

# ***Lockheed Martin Aeronautics – Lockheed Martin Aero Standard Approach (LMASA)***

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and User Group***

***November 17-19, 2009***

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- **Lockheed Martin Aeronautics Overview**
- **LMASA Overview**
- **PIID Evidence Standard**
- **PIID Repository Standard**
- **Opening Brief Standard**
- **PIID Population Approach**
- **PIID Reviews**

# Lockheed Martin Aeronautics Overview



29,000 employees across the company and around the world



# 2007 SCAMPI A Was Significant Effort



- **Document review**
  - *Over 3900 items examined*
  - *Included classified data*
  - *Only 9 Information Needs*
- **Interviews**
  - *Over 100 participants at 3 sites*
  - *Conducted 9 group interviews*
  - *Included major engineering disciplines*
    - Hardware
    - Software
    - System
- **Appraisal Team**
  - *Team consisted of 11 members*
    - 5 internal, 6 external
    - 4 SCAMPI Lead Appraisers<sup>SM</sup>
  - *Consistent mini-team assignments*



The Systems and Software Consortium completed a CMMI® - Based Appraisal on August 30, 2007 in accordance with the Standard CMMI® Appraisal Method for Process Improvement (SCAMPI<sup>SM</sup>), V1.1 and determined that

**Lockheed Martin Aeronautics**

achieved

**Process Maturity Level 3**

as defined by the SEI CMMI® Version 1.1 SE/SW Continuous Representation.

Gene Jorgensen, SSCI  
SEI Authorized Lead Appraiser

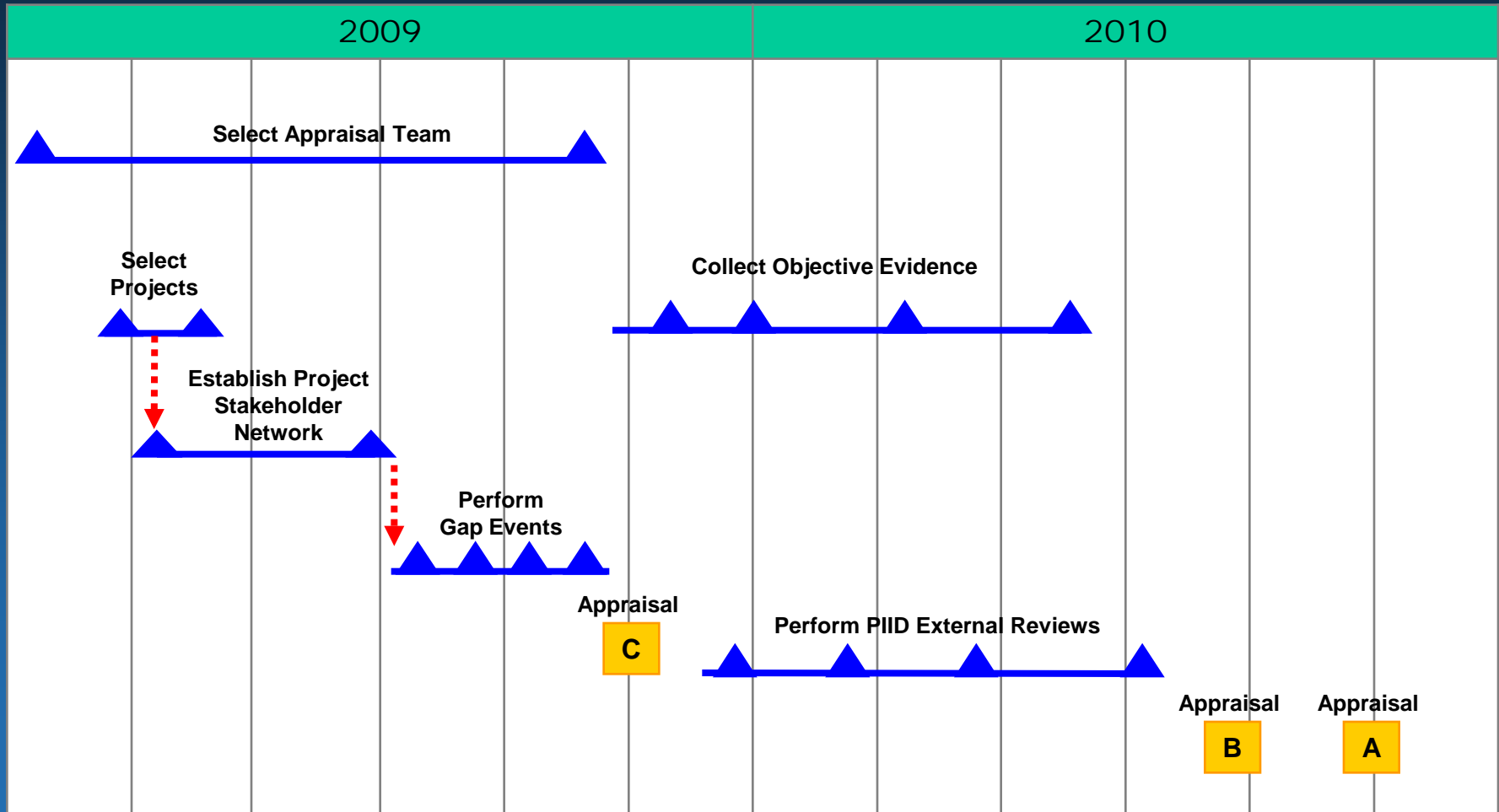
Drew Allison, SSCI  
Appraisal Team Member



