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

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Presentation Topics

- **Lockheed Martin Aeronautics Overview**
- **LMASA Overview**
- **Opening Brief Standard**
- **PIID Evidence Standard**
- **Conclusions**

29,000 employees across the company and around the world

International - 39

Johnstown, PA – 103

Clarksburg, WV - 78

Palmdale, CA
3,834

Marietta, GA
6,864

Greenville, SC - 3400

Fort Worth, TX
14,529

Meridian, MS - 134

Pinellas Park, FL - 174

U-2

F-22

F-117

YF-22

F-16

C-130J

X-35

F-35C CV

F-35B STOVL

C-5

F-35A CTOL

2007 SCAMPI A Lessons Learned

- **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
CM – Configuration Management
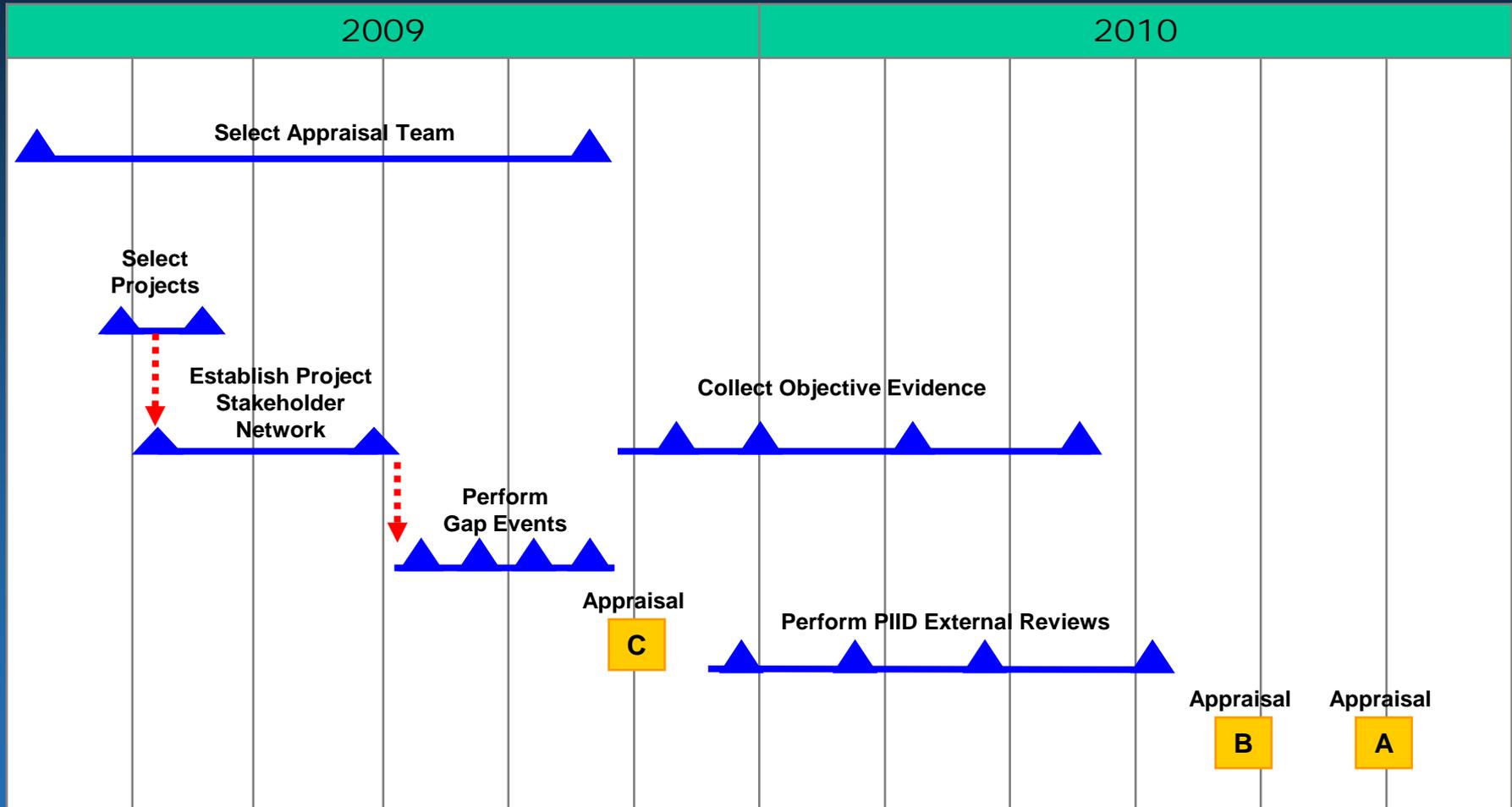LM Aero – Lockheed Martin Aeronautics

