Product-Based Approach for CMMI® Appraisals

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Application Domain

Government Communications Systems Division
· $1.1 B in Sales · 6,200 Employees · ISO 9001 · SEI CMM® Level 4

Aerospace & Ground Communication Systems
- Advanced Avionics
- Airborne Communications
- Satellite Antennas
- Satellite Electronics

Integrated Information Communication Systems
- C4I Systems
- Communications Systems (SATCOM and Terrestrial)
- Intelligence Systems
- Information Warfare and Network/Internet Security
- Commercial Systems and Products

- Computer-Controlled, Highly Distributed Communications and Control Systems to Support Air Traffic Management
- High-Reliability Satellite Communications Systems to Support Air Traffic Management
- GPS Applications for ATM—Automatic Dependent Surveillance
- Data Handling and Control Systems
- Image Processing
- Meteorological Processing Systems
- Range Systems
- Air Traffic Control Systems
- Transportation Communications Systems
<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Focus</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>Continuous Process Improvement</td>
<td>Organizational Innovation and Deployment, Causal Analysis and Resolution</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td>Quantitative Management</td>
<td>Organizational Process Performance, Quantitative Project Management</td>
</tr>
<tr>
<td>2 Managed</td>
<td>Basic Project Management</td>
<td>Requirements Management, Project Planning, Project Monitoring and Control, Supplier Agreement Management, Measurement and Analysis, Process and Product Quality Assurance, Configuration Management</td>
</tr>
<tr>
<td>1 Initial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appraisal History

**Formal**

- **SW-CMM®**
  - Level 1: 1991 SPA
  - Level 2: 1993 SPA
  - Level 3: 1994 SPA
  - Level 3: 1996 - 1998 SCEs
  - Level 3: 2000 CBA IPI
  - Level 4: 2002 CBA IPI

- **CMMI®**
  - 2003 SCAMPI™

- **SE-CMM**
  - 1996 – 1997 SE CMA

**Informal**

- **Mini-Assessments**
  - SW-CMM® (40)
  - CMMI® (20)
Mini-Assessment Method

- Project selection by Management
- Participant preparation led by EPG
  - Program Management, Systems Engineering, Software Engineering and Quality Assurance
  - PA worksheets completed (scores and artifact notes)
  - Inputs consolidated
- Delphi group meeting conducted by EPG
  - Lowest score if consensus cannot be reached
  - No examination of data
- Results presented to project by EPG
  - CMMI®-SE/SW summary
  - PA strengths/weaknesses
- Action Plan developed and tracked by project
- Organizational improvements facilitated by EPG
Mini-Assessment Guidelines

• Scoring matrix is applied to all the PA practices (specific & generic) to ensure the CMMI® goals are addressed

• Each PA practice is scored:
  - 5 : Exemplary Best Practice (Outstanding)
  - 4 : Fully Implemented (Strong)
  - 3 : Largely Implemented (Marginal)
  - 2 : Partially Implemented (Weak)
  - 1 : Not Implemented (Poor)

• Evidence is noted in the worksheet to include:
  - Direct Artifacts: tangible resulting directly from implementation of a specific or generic practice
  - Indirect Artifacts: a consequence of performing a specific or generic practice or that substantiates its implementation
# Mini-Assessment Evaluation Matrix

<table>
<thead>
<tr>
<th>Score</th>
<th>Practice Characterization</th>
<th>Deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Exemplary Best Practice (FI+)</strong></td>
<td>• Above expectations, organizational best practice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Zealous leadership and management commitment to ensure consistent deployment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• World class results sought by others</td>
</tr>
<tr>
<td>4</td>
<td><strong>Fully Implemented (FI)</strong></td>
<td>• Process documented, consistently deployed, effective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Strong infrastructure and management commitment to reinforce process implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Appropriate evidence exists to verify implementation (direct and indirect artifacts)</td>
</tr>
<tr>
<td>3</td>
<td><strong>Largely Implemented (LI)</strong></td>
<td>• Process documented, with mostly consistent deployment and positive results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some support provided by infrastructure/management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Appropriate evidence exists to verify implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• One or more significant weaknesses are noted</td>
</tr>
<tr>
<td>2</td>
<td><strong>Partially Implemented (PI)</strong></td>
<td>• Some process documentation may exist</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Inconsistent deployment with spotty results</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some evidence exists to substantiate partial deployment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Significant weaknesses are noted</td>
</tr>
<tr>
<td>1</td>
<td><strong>Not Implemented (NI)</strong></td>
<td>• Documentation, deployment, and infrastructure are poor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Little support, commitment, or recognition of the need</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Limited/no evidence to substantiate implementation</td>
</tr>
</tbody>
</table>
Why Product-Based Approach?

- How can intensive data collection for CMMI® appraisals be enacted efficiently?
  - Direct/indirect artifacts required for each process instantiation

- What level of CMMI® model expertise should we expect from project practitioners?
  - Experts in model implementation and interpretation?
  - Experts in organizational process implementation, mapped to the CMMI® model?