- **The 2007 SCAMPI A readiness strategy was man-power intensive**
- **The 3 day Introduction to CMMI course did not map to LM Aero terminology**
- **Including dynamic data in the PIID created problems**
- **Lack of common file structure across the program PIID repositories allowed for a convoluted mess**
- **Not restricting the file types included in the PIID was problematic**
- **Allowing duplication of artifacts within a program PIID created CM issues**
- **Significant planning did not prevent all network access issues for the appraisal team**
- **Comprehensive documented PIID archival process is important**

PIID – Process Implementation Indicator Description

# 2009 – 2010 Integrated Master Schedule





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# **Lockheed Martin Aeronautics Standard Approach (LMASA) Overview**



- **LMASA provides unambiguous guidance to the appraisal projects in how LM Aero has decided to present our evidence to the SCAMPI team during our appraisal**
- **The 2007 SCAMPI involved 3 appraisal projects, more than 100 participants, across 3 widely-dispersed sites collecting more than 3900 data items, a standard approach was needed for programs to populate the PIID**
- **LMASA was initially developed for the 2007 SCAMPI to provide guidance for the CMMI Generic Practices**
- **In order to reduce cost for the 2010 SCAMPI, LMASA was expanded to all practices of the CMMI and to include our PIID Evidence Storage Approach**





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- Reviewed the PIID evidence provided from all projects for the 2007 SCAMPI to develop stream-lined guidance for evidence for each practice for the 2010 SCAMPI
  - *Identified specific work products that relate to LM Aero and the specific appraisal projects*
  - *Identified where evidence was needed for systems, software and hardware examples*
- Reviewed LMASA with the projects and the process owners for every practice
  - *Validated usability of LMASA*
  - *Improved the project 's understanding of what the 'best evidence' looked like*
  - *Determined what actions if necessary were needed to comply with LM Aero best practices embodied in the OSP*
- Reviewed LMASA with Lead Appraiser and selected Appraisal Team Members during Class C Appraisal August 2009



- **Example - GP 2.2 Plan**
  - ***Organizational Directive***
    - One record that points to where in Your Process a plan is required (All PAs)
    - One record that points to Section 1.B of AC-5604 for the list of all plans, one of which is yours (even if it is not visible due to being part of another plan, such as the SEMP) (Project PAs only)
  - ***Program Directive = Organizational Directive***
    - If you obtained a tailoring regarding your plan, create a record that shows that tailoring
  - ***Direct Evidence***
    - A finalized, approved plan



**CMMI  
Practice  
Info**

## CMMI Practice Report for CM GP 2.4

**Process Area:** Configuration Management

**Category:** Support

The purpose of Configuration Management (CM) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

**Goal** GG 2 Institutionalize a Managed Process

The process is institutionalized as a managed process.

