Goddard’s Software Process Improvement Project

First Year Using CMMI

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Agenda

- Background
  - NASA Software & Systems Initiatives
  - GSFC’s Plan
- Phase 1
  - Choice of Pilot Areas
  - CMMI Pre-Appraisals
- Lessons Learned
- Next Steps
The NASA Software & Systems Engineering Initiatives

**Software Initiative Goal:** Advance software engineering practices (development, assurance, and management) to effectively meet the scientific and technological objectives of NASA.

<table>
<thead>
<tr>
<th>Strategies</th>
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<tbody>
<tr>
<td>- Process and Product Improvement</td>
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<tr>
<td>- Safety, Reliability, and Quality</td>
</tr>
<tr>
<td>- Research</td>
</tr>
<tr>
<td>- Skill of Workforce</td>
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**Systems Engineering Initiative:** .... “Define and pilot a methodology for assessment of the systems engineering capability, which addresses knowledge and skill of the workforce, processes, and tools and methodology.”..... NASA Chief Engineer
GSFC Software Development
Process Improvement Plan

Developed Software Plan to improve the processes and practices in use at GSFC using the Capability Maturity Model Integrated (CMMI) as a measure of progress
- Focuses on Mission Critical Software
- Signed by GSFC Director

Are working with Systems Engineering to help them pilot CMMI

Software Long Term Goals
- Increase percentage of projects that are on-time and within cost by at least 10%
- Increase productivity by at least 5%
- Decrease cycle time by 10-20%
- Reduce error rate after delivery by at least 20%
Implementation Phases in GSFC’s Improvement Plan

Phase 1: Pilot Phase (FY02)
- Benchmark several representative GSFC areas
- Estimate effort, cost to improve identified gaps
- Evaluate implementation approach

Phase 2: Implementation Phase (FY03-FY07)
- Implementation of PI on all critical projects
- Begin by working with new projects to field improvements
- Eventual target …CMMI Level 3

Phase 3: Maintain Level and Continue Improvement
- Include other less critical areas? (e.g. science processing)
Phase 1

Pilot Areas
CMMI Pre-Appraisals
Pre-Appraisal Areas
Selected for Phase 1

3 Pre-Appraisals Completed in FY02:
1. Flight Software (11/01)
2. Project Level-Focus on Systems Engineering & Acquisition (4/02)
3. Ground Software (9/02)

Note: The Instrument area appraisal was not done due to lack of available projects and time constraints
Goals of the Pre-Appraisals

How long does it take?

How much preparation?

How does CMMI apply at GSFC?

SE & CMMI?

Where are we?

Can we do it?
Key Points for Pre-Appraisals

• EPG tried to minimize time required from project participants

• Pre-appraisals were conducted less formally than SCAMPI
  – More reliance on interviews
  – Less verification of information and document review
  – No maturity ratings determined. Used strengths and improvement opportunities in the CMMI Process Areas.

• Pre-appraisal methodology evolved during course of year

• Findings were the result of team consensus, supported by multiple data points from multiple sessions.

• Appraisal team: 3 SEI-authorized appraisers, 3-4 GSFC with appropriate expertise (SW or SE)
Phase 1 Pre-Appraisals

- **Pre-Appraisal #1: Flight Software -2 projects**
  - Both projects in-house, integrated contractor/civil servant teams
  - One project complete with all documentation in place
  - Other project at PDR point -Development after GSFC ISO

- **Pre-Appraisal #2: Flight Projects -3 projects**
  - Project 1: Start 2000, In Formulation, Large budget, International with multiple spacecraft, Will be in-house developed
  - Project 2: Start ‘91, In Implementation, (CDR in ‘99), L’-04, Large budget, ~30 Civil Servants , Multiple contractors
  - Project 3: Part of program with 3 project series, Several launches complete, (turn-key), Spacecraft budget about 1/2 of other two, mostly contractors, few Civil Servants

- **Pre-Appraisal #3: Ground Software -2 projects**
  - Both projects in-house, integrated contractor/civil servant teams
  - One project complete with all documentation in place
  - Other project in testing -Development started under ISO system
## Differences in the Pre-Appraisals

