Beyond CMMI-SE/SW V1.0

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CMMI Project Co-Chair

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March 13, 2001
Agenda

CMMI Project – Current Status (V1.0)
- Policy
- Schedule
- Product Suite Elements

CMMI Project – Future Status (V1.1)
- Critical “ilities”
- Strategy for V1.1 and beyond
  “Process Improvement Improvements”
Representative Legacy CMM Benefits
CMMI Policy

The OSD CMMI Sponsors, at Steering Group recommendation and with Industry sponsor concurrence, have established the sunset schedule for the SW-CMM legacy model (SW-CMM v1.1) to be three years after formal release of CMMI-SE/SW/IPPD, which occurred in December 2000. The Electronic Industries Association G47, owners of EIA/IS-731, have also agreed to this sunset policy and schedule for that source document. The CMMI source model sunset will therefore occur in December, 2003.

In order to provide additional refinement and update based on the continuing CMMI pilot program while maintaining the overall stability of the Product Suite, CMMI v1.1 is planned for release later this year. The minor product suite update will include the provision for external evaluations using the CMMI models as well as assessments for internal process improvement.
# CMMI Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>December 4, 2000</td>
<td>Released latest published models</td>
</tr>
<tr>
<td></td>
<td>- CMMI-SE/SW v1.02</td>
</tr>
<tr>
<td></td>
<td>- CMMI-SE/SW/IPPD v1.02</td>
</tr>
<tr>
<td>December 2000</td>
<td>Released CMMI-SE/SW/IPPD/A for initial piloting</td>
</tr>
<tr>
<td>Winter 2001</td>
<td>Publish models V1.1</td>
</tr>
<tr>
<td>Fall 2003</td>
<td>Complete sunset period for precursor models</td>
</tr>
</tbody>
</table>
The Frameworks Quagmire

PSP
People CMM
SA-CMM
 FAA-iCMM
CMMI*

SW-CMM
SE-CMM
SSE-CMM
SA-CMM

ISO 15504* (SPICE)
IPD-CMM*

IEEE Stds. 730,828
829, 830,1012,1016
1028,1058,1063

SDCCR
SDCE
SCE

MIL-Q-9858
NATO
AQAP1,4,9

EQA

Trillium
Baldrige

BS 5750

ISO/IEC
12207

IEEE 1074

DO-178B

DOD-STD-2168

DOD-STD-7935A

ISO/IEC J-STD-016

EIA/IEEE 12207

EIA/IEEE J-STD-016

EIA 632 *

EIA/IS 632

IEEE 1220

IEEE 1220

EIA/IS 632

AF IPD Guide

TickIT
Q9000

ISO 10011

ISO 15288*

ISO 9000 Series

DOD-STD-2168

DOD-STD-7935A

MIL-STD-498

MIL-STD-1679

MIL-STD-499B*

MIL-STD-498

MIL-Q-9858

IPD-CMM*

SDCCR
SDCE
SCE

IEEE Stds. 730,828
829, 830,1012,1016
1028,1058,1063

ISO 15504* (SPICE)

* Not yet released

Also see www.software.org/quagmire

Courtesy Sarah Sheard, SPC
quag14d: 5 June 1998
CMMI Design Goals and Benefits

Design Goals

- Integrate the source models, eliminate inconsistencies, reduce duplication
- Reduce the cost of implementing model-based process improvement
- Be sensitive to impact on legacy efforts

Benefits

- Efficient, effective assessment and improvement across multiple process disciplines
- Reduced training and assessment costs
- A common, integrated vision of improvement for all elements of an organization
- Integration of systems engineering and software environments for additional productivity & quality gains
## Model Metrics

<table>
<thead>
<tr>
<th>Release</th>
<th>PAs/ FAs</th>
<th>Goals/ Themes*</th>
<th>Activities/ Practices**</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-CMM V1.1</td>
<td>18</td>
<td>52</td>
<td>316</td>
</tr>
<tr>
<td>SW-CMM V2C</td>
<td>19</td>
<td>62</td>
<td>318</td>
</tr>
<tr>
<td>EIA/IS 731</td>
<td>19</td>
<td>77</td>
<td>383</td>
</tr>
<tr>
<td>IPD-CMM V0.98</td>
<td>23</td>
<td>60</td>
<td>865</td>
</tr>
<tr>
<td>CMMI V1.0 SE/SW</td>
<td>22</td>
<td>70</td>
<td>417</td>
</tr>
<tr>
<td>CMMI V1.02 SE/SW/IPPD</td>
<td>24</td>
<td>76</td>
<td>460</td>
</tr>
</tbody>
</table>

* Ratable components

** Key to implementation effort
The CMMI Product Line Approach

- Team of Teams
- Modeling and Discipline Experts
- Collaborative Process
Anticipated Benefits at Northrop Grumman

- Extend Software Level 3 benefits to total project
  - Many projects have major non-software content
  - Therefore, the potential benefits are great
- Allow Integrated Product Teams (IPTs) to achieve their true potential
  - Integrated processes essential for effective team work

  “IPT members are not functioning as a team if they play by different rules.”