**Practice:** GP 2.4 Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the configuration management process.

### Example Direct Artifacts

LMASA: Program Management Plan establishing responsibility for CM by roles; Program Org Chart showing people assigned to CM roles (same as in GP 2.3)

CMMI: • Documentation assigning responsibility for process activities, work products, or services; e.g., job descriptions, or plans for performing the process (see GP2.2).

- Task descriptions and activities for defined roles.

### Appraiser Considerations

LMASA Organizational Guidance: AC-5604, Plan and Baseline the Program, 3.C, 3.D.5.e AC-5605, Organize the Program, 3.C, 3.D.5.e AC-5607, Monitor and Control Program Performance

LMASA Considerations: For Aero, AC-5604 establishes responsibility for various elements of the program plan. AC-5605 specifically addresses the assignment of personnel for programs. Section 3.C describes the assignment of management personnel to the lowest tier. Section 3.D.5.e describes the assignment of personnel to roles within each IPT to the various team members. Responsibilities, roles, and personnel assignments are covered in the Program Management Plan and the Program Organization Charts, as well as in IPT Charters.

CMMI Considerations: • These activities may be distributed across different groups within the organization (e.g. systems, software, CM group).

- Responsibility may change as development progresses across the life cycle.

## Standards for Direct and Indirect evidence

### Example Indirect Artifacts

LMASA: Affirmations from Program In-Brief.

CMMI: • Assignment is often in the project plan or configuration management plan

### Typical Work Products

## Other contextual help

# PIID Evidence Standard- SP Example



## CMMI Practice Report for PP SP 1.2

**Process Area:** Project Planning

**Category:** Project Management

The purpose of Project Planning (PP) is to establish and maintain plans that define project activities.

**Goal:** SG 1 Establish Estimates

Estimates of project planning parameters are established and maintained.

**Practice:** SP 1.2 Establish Estimates of Work Product and Task Attributes

Establish and maintain estimates of the attributes of the work products and tasks.

### Example Direct Artifacts

LMASA: BOEs ("establish") and EACs ("maintain") showing the generation of estimates based on attributes of work products and tasks; i.e., the estimation of attributes such as "Source Lines of Code" or "engineering drawings" which are then used to develop estimates of cost and schedule. These could be called "Task Sheets" or "Software Task Sheets". "Maintain" can also be shown by the collection of metrics reflecting the attributes used to generate the estimate in the BOE.

CMMI: [4. Attribute estimates]

- Estimates of the attributes of the work products and tasks (e.g., size)
- Estimates, as appropriate, of labor, machinery, materials, and methods that will be required by the project.
- Estimates revision history.

### Appraiser Considerations

LMASA Organizational Guidance: AC-5604, Plan and Baseline the Program, 3.A.5.c ("establish") CPD-3032, Estimating and Pricing Process

LMASA Considerations: For Asro, the Capture Team will analyze the technical solution to identify the program attributes of work products and tasks that will be used as the basis to estimate effort. The Capture Team will then use the attributes of work products, tasks, and technical requirements (reference CPD-3033, Contract Technical Requirements, Proposal Technical Requirements and CPD-3034, Contract Technical Requirements-Proposal Planning) to develop the effort estimate in accordance with CPD-3032, Estimating and Pricing Process  
Thursday, November 05, 2009

**Standards for Direct and Indirect evidence**

### Example Indirect Artifacts

LMASA: Rationale section of BOE Forms showing identified attributes.

CMMI: [1. Technical approach]

- [2. Size and complexity of tasks and work products]
- [3. Estimating models]
- Estimating tools, algorithms, and procedures
- Operational definitions (e.g., procedure/criteria) for establishing and documenting the estimates of the attributes of the work products and tasks.
- Bases of Estimates (BOEs)
- Use of validated models.
- Use of models that are calibrated with historical data.

