Overview of the Capability Maturity Model<sup>SM</sup> Integration (CMMI*) Development Project

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CMM Integration Project

Steering Group
P. Babel / B. Rassa

Stakeholder/Reviewers

Project Control
M. Konrad
M. Cavanaugh

Product Development Team
Project Manager
J. Ferguson

Chief Architect
R. Bate

Coordinating IPT

Common Model
Comps. IPT
C. Wells
C. Weber

Architecture
IPT
W. Schoening
R. Bate

IPPD
IPT
J. Consiglio
R. Turner

Assessment
Meth. IPT
R. Hefner
D. Dunaway

Training
Meth. IPT
G. Wolf
J. Gross

Reqmts.
IPT
A. Clouse
B. McNeill
Steering Group Members

- Phil Babel US Air Force (Co-Chair)
- Bob Rassa Raytheon (Co-Chair)
- Clyde Chittister SEI
- David E. McConnell US Navy
- Michael Devine US Army
- Linda Ibrahim FAA
- Bob Lentz General Dynamics
- Mike Phillips SEI
- Joan Weszka Lockheed Martin
- Hal Wilson Litton PRC
- Mike Zsak OUSD (A&T)
- Joe Farinello Support from OUSD (A&T)
- Brenda Zettervall Support from OUSD (A&T)

Product Development Team

Common Model Components IPT

- Curt Wells Lockheed Martin (Co-lead)
- Charlie Weber SEI (Co-lead)
- Linda Brown Comarco
- Chris Cheetham NSA
- Barb Denny Rockwell Collins
- Mike Konrad SEI
- Larry LaBruyere TRW
- Frank McVey Boeing
- Dave Zubrow SEI
Product Development Team
Architecture IPT

- Bill Schoening  Boeing (Co-lead)
- Roger Bate  SEI (Co-lead)
- Mark Cavanaugh  SEI
- Joe Graffius  Honeywell
- Craig Hollenbach  PRC
- Jane Moon  Raytheon

Product Development Team
IPPD IPT

- John Consiglio  GD-Electric Boat (Co-lead)
- Rich Turner  FAA (Co-lead)
- John Kordik  USAF
- John Price  USAF
Product Development Team
Assessment Methodology IPT

• Rick Hefner  TRW (Co-lead)
• Donna Dunaway  SEI (Co-Lead)
• Dennis Ahern  Northrop-Grumman
• Don Barber  Honeywell
• Dennis Goldenson  SEI
• Dave Kitson  SEI
• Guy Taylor  USN
• Karen Womack  CSC

Product Development Team
Training Methodology IPT

• Gary Wolf  Raytheon (Co-lead)
• Jon Gross  SEI (Co-lead)
• Bruce Allgood  USAF
• Peter Capell  SEI
• Larry Jones  SEI
Product Development Team
Requirements IPT

- Aaron Clouse  Raytheon (Co-lead)
- Bob McNeill  IBM/SEI (Co-lead)
- Jack Ferguson  SEI
- Lt Col Joe Jarzombek  USAF
- Sandy Shrum  SEI

The Current Situation

Explosion of CMMs and CMM-like models
Multiple models within an organization
Multiple assessments
Multiple training
Multiple expenses
Why is this a problem?

Similar process improvement concepts, but...
- Different model representations (e.g. staged, continuous, questionnaire, hybrid)
- Different terminology
- Different content
- Different conclusions
- Different appraisal methods

Key Concept in Model-based Process Improvement

Improvement in any discipline is a function of performing:
- *implementing practices* that reflect the fundamentals of a particular topic (e.g. configuration management)
- *institutionalizing practices* that lead to sustainment and improvement of an implementation
Thus all CMMI source models contain:

- *Implementing practices* grouped by affinity

- *institutionalizing practices* that vary from model to model, however all models specify – *levels* that describe increasing capability to perform

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**Improvement Levels**

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>Not performed</td>
<td>(0)</td>
</tr>
<tr>
<td>Repeateable</td>
<td>Planned and tracked</td>
<td>(2)</td>
</tr>
<tr>
<td>Defined</td>
<td>Standard</td>
<td>(3)</td>
</tr>
<tr>
<td>Quantitively Managed</td>
<td>Measured</td>
<td>(4)</td>
</tr>
<tr>
<td>Continuously Improving Process</td>
<td>Optimizing</td>
<td>(5)</td>
</tr>
</tbody>
</table>