2010 SCAMPI A Improvements

- **A more centralized approach to program support was used**
- **More comprehensive use of "In-Briefings" to provide affirmations for Generic Practices reduced the artifacts required**
- **LMASA was refined to target more specific artifacts, based on the standard processes, resulting in less evidence required**
- **"Gap Events" were used to improve LMASA as well as program understanding of evidence needs**
- **The PIID Tool was changed to facilitate appraisal preparation:**
  - *Incorporation of LMASA Guidance into PIID Tool*

LMASA – Lockheed Martin Aeronautics Standard Approach

2009 – 2010 Appraisal Planning Schedule

2009	2010

Select Appraisal Team

Select Projects

Establish Project Stakeholder Network

Collect Objective Evidence

Perform Gap Events

Appraisal

C

Perform PIID External Reviews

Appraisal

B

Appraisal

A

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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**

- **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. It also was refined through extensive review to tightly align with our standard processes and their products.**

- **The 2007 SCAMPI A involved 3 appraisal projects, more than 100 participants, across 3 widely-dispersed sites collecting more than 3900 data items.**

- **The 2010 SCAMPI A involved five projects (two focus, three non-focus) across the same three sites, but required only about 2600 data items**

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

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

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Developed PIID Evidence Standard

- **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 the LMASA for every practice with the projects and the process owners in a series of "Gap Events"**
  - *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**

Structure of PIID Evidence Standard

- **CMMI Identifiers**
  - *Process Area*
  - *Specific or Generic Practice (SP/GP)*
  - *Practice Number*
- **Explanation (Added)**
  - *Text to explain how the practice is implemented in the Aero environment*
- **Guidance (Refined)**
  - *The references to the Aero standard processes which address this practice were updated and made more explicit (typically to the paragraph level)*
- **Direct and Indirect Evidence (Refined)**
  - *Updated and tied more directly to work products identified in the Aero standard processes*

Samples from the PIID Evidence Standard

Process Area	Type (GP/SP)	Practice Number	Practice Statement	Explanation	Organizational Guidance	Direct Evidence	Indirect Evidence
PA	Type	Practic	Statemen	Explanation	Organizational Guidance	Direct evidence	Indirect Evidenc
PP	SP	1.2	Establish and maintain estimates of the attributes of the work products and tasks.	For Aero, 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 or AC-5631, Estimating and Pricing Process. The resulting estimates and their rationale are documented in Basis of Estimate (BOE) sheets.	AC-5604, Plan and Baseline the Program, 3.A.5.c ("establish") CPD-3032, Estimating and Pricing Process	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.	Rationale section of BOE Forms showing identified attributes.

- **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**

PIID Evidence Standard- GP Example

CMMI Practice Info

Standards for Direct and Indirect evidence

Other contextual help

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.

Example Indirect Artifacts

LMASA: Affirmations from Program In-Brief.

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

Typical Work Products

Appraiser Considerations

LMASA Organizational Guidance: AC-5604, Plan and Baseline the Program, 3□□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 assigment 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.

- **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.*

PIID Evidence Standard- SP Example

CMMI Practice Report for PP SP 1.2

CMMI Practice Info

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.

Standards for Direct and Indirect evidence

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.

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

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 Aero, 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

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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 Attr... ...ntain estimates of the attributes of the work products and tasks.

CMMI practice identifier

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

file server hyperlink not a web page

Location:

*Link: \\FTWSS03\F-16_USAF_EPAF_TEAM\Mission_Planning\F16_UPC_MPE_DO_5\CMMI Evidence\PP\SPs\Dire(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
Show retired records   Record 1 of 1.   Refresh   Retire   Edit CA