### Typical Work Products

Technical approach  
Size and complexity of tasks and work products  
Estimating models  
Attribute estimates

**Other contextual help**

**CMMI Practice Info**

# PIID Evidence Standard– SP Example

## PP SP 1.2



- **Example Direct Artifacts**
  - *LMASA: BOEs (“establish”) and EACs (“maintain”) showing the generation of estimates based on attributes of work products and tasks; i.e. the estimation of attributes such as “Source Lines of Code” or “engineering drawings” which are then used to develop estimates of cost and schedule. These could be called “Task Sheets” or “Software Task Sheets.” “Maintain” can also be shown by the collection of metrics reflecting the attributes used to generate the estimate in BOE.*
- **Example Indirect Artifacts**
  - *LMASA: Rationale section of the BOE Forms showing identified attributes.*



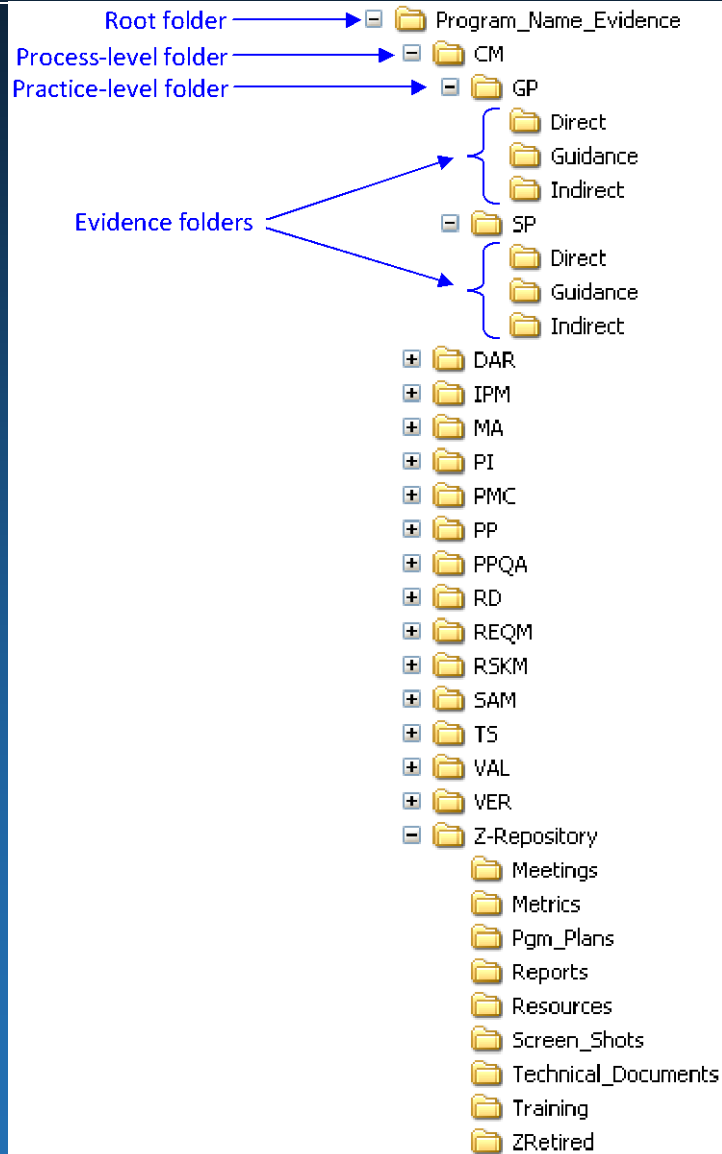
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- **Institutionalized Best Practices from the 2007 Appraisal**
  - *Program evidence folders with consistent folder architecture*
  - *Hyperlinks to evidence embedded in the PIID*
  - *Use of screen shots of tools*
  - *Use of a thread of evidence for multiple practices*
- **Defined a detailed structure for evidence folders**
  - *Program Integrators supporting the projects followed a common architecture*
- **Educated the Program and Functional POCs with PIID population responsibilities on this approach**



