CMMI® - Staged or Continuous?

Presented by:
Sandra L. Cepeda
President and CEO
Cepeda Systems and Software Analysis, Inc.

Sponsored by AMRDEC Software Engineering Directorate

March 2005
Agenda

- What Is the CMMI?
- Staged and Continuous Representations
  - Understanding Each Representation
  - Advantages of Each Representation
  - Improving a Process Area (Continuous Representation)
  - Improving Maturity Levels (Staged Representation)
- Examples of Uses of Each Representation
- Equivalence Staging
- Summary and Recommendations
What Is the CMMI?

- CMMI Is a Process-Improvement Model That Provides a Set of Best Practices That Address Productivity, Performance, Costs, and Stakeholder Satisfaction

- CMMI Is NOT a Set of “Bolt-On Processes” That Last Only As Long As the Wheel Is Squeaking. CMMI Provides a Consistent, Enduring Framework That Accommodates New Initiatives

- CMMI Focuses on the Total-System Problem, Unlike Other Predecessor CMMs

- CMMI Facilitates Enterprise-Wide Process Improvement, Unlike Single-Discipline Models
Staged and Continuous Representations

**Process Areas (SE/SW/IPPD/SS)**
- Organizational Innovation & Deployment (OID)
- Causal Analysis and Resolution (CAR)
- Organizational Process Performance (OPP)
- Quantitative Project Management (QPM)
- Requirements Development (RD)
- Technical Solution (TS)
- Product Integration (PI)
- Verification (VER)
- Validation (VAL)
- Organizational Process Focus (OPF)
- Organizational Process Definition (OPD)
- Organizational Training (OT)
- Integrated Project Management (IPM)
- Risk Management (RSKM)
- Decision Analysis and Resolution (DAR)
- Organizational Environment for Integration (OEI)
- Integrated Teaming (IT)
- Integrated Supplier Management (ISM)
- Requirements Management (REQM)
- Project Planning (PP)
- Project Monitoring and Control (PMC)
- Measurement and Analysis (MA)
- Process and Product Quality Assurance (PPQA)
- Configuration Management (CM)
- Supplier Agreement Management (SAM)

**Two Representations Per CMMI Model**
- Essentially the Same Content But Organized in a Different Way
A Representation Allows an Organization to Pursue Different Improvement Objectives and Presents Model Components Differently

- **Staged Representation** Uses **Maturity Levels** to Measure Process Improvement
  - Maturity Levels Apply to an Organization’s **Overall Maturity**
  - Pre-Defined Sets of Process Areas Define an Improvement Path for the Organization

- **Continuous Representation** Uses **Capability Levels** to Measure Process Improvement
  - Capability Levels Apply to an Organization’s Process-Improvement Achievement for Each Process Area (PA)
  - Improvements Are Characterized Relative to an Individual PA

The Content Is **Nearly Identical** in Both Representations

So Why Both?

- The Representation of Each Source Model Was Different
  - Software CMM—Staged
  - SE-CMM, SECM—Continuous

- Ease of Adoption by Legacy Communities

- Both Representations Provide Inherent Benefits
## Advantages of Each Representation

<table>
<thead>
<tr>
<th>Continuous Representation</th>
<th>Staged Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Maximum Flexibility for Prioritizing Process Improvements and Aligning Them With Business Objectives (Requires Understanding of PA Relationships)</td>
<td>- Predefined and Proven Path With Case Study and ROI Data (Reduces Guess-Work)</td>
</tr>
<tr>
<td>- Enables Increased Visibility of Improvement Within Process Areas</td>
<td>- Focuses on Organizational Improvement</td>
</tr>
<tr>
<td>- Quick Wins Can Be Easily Defined to Increase Buy-In</td>
<td></td>
</tr>
<tr>
<td>- Increases Focus on Risks Specific to Each Process Area</td>
<td></td>
</tr>
<tr>
<td>- Improvement of Process Areas Can Occur at Different Rates</td>
<td>- Overall Results Summarized in a Maturity Level</td>
</tr>
<tr>
<td>- Less Upfront Investment Might Be Required</td>
<td>- Provides Familiar Benchmarking Capability (Normally Used to Qualify Bidders)</td>
</tr>
<tr>
<td>- Easy Upgrade From SE-CMM and SECM</td>
<td>- Easy Upgrade From SW-CMM</td>
</tr>
</tbody>
</table>
Improving Process Area Capability and Maturity Levels
CMMI Model Structure