...
CMMI Design Approach

Requirements

CMMI Requirements

- Preserves Gov’t/Industry Process Investment
- Enhances use of multiple models
## Design Goals
Eliminate inconsistencies,
Reduce duplication,
Reduce the cost of implementing model-based process improvement,
Increase clarity and understanding, by using:
- Common terminology
- Consistent style
- Uniform construction rules
- Common components…, with
Minimal impact on legacy efforts

## Benefits
Efficient, effective assessment and improvement across multiple process disciplines in an organization
Reduced training and assessment costs
A common, integrated vision of improvement for all elements of an organization
A means of representing new discipline-specific information in a standard, proven process improvement context
CMMI Design Approach

Inputs

Source Models

Capability Maturity Model for Software V2, draft C
EIA Interim Standard 731, System Engineering Capability Model
Integrated Product Development Capability Maturity Model, draft V0.98
### SW-CMM V2 Key Process Areas

<table>
<thead>
<tr>
<th>Requirements Management</th>
<th>Software Product Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software Project Planning</td>
<td>Project Interface Coordination</td>
</tr>
<tr>
<td>Software Project Control</td>
<td>Peer Reviews</td>
</tr>
<tr>
<td>Software Acquisition Management</td>
<td>Organization Software Asset Commonality</td>
</tr>
<tr>
<td>Software Quality Assurance</td>
<td>Organization Process Performance</td>
</tr>
<tr>
<td>Software Configuration Management</td>
<td>Statistical Process Management</td>
</tr>
<tr>
<td>Organization Process Focus</td>
<td>Defect Prevention</td>
</tr>
<tr>
<td>Organization Process Definition</td>
<td>Organization Process &amp; Technology Innovation</td>
</tr>
<tr>
<td>Integrated Software Management</td>
<td>Organization Improvement Deployment</td>
</tr>
<tr>
<td>Organization Training Program</td>
<td></td>
</tr>
</tbody>
</table>

### SECM Focus Areas

| Define Stakeholder and System Level Requirements | Coordinate with Suppliers |
| Define Technical Problem | Manage Risk |
| Define Solution | Manage Data |
| Assess and Select | Manage Configurations |
| Integrate System | Ensure Quality |
| Verify System | Define and Improve the Systems Engineering Process |
| Validate System | Manage Competency |
| Plan and Organize | Manage Technology |
| Monitor and Control | Manage Systems Engineering Support Environment |
| Integrate Disciplines | |
IPD-CMM Process Areas

- Product Selection
- Product Life Cycle Definition
- Product Requirements Evolution
- Product Solution
- Product Build, Verification & Test
- Product Support & Retirement
- Process Planning
- Configuration Management
- Ensuring Quality
- Process Monitoring and Control
- Organization Training Program
- Organization Process Definition
- Organization Process Focus
- Quantitative Techniques
- Product Line Evolution
- Process Change Management
- Project Leadership
- Leadership Mechanisms
- Work Environment
- Team Environment
- Shared Vision
- Organization Leadership
- Organizational Environment Adaptation

Example Map of Process Areas To Source Models

<table>
<thead>
<tr>
<th>CMMI PA</th>
<th>SW-CMM V2.0C</th>
<th>EIA SECM V1.0</th>
<th>IPD-CMM V0.98</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements Management</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Supplier Agreement Management</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Configuration Management</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Data Management</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Training</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Customer and Product Support</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Staged Representations

Key Process Areas are grouped in the stages (levels) from 2 to 5

A Key Process Area contains specific practices (activities) to achieve the purpose of the process area.

For a Key Process Area at a given stage, institutionalization practices are integral to the process area.

### Staged Model  SW-CMM V2

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>Continuous process improvement</td>
<td>Org Improvement Deployment, Org Process and Tech Innovation, Defect Prevention</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td>Quantitative management</td>
<td>Organization Process Performance, Statistical Process Management, Org Software Asset Commonality</td>
</tr>
<tr>
<td>3 Defined</td>
<td>Process Standardization</td>
<td>Peer Reviews, Project Interface Coordination, Software Product Engineering, Organization Training Program, Organization Process Definition, Organization Process Focus</td>
</tr>
<tr>
<td>2 Repeatable</td>
<td>Basic Project Management</td>
<td>Software Configuration Management, Software Quality Assurance, Software Acquisition Management, Software Project Control, Software Project Planning, Requirements Management</td>
</tr>
<tr>
<td>1 Initial</td>
<td>Competent people and heroics</td>
<td></td>
</tr>
</tbody>
</table>
Continuous Representations

A process area contains specific practices to achieve the purpose of the process area.

Generic practices are grouped in Capability Levels

Generic practices are added to the specific practices of each process area to attain a capability level for the process area.

The order in which Process Areas are addressed can follow a recommended staging.