# PIID Repository Standard - Evidence Directories



- **CMMI Evidence directory and its subfolders are structured to have a seamless connectivity to the PIID data structure**
- **This repository is stored on a server controlled by the project**
- **Permission to add/delete the contents of the repository is highly restricted. Read access only for SCAMPI participants appropriately cleared. The program POCs have permission to add and remove access.**
- **Each PA shall have an independent folder that contains subfolders representing GPs and SP and the corresponding direct or indirect evidence.**

# PIID Repository Standard - Z-Repository



Folder Name	Typical Contents
<b>Meetings</b>	Mtg minutes, Outbrief presentations, attendance rosters, etc.
<b>Metrics</b>	Scorecards, EVMS measures, AutoMet data, emails associated with metrics, etc.
<b>Plans</b>	Program documentation that instantiates core processes on the program; plans are usually marked with a unique plan number. Examples in the PMP, SDP, Risk Plan.
<b>Reports</b>	Test reports, certification reports, AutoMet data reports, supplier audit reports,...
<b>Resources</b> (people, \$\$\$, and tools)	Staffing lines/rockpiles, org charts, tool purchases/upgrades, budget details, assignment of POCs, team charters, ...
<b>Screen Shots</b>	Screen shots of user applications that do not intuitively fit into a specific category.
<b>Tech Documents</b>	Not official program plans; this category includes Config Description Documents, Customer correspondence (e.g., CDR close out letter, etc), change requests, worry lists (prior to becoming program risks), SOW, WBS, invoices, shipping paper work,
<b>Training</b>	Typical artifacts include course material, course syllabus, training rosters, ...
<b>Retired</b>	As evidence is refreshed, the previous version is moved to this folder.

- The Z-Repository is used to store a single instance of each artifact. Its structure has folders that are categorized by the different types of evidence data.

- Evidence provided via a Microsoft object (Word, Powerpoint, etc) or an Adobe object. For cases where evidence is extracted from a database or tool, the evidence is submitted as a screenshot of that interface.

# PIID Repository Standard – Screen Shot from PIID Tool



## Practice Implementation Indicator Descriptions

Practice: PP SP 1.2

Classification: Implementation Direct

[More Info](#)

Project Planning

Establish Estimates of Work Product and Task Attributes and tasks.

CMMI practice identifier

Maintain estimates of the attributes of the work products and tasks.

Document No.: N/A      \*Adequacy: Fully Satisfied      \*Owner Org: F-16 MPEC

\*Document Title: BOEs - Source Lines of Code Estimate

\*Section: Sec 2.1.2.1 Pages 39-40

Location:

\*Link: [\\FTWSS03\F-16\\_USAF\\_EPAF\\_TEAM\Mission\\_Planning\F16\\_UPC\\_MPE\\_DO\\_5\CMMI\\_Evidence\PP\SPs\Direr](\\FTWSS03\F-16_USAF_EPAF_TEAM\Mission_Planning\F16_UPC_MPE_DO_5\CMMI_Evidence\PP\SPs\Direr)      [Edit](#)      [Chk](#)

\*Rationale: The Basis of Estimate (BOE) in Section 2.1.2.1 Pg 39-40 demonstrates the source lines of code that is a key attribute (Size) of the MPEC work product.

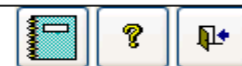
Comments:

PIID Record State: Reviewed      ID: 23346      [Go To](#)      \* - Required fields.

Show pending records only



[Submit](#)      [Accept](#)      [Reject](#)  
[Refresh](#)      [Retire](#)      [Edit CA](#)



Show retired records

Record 1 of 1.