Staged

- Maturity Levels (1-5)
  - Process Area 1
    - Generic Goals (2-3)
      - Commitment To Perform
      - Ability To Perform
      - Directing Implementation
      - Verification
      - Generic Practices (2.1-2.10 3.1-3.2)
  - Process Area 2
  - Process Area N

Continuous

- Process Area 1
  - Generic Goals (1-5)
  - Specific Goals
  - Specific Practices
  - Generic Practices (1.1, 2.1-2.10 3.1-3.2, 4.1-4.2 5.1-5.2)
- Process Area 2
- Process Area N
  - Specific Goals
  - Specific Practices
  - Capability Levels (0-5)
Maturity Levels and Capability Levels

**Continuous**
...for a Single Process Area or Selected Set of Process Areas

- **CL0 (Incomplete)**: Managed: Process Characterized for Projects and Is Often Reactive
- **CL1 (Initial)**: Defined: Process Characterized for the Organization and Is Proactive
- **CL2**: Quantitatively Managed: Process Measured and Controlled
- **CL3**: Optimizing: Focus on Process Improvement
- **CL4**: Managed: Process Characterized for Projects and Is Often Reactive
- **CL5**: Quantitatively Managed: Process Measured and Controlled

**Staged**
...for a Pre-Defined Set of Process Areas Across an Organization

- **Maturity Level 1**: Initial: Process Unpredictable, Poorly Controlled, and Reactive
- **Maturity Level 2**: Defined: Process Characterized for the Organization and Is Proactive
- **Maturity Level 3**: Quantitatively Managed: Process Measured and Controlled
- **Maturity Level 4**: Optimizing: Focus on Process Improvement
- **Maturity Level 5**: Managed: Process Characterized for Projects and Is Often Reactive

**Process Area Capability**
- **PA1**: RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR, OEI, IT, ISM
- **PA2**: OPP, QPM
- **PA3**: OID, CAR
- **PA4**: REQM, PP, PMC, MA, PPQA, CM, SAM
- **PA5**: RQ, PP, PMC, MA, PPQA, CM, SAM
# Process Areas

## SE/ SW/ IPPD/ SS Version 1.1

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Acronym</th>
<th>Maturity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROCESS MANAGEMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational Process Focus</td>
<td>OPF</td>
<td>3</td>
</tr>
<tr>
<td>Organizational Process Definition</td>
<td>OPD</td>
<td>3</td>
</tr>
<tr>
<td>Organizational Training</td>
<td>OT</td>
<td>3</td>
</tr>
<tr>
<td>Organizational Process Performance</td>
<td>OPP</td>
<td>4</td>
</tr>
<tr>
<td>Organizational Innovation and Deployment</td>
<td>OID</td>
<td>5</td>
</tr>
<tr>
<td>Project Planning</td>
<td>PP</td>
<td>2</td>
</tr>
<tr>
<td>Project Monitoring and Control</td>
<td>PMC</td>
<td>2</td>
</tr>
<tr>
<td>Supplier Agreement Management</td>
<td>SAM</td>
<td>2</td>
</tr>
<tr>
<td>Integrated Project Management for IPPD (IPPD)</td>
<td>IPM</td>
<td>3</td>
</tr>
<tr>
<td>Risk Management</td>
<td>RSKM</td>
<td>3</td>
</tr>
<tr>
<td>Integrated Teaming (IPPD)</td>
<td>IT</td>
<td>3</td>
</tr>
<tr>
<td>Integrated Supplier Management (SS)</td>
<td>ISM</td>
<td>3</td>
</tr>
<tr>
<td>Quantitative Project Management</td>
<td>QPM</td>
<td>4</td>
</tr>
<tr>
<td><strong>PROJECT MANAGEMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Requirements Management</td>
<td>REQM</td>
<td>2</td>
</tr>
<tr>
<td>Requirements Development</td>
<td>RD</td>
<td>3</td>
</tr>
<tr>
<td>Technical Solution</td>
<td>TS</td>
<td>3</td>
</tr>
<tr>
<td>Product Integration</td>
<td>PI</td>
<td>3</td>
</tr>
<tr>
<td>Verification</td>
<td>VER</td>
<td>3</td>
</tr>
<tr>
<td>Validation</td>
<td>VAL</td>
<td>3</td>
</tr>
<tr>
<td><strong>ENGINEERING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Configuration Management</td>
<td>CM</td>
<td>2</td>
</tr>
<tr>
<td>Process and Product Quality Assurance</td>
<td>PPQA</td>
<td>2</td>
</tr>
<tr>
<td>Measurement and Analysis</td>
<td>MA</td>
<td>2</td>
</tr>
<tr>
<td>Decision Analysis and Resolution</td>
<td>DAR</td>
<td>3</td>
</tr>
<tr>
<td>Organizational Environment for Integration (IPPD)</td>
<td>OEI</td>
<td>3</td>
</tr>
<tr>
<td>Causal Analysis and Resolution</td>
<td>CAR</td>
<td>5</td>
</tr>
</tbody>
</table>