Presentation Topics
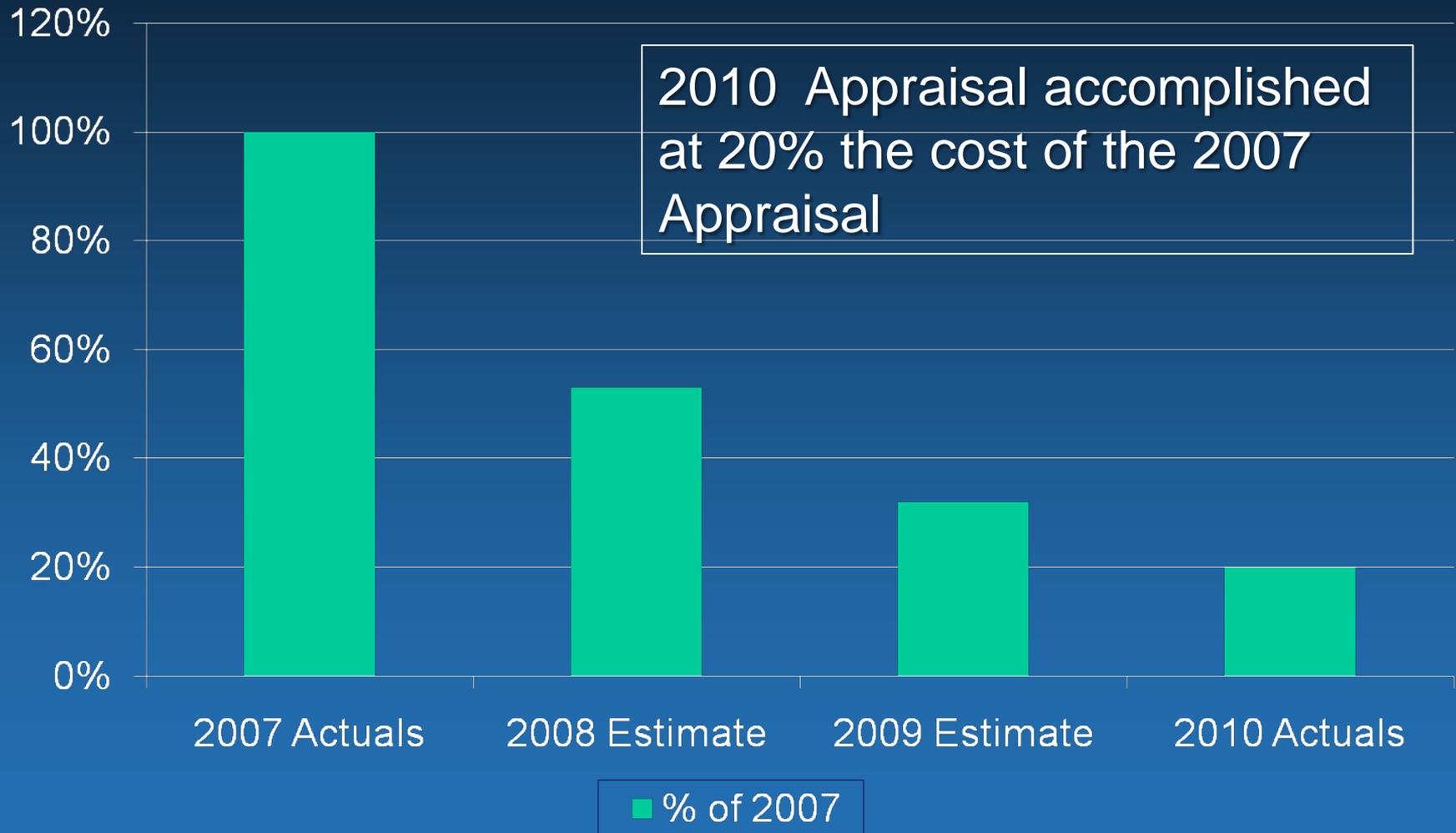
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Reduced Cost of Appraisal

2010 Appraisal accomplished at 20% the cost of the 2007 Appraisal

Bar chart showing % of 2007 for: 2007 Actuals (100%), 2008 Estimate (~53%), 2009 Estimate (~32%), 2010 Actuals (20%)

■ % of 2007

Conclusions

- **Use of improved evidence collection tools and methods greatly reduced the cost of appraisal preparation**
  - *Initial estimate for preparation for 2010 appraisal was reduced to 52% of the cost of the 2007 appraisal*
  - *A later estimate for preparation for 2010 appraisal was reduced to 32% of the cost of the 2007 appraisal,*
  - *Actual cost of preparation for the 2010 appraisal was 20% of the actual cost for the 2007 appraisal, despite the inclusion of two additional projects*
- **Development of the LMASA also resulted in corrections and improvements to the standard processes**
- **Use of LMASA by the programs resulted in improved adherence to the standard process**

Questions?