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# ***Opening Brief Standard*** ***- Strategy for Affirmations for GPs***



- **Provide as many affirmations for GPs in the Opening Briefings as possible**
- **Developed a template for the projects to use for their Opening Briefings**
  - ***Targeted specific GPs to consistently address in each Program Opening Brief***
  - ***Coordinated via cross-program dry runs***

# Sample of Opening Brief Slide Covering GPs

## GP 2.2 Plan the Process



Artifact	PP	PMC	IPM	RSKM	REQM	RD	TS	PI	VER	VAL	CM	PPQA	MA	SAM	DAR
<b>Program Management Plan</b>	X	X	X	X							X		X	X	X
<b>Systems Engineering Management Plan</b>							X	X		X	X			X	
<b>Configuration Management Plan</b>											X				
<b>Software Development Plan for the Mission Systems</b>		X					X	X			X				
<b>Requirements Management Master Plan</b>					X	X									
<b>Requirements Work Package Concept of Operation</b>						X									



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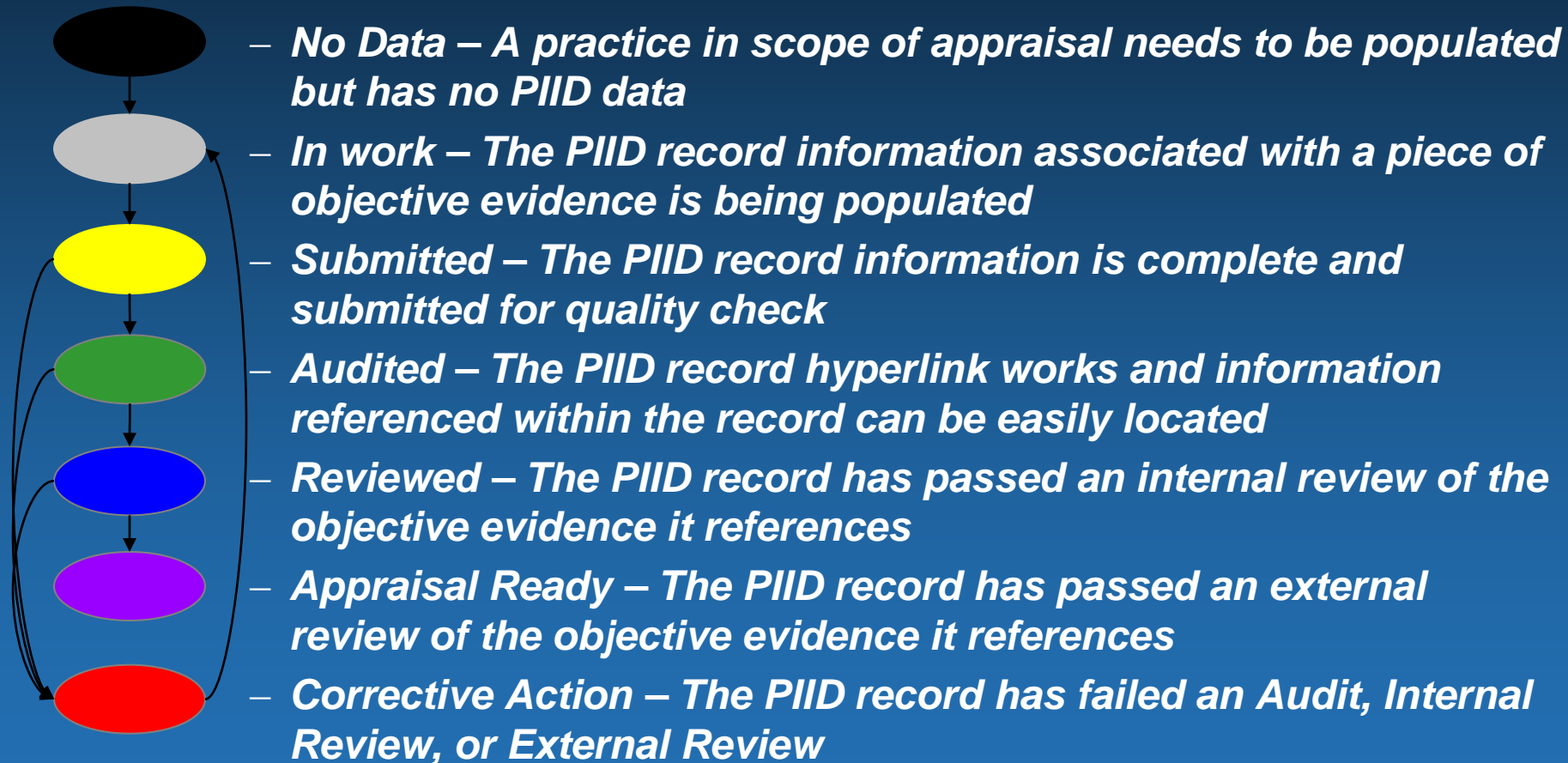