- How can the data collection effort be balanced among an internal appraisal team and project staff?
The Problem - 1

- **Model coverage**
  - SCAMPI\textsuperscript{SM} Class A requires at least 1 direct + 1 indirect artifact/affirmation
  - Projects must furnish Practice Implementation Indicators (PIIs) for each CMMI\textsuperscript{R} specific/generic practice within scope
  - Example: CMMI\textsuperscript{R}-SE/SW Level 3 (staged representation) for 4 projects:
    - 15 project-level PAs: 297 practices * 2 artifacts * 4 projects = 2,376 artifacts
    - 3 organizational PAs: 55 practices * 2 artifacts * 1 OU = 110 artifacts
    - Total: 2,486 artifacts (minimum)
The Problem - 2

• Organizational issues
  – Organizational/project process architecture relative to CMMI®
  – Natural frame of reference is the organizational processes, not CMMI®
  – Detailed model expertise
  – Terminology
  – Cost and schedule to collect project evidence
  – Labor-intensive mapping
An Approach

- Specify required data collection needs as project or data-centric
  - Derived from standard organizational processes, terminology, and assets
  - Typical evidence pre-mapped to candidate associated CMMI® practices

- Leverage and cross-correlate model built-in dependencies for improved appraisal data management
  - Relationships (threads) among Goals, PAs and practices (GPs, SPs)
    - PP, PMC, IPM
    - CM, GP2.5
  - Single work products / indicators that satisfy multiple practices
### Correlating Indicators (example)

<table>
<thead>
<tr>
<th>SP/GP</th>
<th>Summary</th>
<th>Project Plan</th>
<th>Commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP.SP2.7</td>
<td>Establish the project plan</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PP.SP3.3</td>
<td>Obtain plan commitment</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PMC.SP1.1</td>
<td>Monitor project planning parameters</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PMC.SP1.2</td>
<td>Monitor commitments</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>PMC.GP2.2*</td>
<td>Plan the process</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>IPM.SP1.4</td>
<td>Integrate plans</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>IPM.SP1.4</td>
<td>Manage project using integrated plans</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>DAR.GP2.2*</td>
<td>Plan the process</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

*GP2.2 elaborations for many PAs: “This plan for performing the ... process is typically a part of the project plan, as described in the Project Planning process area.”

Other potential PII threads spanning PAs:
- Interfaces
- Scenarios
- Stakeholders
- Training
- Metrics
- Reviews
- etc.

Identifying Appraisal Artifacts

• Method requirements for direct and indirect artifacts
• GPs, SPs, subpractices
• Typical Work Products

SCAMPI<sup>SM</sup> Method

CMMI® Model

PIID Templates

Project Evidence Template

Completed Project Evidence Sheet

Org. Std. Processes

• Required Work Products
• Standard terminology
• Templates, assets, checklists

Project Defined Processes

Completed Project Evidence Sheet

• Project plans/processes
• Implementation artifacts

Appraisal Database

• SCAMPI<sup>SM</sup> appraisals
• Mini-assessments

• Model implementation map
• PIIs
  - Direct/indirect artifacts
  - Instrument responses
  - Interviews (F2F affirmations)
• Evidence review
## Project Evidence Sheet (example)

<table>
<thead>
<tr>
<th>Evidence Number</th>
<th>Evidence Description (SE + SW)</th>
<th>Examples / Notes for Clarification</th>
<th>Keyword</th>
<th>CMMI</th>
<th>Project Evidence Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>IMP/IMS Integrated Master Plan / Integrated Master Schedule (or equivalent indicating integration of plans/schedules across disciplines)</td>
<td>Project Mgmt PP.SP2.1; 2.6; 2.7; 3.1 IPM.SP1.3; 1.4; 2.1; 2.2</td>
<td></td>
<td></td>
<td><a href="http://somehyperlink.html">http://somehyperlink.html</a></td>
</tr>
<tr>
<td>5</td>
<td>Work Breakdown Structure (WBS) Used to decompose work for estimating, and identify cost account responsibility.</td>
<td>Project Mgmt PP.SP1.1; 2.4</td>
<td></td>
<td></td>
<td>\device\pathname\file.doc</td>
</tr>
<tr>
<td>6</td>
<td>Project estimates / PWAs Size, effort, cost, budget, staffing. BOEs, LOC estimates, rationale, SLIM models, etc. Project Work Authorizations (PWAs/H-1000s).</td>
<td>Project Mgmt PP.SP1.2, 1.3, 1.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Proposal Cost Review (PCR) packages (aka Engineering Review) Management review of engineering proposals and estimates</td>
<td>Project Mgmt PP.SP3.3 PP.GP2.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Project organization chart Roles, responsibilities, reporting relationships</td>
<td>Project Mgmt PP.SP2.4, 2.6, 2.7 *.GP2.3, 2.4, 2.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Project schedules Program master schedule, and lower level detailed schedules as appropriate</td>
<td>Project Mgmt PP.SP2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Planning records Records or minutes of planning, rolling wave, or replanning cycles. Incremental planning or corrective action replans/adjustments.</td>
<td>Project Mgmt PP.SP2.7; 3.2; 3.3 PM.GP2.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Project financial reports (PCS) Monthly cost/schedule status reports from PCS/EVMS (e.g., C/SSR, CPI, SPI, variance)</td>
<td></td>
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</tr>
</tbody>
</table>

**Typical project work products or assets commonly available as a result of implementing standard processes. Project products and terminology may vary.**

**Categories of evidence, for convenience in grouping related pieces of evidence.**

**Potential areas in CMMI® model that may be satisfied (all or in part) by the identified project evidence.**

**Path(s) or hyperlink(s) to example artifacts or repository where the evidence can be found.**
Lessons Learned - 1

- Establish a guide for how the CMMI® is implemented in organizational/project processes
  - Internal users (projects, managers, EPG)
  - External users (customers, appraisal teams)

- References to evidence must be very specific
  - Concise list of implementation artifacts covering the practice
  - Paragraph numbers within a document
  - Hyperlinked files/directories
  - Facilitate efficient on-line access and review

- Trade-off how much projects must understand CMMI® details
  - Organization/project process and product knowledge vs.
  - Model knowledge
Lessons Learned - 2

• Facilitate or review the entry of project evidence
  – Appropriate
  – Relevant
  – Complete

• Consistent use of standard data-centric project evidence facilitates process institutionalization
  – Standard organizational processes, terminology, and assets
  – Pre-mapped to associated CMMI® practices
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