Anticipated Benefits at Litton PRC

“Litton PRC recognized the value of repeatable systems and software engineering processes in 1996. Litton PRC now has systems engineering and software development processes integrated in a standardized, repeatable process environment. That environment was the foundation for achievement of our SEI SW-CMM Level 5 rating in March 2000. The achievement of continuous process improvement using this integrated approach has enabled us to reduce critical software errors to perform with markedly lower costs on more predictable schedules. We fully expect Capability Maturity Model Integration (CMMI) will yield comparable benefits of improved performance against cost and schedule objectives. The considerable potential benefits for our customers and our operations has driven Litton PRC’s involvement in the development of the CMMI since its inception and the initiation of our transition to the CMMI-SE/SW model.”

- Barry Rhine, President, Litton PRC
Anticipated Benefits at Raytheon

“Raytheon is totally committed to implementing CMMI. We believe that implementation of the integrated maturity model, including software, systems engineering, and IPPD, will further improve our software productivity, and provide more predictable development schedules and improved overall product performance. This will be a ‘win-win’ for our company and our customers, with a bonus ‘win’ for our employees, who we strongly believe will enjoy working on programs with an orderly and relatively problem-free integration & test activity”

- Jack Kelble, VP of Engineering, Raytheon Electronic Systems
CMMI Model Representations

Staged

ML5
ML4
ML3
ML2
ML1

Organization

Continuous

Capability

0 1 2 3 4 5

PA PA PA

Process

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CMMI-SE/SW/IPPD/A - Staged

Focus
Continuous Process Improvement (2 PAs)
Quantitative Management (2 PAs)

Optimizing (5)
- Organizational Innovation and Deployment (OID)
- Causal Analysis and Resolution (CAR)

Quantitatively Managed (4)
- Requirements Development (RD)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (VER)
- Validation (VAL)
- Organizational Process Focus (OPF)
- Organizational Process Definition (OPD)
- Organization Training (OT)
- Integrated Project Management (IPM)
- Risk Management (RSKM)
- Decision Analysis and Resolution (DAR)

Defined (3)
- Requirements Management (REQM)
- Project Planning (PP)
- Project Monitoring and Control (PMC)
- Supplier Agreement Management (SAM)
- Measurement and Analysis (M&A)
- Process and Product Quality Assurance (PPQA)
- Configuration Management (CM)

Managed (2)
- Integrated Supplier Management (ISM)
- Integrated Supplier Management (ISM)

Initial (1)
- Ad hoc, chaotic processes

Process Standardization (11 PAs)
Basic Project Management (7 PAs)

* Additional PA goals and activities added for IPPD
CMMI Model Structure

Staged

- Maturity Levels
  - Process Area 1
  - Process Area 2
  - Process Area n

- Specific Goals
  - Commitment to Perform
  - Ability to Perform

- Generic Goals
  - Directing Implementation
  - Verifying Implementation

Continuous

- Capability Levels
  - Process Area 1
  - Process Area 2
  - Process Area n

- Specific Goals
  - Specific Practices

- Generic Goals
  - Specific Practices
  - Generic Practices
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (Defined)</td>
<td>Institutionalize a Defined Process.</td>
<td>Establish a defined process. Collect improvement information.</td>
</tr>
<tr>
<td>2 (Managed)</td>
<td>Institutionalize a Managed Process.</td>
<td>Establish org. policy. Manage configurations.</td>
</tr>
<tr>
<td></td>
<td>Plan the process. Identify &amp; involve relevant stakeholders. Manage configurations.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provide resources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assign responsibility. Monitor and control the process.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Train people.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform managed process. Objectively verify adherence. Review status with mgmt.</td>
<td></td>
</tr>
<tr>
<td>1 (Performed)</td>
<td>Achieve Specific Goals.</td>
<td>Identify work scope. Perform base practices.</td>
</tr>
<tr>
<td>0 (Incomplete)</td>
<td>(None)</td>
<td>(None)</td>
</tr>
</tbody>
</table>
## CMMI Process Area Contents

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Introductory Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goals: Specific and Generic</strong></td>
<td><strong>Generic Practices</strong></td>
</tr>
<tr>
<td><strong>Specific Practices</strong></td>
<td><strong>Notes</strong></td>
</tr>
<tr>
<td><strong>Work Products</strong></td>
<td><strong>Subpractices</strong></td>
</tr>
<tr>
<td><strong>Amplifications</strong></td>
<td><strong>Elaborations</strong></td>
</tr>
</tbody>
</table>

### Required
- **Goals: Specific and Generic**
- **Generic Practices**

### Expected
- **Specific Practices**

### Informative
- **Subpractices**
CMMI-SE/SW Compared to SW-CMM v1.1

Organizations using SW-CMM v1.1 should be able to transition to CMMI by focusing on the following changes:

- Measurement and Analysis at ML2
- Risk Management & Decision Analysis and Resolution at ML3
- Expansion of Software Product Engineering
- Refocus of Measurement and Analysis CF to Directing Implementation CF

Most SW-CMM v2 Draft C updates have been incorporated.
CMMI-SE/SW Compared to SECM