- **Improved the PIID Lifecycle from the 2007 SCAMPI to allow for 'corrective action' and 'refresh' states**
- **Developed "How to Build a SCAMPI Quality PIID" providing details for the PIID evidence storage approach**
- **Assigned CMMI project team members and program personnel to work as a team to identify the best evidence**
- **CMMI project team members review the PIID evidence for approval or to identify corrective action**
- **PIID contents are verified before the appraisal**

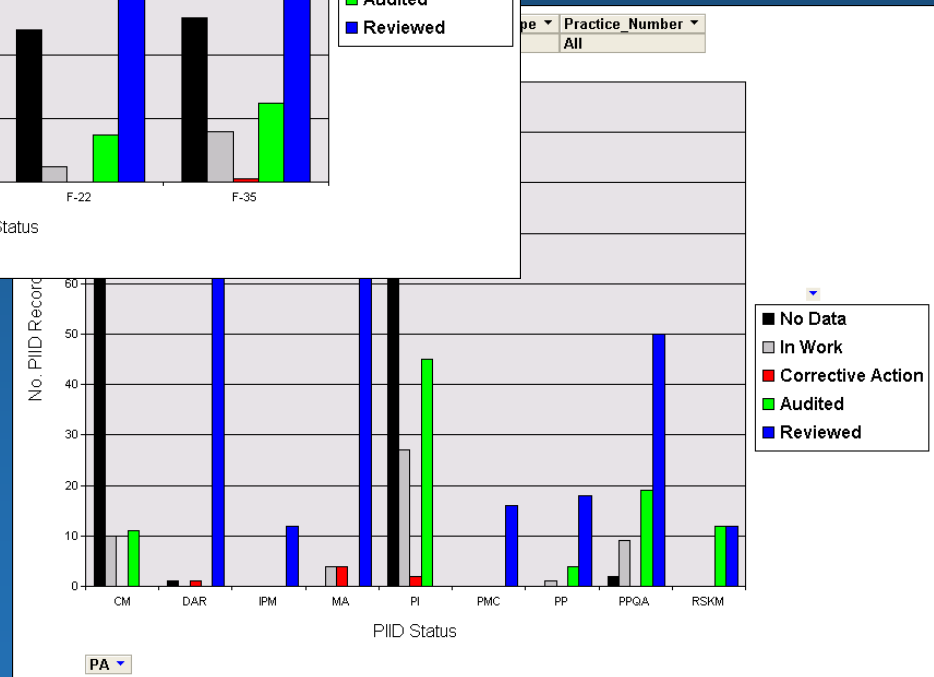
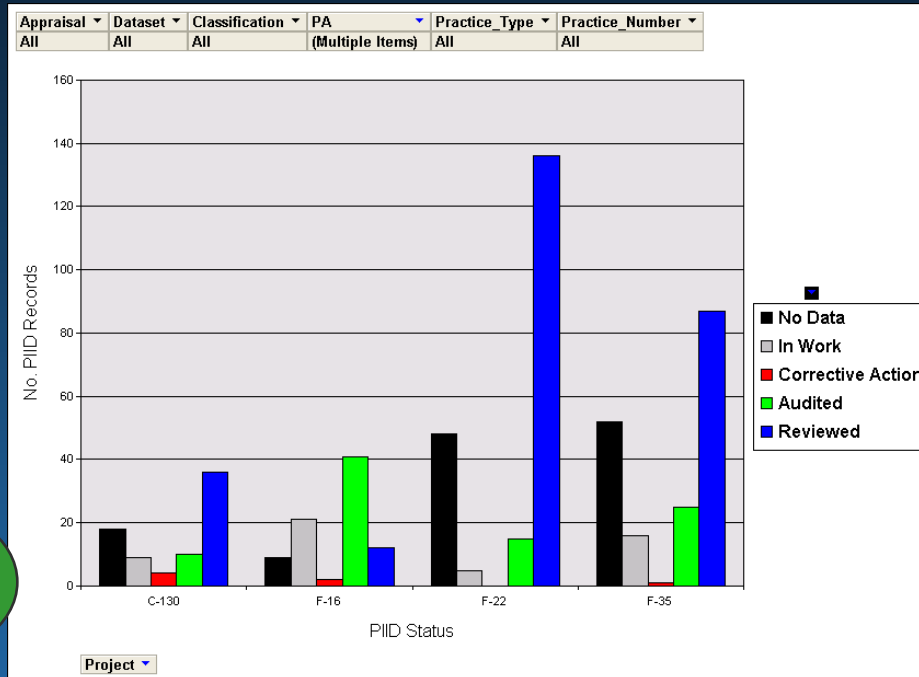
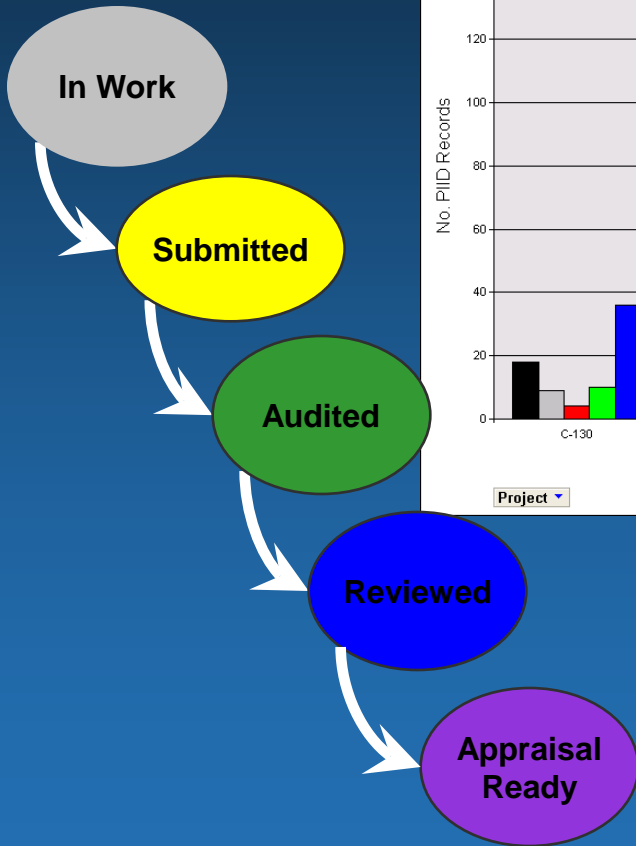




## • PIID Record Life Cycle States



# PIID Verification and Validation





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- **Four PIID Reviews scheduled prior to SCAMPI B**
  - *Allows for minimum number of CMMI project staff to support the appraisal projects*
  - *Spreads population of the PIID over 8 months*
  - *Provides dry run of the classified data*
  - *Demonstrates network and security accessibility for non-Aero and non-LM members*



- **Early indications are very positive**
  - ***First PIID Review completed September 28-October 1***
  - ***Review was completed ½ day early***
  - ***Four of the five programs had less than 10 corrective actions each, most were resolved during the PIID Review dates***
  - ***Significant overall project cost efficiencies have been realized***

# Questions?