<table>
<thead>
<tr>
<th>Level of Focus</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
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<tbody>
<tr>
<td>Emphasis</td>
<td>Subsystem</td>
<td>Code 400 Project</td>
<td>Subsystem</td>
</tr>
<tr>
<td>Software Development</td>
<td>Systems Engineering, Acquisition</td>
<td>Software Development</td>
<td></td>
</tr>
<tr>
<td>Mode</td>
<td>Discovery -1/2 Doc. Review -1/2 Interviews</td>
<td>Discovery -Heavy emphasis on interviews</td>
<td>Verification -Few interviews -Lots of document review</td>
</tr>
<tr>
<td>Draft Findings Briefing Held?</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Days Spent</td>
<td>6 Days</td>
<td>9 Days</td>
<td>13 Days</td>
</tr>
<tr>
<td>Interviewee Preparation</td>
<td>Minimal</td>
<td>Gave sample questions</td>
<td>Minimal</td>
</tr>
<tr>
<td>Interviewed Support Orgs.</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
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## PIIDs (Process Implementation Indicator Documents)

<table>
<thead>
<tr>
<th>RM</th>
<th>Direct Artifact</th>
<th>Indirect Artifact</th>
<th>Affirmation</th>
<th>Char.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM SP 1.1-1</td>
<td>Requirements Doc</td>
<td>Req. Q &amp; A</td>
<td>PM-affirms</td>
<td>FI</td>
</tr>
<tr>
<td>RM SP 1.2-1</td>
<td>Signatures on Req.</td>
<td>Presentation Mat.</td>
<td></td>
<td>FI</td>
</tr>
<tr>
<td>RM SP 1.3-1</td>
<td>Req. Change History</td>
<td>Slide 11 of CDR</td>
<td>PM affirms</td>
<td>FI</td>
</tr>
<tr>
<td>RM SP 1.4-1</td>
<td>Test Matrix (partial)</td>
<td>Slide 11 of CDR</td>
<td>PM affirms</td>
<td>LI</td>
</tr>
<tr>
<td>RM SP1.5-1</td>
<td></td>
<td>Slide 14 of CDR</td>
<td>Done sometimes</td>
<td>PI</td>
</tr>
<tr>
<td>GP 1.1</td>
<td>Req. Doc., DB’s….</td>
<td></td>
<td>PM affirms</td>
<td>FI</td>
</tr>
<tr>
<td>GP1.2</td>
<td></td>
<td></td>
<td>No org. policy</td>
<td>NI</td>
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**Key:**
- **FI**: Fully Implemented
- **LI**: Largely Implemented
- **PI**: Partially Implemented
- **NI**: Not Implemented
Evaluation of Phase 1

What did we learn?
Would we choose the same approach again?
Advantages of CMMI Pre-Appraisal Approach

• CMMI Pre-Appraisals provided fairly accurate benchmark of state of all three areas evaluated

• Pre-appraisal was a “quick-look” - Provided a wealth of information in a short period of time (1 week)

• Involvement of external appraisers helps facilitate cooperation from projects; Provides credibility for Senior Managers

• Pre-appraisal was excellent training for internal appraisers involved

• Future pre-appraisals and benchmarking could now be done by internal appraisers (Have experience base)
Disadvantages of CMMI Pre-Appraisal Approach

- Whole pre-appraisal approach was very time-consuming
  - Majority of our resources expended on convincing projects to participate, appraisal preparation, appraisals
  - Little time left to actually support improvement activities with projects
- More difficult to estimate costs of addressing weaknesses (doing actual improvements) than anticipated
- Difficult to show Senior Management that projects were “better” because we were doing pre-appraisals, not process improvement (*Early wins are important!*)

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Lessons Learned on Pre-Appraisals

- It takes time to prepare ……
  - Scheduling interviews hard- allow lots of time
  - Assign internal appraisers process areas
  - Gather documents, fill out PIIDS
  - Prepare interviewees
  - Set expectations for pre-appraisal team
  - Brief pre-appraisal team
- Choose projects in various phases
  - Early phase: more opportunity to change
  - Mid-stream: probably typical of current processes
  - Late or done: all documentation in place
Lessons Learned

• Choose interviewees to cover all process areas
• Use of PIIDs captured more information on strengths & weaknesses by *Specific Practice* for later improvement work
  – Need a process for completing PIIDS
  – Too time intensive for Projects to fill out, but some EPG/Project interaction necessary
  – Projects didn’t have CMMI knowledge to complete
• Conduct a draft findings briefing
• Knowledge of org. process structure more important than CMMI knowledge
Next Steps

• Prioritize improvement opportunities based on the Goddard business direction.
  – Use Continuous Model of CMMI
  – Focus on improving smaller part of s/w organization
  – Expand using assets developed as resources

• Continue working with the NASA Systems Engineering Working Group on the use of CMMI for evaluating systems engineering capability.
  – Start small pilot in systems engineering area
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