EIA 731 users should be able to transition to the CMMI-SE/SW model by recognizing:

- Continuous representation (+ “equivalent” staged representation)
- Some lower-level differences
- Application of common SE/SW practices to SE community
## Assessment Class Attributes

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage Mode</td>
<td>• Benchmark</td>
<td>• Initial</td>
<td>• Quick Look</td>
</tr>
<tr>
<td></td>
<td>• Baseline establishment</td>
<td>• Incremental</td>
<td>• Incremental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Self-assessment</td>
<td>• Gap analysis</td>
</tr>
<tr>
<td>Relative:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cost/Duration</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>• Confidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Accuracy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rating?</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Reference: Assessment Requirements for CMMI (ARC)
Standard CMMI Assessment Method for Process Improvement (SCAMPI)

Based on CMM®-Based Appraisal for Internal Process Improvement (CBA IPI) and EIA IS 731 Appraisal Method

Satisfies all of the ARC requirements for a Class A method

Must be led by authorized SCAMPI Lead Assessor

Tailorable to organization and model scope

Artifacts:

- SCAMPI Method Description
- Appraisal questionnaire, work aids, templates
Assessment Expectations

We have simplified the method, but …

- CMMI models have more process areas and more practices than each of the individual source models

Our goal:

- Assuming an organization of 3-6 projects, 6-9 team members, experienced Lead Assessor
- SCAMPI assessment of all process areas through Levels 2-5 in 2-3 weeks
- SCAMPI assessment of process areas through Level 3 in 2 weeks (100 hours)
Training Opportunities

- Introduction to CMMI (Staged)
- Introduction to CMMI (Continuous)
- Intermediate Concepts in CMMI
- SCAMPI Lead Assessor Training
- Instructor Training for CMMI
Strategy for CMMI v1.1 and beyond

Model:

- Maintain model stability
- Determine value of advanced practices and a single, combined representation
- Expand disciplines addressed in CMMI Models
- Improve understanding of Level 4 & 5

Method:

- Document an integrated appraisal method (assessments, evaluations)
- Enhance appraisal efficiency
- Improve training for both types of appraisals
Challenges for CMMI v1.1

Stability
- No V1.0 transition effort (training, process improvement) is wasted

Usability
- Deficiencies noted in Change Requests are corrected to enhance utility

Evolvability
- Discipline additions (e.g. acquisition) can be made without impact to the core (common) model elements
- CMMI appraisals for both external sponsors and for internal process improvement must be consistent and repeatable
“Process Improvement Improvement” 1
The CMMI model builds upon the legacy:

- Expanded model scope
  - Risk Management
- Verification and Validation
- Requirements Development and Traceability

- Better coverage of quantitative engineering management
“Process Improvement Improvement” ²
The CMMI Product Suite provides a foundation for *enterprise wide improvement* and adds:

- New emphasis on products and services as well as process
- Emphasis on both process capability and organizational maturity
- Early emphasis on Measurement and Analysis
CMM Integration Legacy

CMM Integration (CMMI<sup>SM</sup>) builds on the success of the CMM for Software (SW-CMM®)
- improved productivity
- reduced cycle times
- earlier defect detection
- reduced defects in fielded products
- improved customer and employee satisfaction

CMM Integration (CMMI<sup>SM</sup>) builds on the knowledge of best systems engineering practices in product development
Improvements from Adopting SW-CMM

- **Productivity (increase)**: 35%
- **Time to market (reduction)**: 19%
- **Post-release defect reports (reduction)**: 39%

Savings vs. cost of software process improvement (median) 5:1
Benefits at Boeing

Projects operating at Maturity Level 3 increased productivity by 62%...

... while cycle times improved 36%.

Both customer...

... and employee satisfaction increased with rising maturity levels.
Benefits at Boeing

Planning was more accurate.

Defects could be detected much earlier.

Product quality increased with rising maturity levels.

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Cost, cycle time, and defect density dropped sharply.

Quality, cycle time, and productivity improved dramatically.

Benefits at Motorola

"Achieving [the CMM Level 5] rating provides our customers with the assurance that they are receiving high-performance solutions that improve operations across the enterprise. This team of engineers demonstrated a commitment to excellence that sets themselves and Motorola above their contemporaries."

- Leif Soderberg, Motorola Senior VP and SSG General Manager

"These engineers have continued Motorola’s legacy of excellence in engineering and business practices. Their efforts have ensured the on-time delivery of numerous solutions and this rating validates years of solid work and commitment."

- Mark Fried, Motorola Corporate VP and General Manager of ISD
Benefits at Lockheed Martin

As errors declined...

...productivity increased by 80%.

Benefits of Continuing Process Improvement

SEI SW-CMM Level 5: For the Right Reasons*

Defects are now nearly all found and fixed before testing begins.

Defects escaping into the field have been reduced from 11% to practically 0%.

Programs consistently reach customer satisfaction and performance targets.

Peer reviews increase total project costs by 4%, but reduced rework during testing by 31%. R.O.I. is 7.75:1.

For More Information About CMMI

• Go to CMMI Website
  http://www.sei.cmu.edu/cmmi


• Contact SEI Customer Relations

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