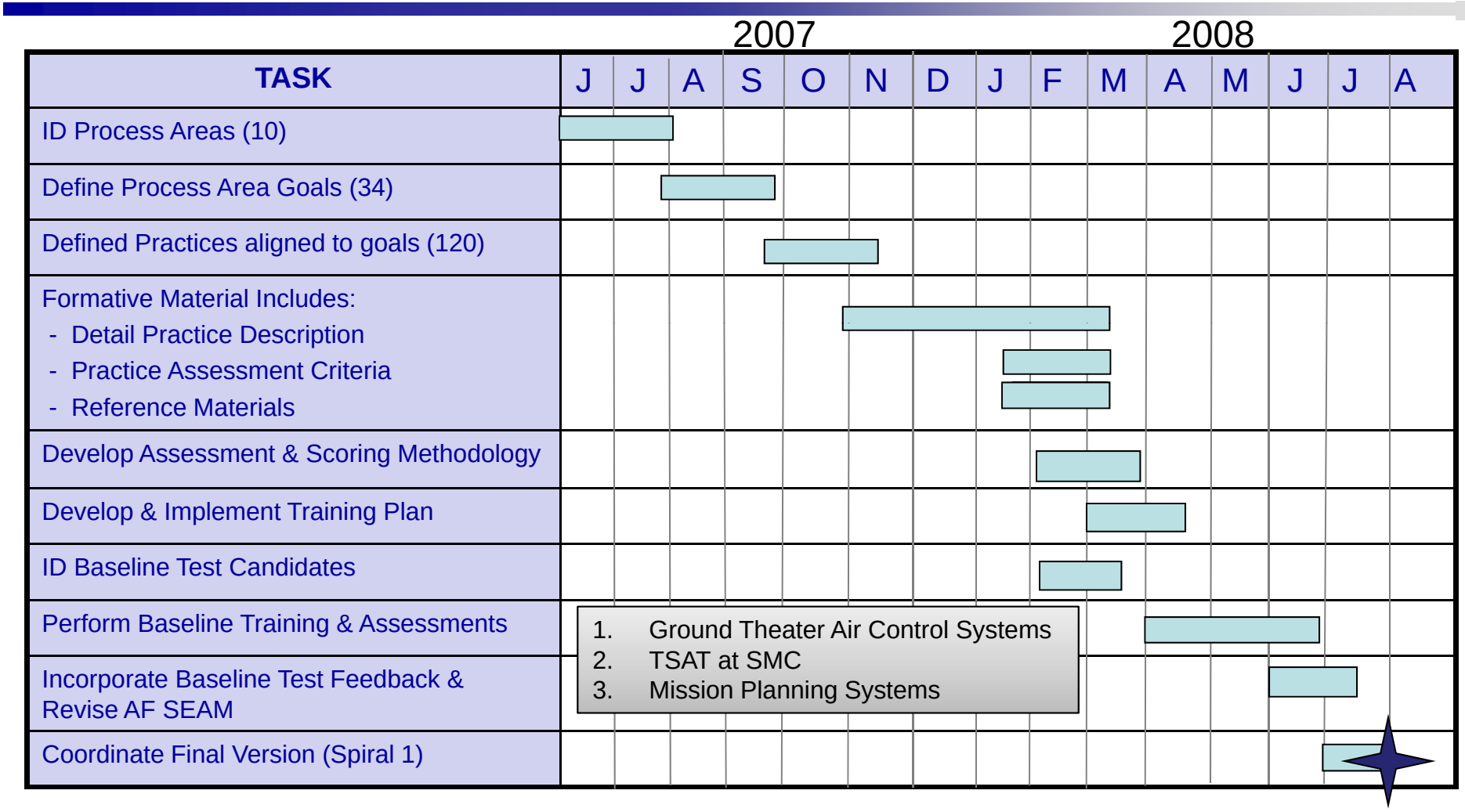


Tool Suite

- **Management Guide**
- **Assessment Tool (Spreadsheet)**
- **Training**
  - **Orientation/Overview**
  - **Self-Assessment**
  - **Validation Team**

"I highly encourage each program at your Center to conduct a self-assessment using this model."
Mr. Jaggers, SAF/AQR, 14 May 2008

Development Schedule



DELIVERED ON TIME !

Implementation By Center

CENTER	5 AUG 08 - FEEDBACK
✓ AAC	"AAC began integrating AF SEAM in our established program assessment process in January 2008 and expects to complete this integration in FY09."
✓ AEDC	"We will begin implementing AF SEAM in October."
✓ ASC	"We are creating a plan to migrate from our current tool to SEAM, tailored with AFMC and ASC specific areas of interest."
✓ ESC	"We have initiated tailoring efforts to implement AF SEAM by the end of the calendar year. We will be working closely with SMC, our acquisition partner, on the tailoring and implementation effort."
✓ OC-ALC	"Strongly support, have plans in place, ready to go!"
✓ OO-ALC	"We are implementing now."
✓ SMC	"SMC plans to adopt AF SEAM and comply with related policies."
✓ WR-ALC	"We'll begin implementation at Robins with pilot assessments in F-15 and Avionics."

Development process yielded 100% buy-in

Spiral 2 Considerations / Lessons Learned

- Capability Enhancement
  - Re-look at process areas for improvements
  - Further refine assessment methodology
  - Strengthen inclusion of software
  - Capture and promulgate best practices/lessons learned
  - Review scoring
  - Examine potential use for SE health assessment
  - Migrate to web-based platform
- Charter
  - Establish vision & mission
  - Establish governance
  - Support team by providing resources
  - Signed @ appropriate level
- Funding
  - Spiral 2 & Sustainment
- Lead POC/Steering Group
  - Staff support
  - Community of Interest
  - Configuration control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QUESTIONS?