Continuous Model - SECM
Source Models

<table>
<thead>
<tr>
<th>SW-CMM V2 Draft C</th>
<th>EIA IS 731 SECM</th>
<th>IPD-CMM V0.97</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staged</td>
<td>Continuous</td>
<td>Hybrid</td>
</tr>
<tr>
<td>Maturity Levels</td>
<td>Capability Levels Categories</td>
<td>Maturity and Capability Levels</td>
</tr>
<tr>
<td>Key Process Areas</td>
<td>Focus Areas</td>
<td>Process Areas</td>
</tr>
<tr>
<td>Key Process Area Goals</td>
<td>Themes</td>
<td>Capability and Process Area Goals</td>
</tr>
<tr>
<td>Activities Common Feature</td>
<td>Specific Practices</td>
<td>Base Practices</td>
</tr>
<tr>
<td>Common Features</td>
<td>Generic Practices</td>
<td>Generic Practices</td>
</tr>
</tbody>
</table>

The Challenge

Given the input models, extract the common and/or best features and provide users the ability to produce single or multiple discipline models, both continuous and staged, tailored to their organizations needs.

Provide users the ability to assess and train based on these output models.
CMMI Design Approach

Design

Our Solution

Develop a Product Suite consisting of a Framework from which the user can easily output tailored, integrated Capability Models and their associated assessment methods and training materials.
Framework

- Components of Capability Models
- Construction rules
- Conceptual architecture
The CMMI Framework Concept

**Framework General**
- Glossary
- CM Development Standards and Guidelines
- Document Templates
- Assessment Methodology
- Framework Training Materials

**Process Management Core (PMC)**
- PMC Generic Practices/Templates
- PMC Process Areas
- PMC Assessment Material
- PMC Model Training Material
- PMC Assessment Training Material

**Integration Core (IC)**
- IPPD Environment
- IC Generic Practices/Templates
- IC Process Areas
- IC Assessment Material
- IC Model Training Material
- IC Assessment Training Material

**Discipline Z**

**Discipline Y**

**Discipline X (DX)**
- DX Process Areas
- DX Assessment Material
- DX Model Training Material
- DX Assessment Training Material
- DX Amplifications

**Output**
- Capability Model
- Assessment Methods
- Model Training Materials
- Assessment Training Materials

Components of Capability Models

- Models
- Training materials
- Assessment materials
Models

- Process areas (PA) (focus areas, key process areas)
- Specific practices (base practices or activities)
- Generic practices (GPs or Common Features)
- Capability levels
- Stages
- Maturity levels
- Discipline-specific amplifications
- Descriptive material

Training Materials

- Introduction to Capability Model
  - Staged
  - Continuous
- Assessment team training
- Lead assessor training
- Use of framework training
Assessment Materials

• Assessment planning
• Data collection methods and tools
  – Staged
  – Continuous
• Analysis methods

Assessment Framework

• Assessment types to address customer needs
• Minimum (core) requirements for all assessment types
• Rules for generating assessment methods
• Compliance criteria
• Tailoring process, guidelines
CMMI Products

Capability Models

Staged and Continuous (with recommended staging) versions of:

- Software Engineering without IPPD
- Systems Engineering without IPPD
- Software+Systems Engineering w/o IPPD
- Software+Systems Engineering with IPPD
Assessment Material

- Assessment requirements
- Assessment methodology
- Assessment data collection methods and tools (e.g., questionnaires, interviews)
- Assessment Team qualifications

Training Material

- Capability Model Training
- Assessment Training
  - Team Training
  - Lead Assessor Training
Developer Material

- Glossary
- Framework and model content criteria
- Framework Training

Example output of CMMI - Single Discipline

IPPD Core

Process Management Core

Supported by
- Assessment methods for integrated model
- Training materials for integrated model

SW Eng
Example output of CMMI-Multiple Disciplines

Status

Concept Exploration (Feb-May)
- Started 5 Feb
- Examined inputs and designed architectures for
  - Framework
  - Resulting models, assessments and training

Product Development (May-Dec)
- Framework and model design
- Plan for models:
  - Draft SW for Stakeholder Review: 3-4Q '98
  - Draft SW for public review: 4Q '98
  - Pilot use of draft SW: 1Q '99
  - Other model drafts are planned to follow the SW model before the end of '98.
- Assessment and training methods for each
Conclusion

CMMI is a collaborative effort among industry, government and the SEI.
We have a development team and Steering Group, and an initial schedule.
We will report status on the SEI web site:
www.sei.cmu.edu
Contact: e-mail customer-relations@sei.cmu.edu
phone (412) 268-5800