CSSA Proprietary – Do not use without permission of CSSA
Doing the Work – Specific Goals and Specific Practices

- A Specific Goal Describes the **Unique** Characteristics That Must Be Present to Satisfy a Process Area
  - “Requirements Are Managed and Inconsistencies With Project Plans and Work Products Are Identified”

- A Specific Practice Is the Description of an Activity That Is Considered Important in Achieving the Associated Specific Goal
  - “Manage Changes to the Requirements As They Evolve During the Project”
Institutionalizing Processes - Generic Goals and Generic Practices

<table>
<thead>
<tr>
<th>Capability Level</th>
<th>Generic Goals</th>
<th>Generic Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL 1</td>
<td>GG1: Achieve Specific Goals</td>
<td>GP 1.1: Perform Base Practices</td>
</tr>
</tbody>
</table>
|                  | GG2: Institutionalize a Managed Process | GP 2.1: Establish an Organizational Policy  
GP 2.2: Plan the Process  
GP 2.3: Provide Resources  
GP 2.4: Assign Responsibility  
GP 2.5: Train People  
GP 2.6: Manage Configurations  
GP 2.7: Identify and Involve Relevant Stakeholders  
GP 2.8: Monitor and Control the Process  
GP 2.9: Objectively Evaluate Adherence  
GP 2.10: Review Status with Higher Level Management |
| CL 2             | GG3: Institutionalize a Defined Process | GP 3.1: Establish a Defined Process  
GP 3.2: Collect Improvement Information |
| CL 3             | GG4: Institutionalize a Quantitatively Managed Process | GP 4.1: Establish Quantitative Objectives for the Process  
GP 4.2: Stabilize Subprocess Performance |
| CL 4             | GG5: Institutionalize an Optimizing Process | GP 5.1: Ensure Continuous Process Improvement  
GP 5.2: Correct Root Causes of Problems |

Common Features Mapping

- Commitment to Perform
- Ability to Perform
- Directing Implementation
- Verifying Implementation
Improving A Process Area
(Continuous Representation)

**Process Area Capability**

<table>
<thead>
<tr>
<th>CL5</th>
<th>CL4</th>
<th>CL3</th>
<th>CL2</th>
<th>CL1</th>
<th>CL0</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1.1 - GP5.2</td>
<td>GP1.1 - GP4.2</td>
<td>GP1.1 - GP3.2</td>
<td>GP1.1 - GP2.10</td>
<td>GP1.1</td>
<td>No GPs Exist</td>
</tr>
</tbody>
</table>

**Optimizing - Agile, Adaptive Learning**
- Defects Are Prevented
- Improvements Are Proactive
- Innovations Are Inserted and Deployed
- Change Is Expected, Not Feared

**Quantitatively Managed - Quantitative Learning and Decision Making**
- Process Performance Is Measured
- Process Is Stable
- Causes of Special Variations Are Addressed

**Defined - Organizational Learning**
- Project’s Process Is Tailored From Organization’s Standard Processes
- Process Is Qualitatively Understood
- Process Contributes to the Organization’s Assets

**Managed - Project Learning**
- Process Is Planned
- Process Performance Is Managed Against Plan
- Corrective Actions Are Taken When Necessary
- Process Is Institutionalized for Consistent Performance
- Process Is Retained During Times of Stress

**Performed - Individual Learning**
- Work Is Performed
- Performance Is Dependent on Individual Practitioner

**Incomplete**
- Work Is Not Performed or Is Incomplete
- Process Is Unpredictable and Poorly Controlled

**PA1**

*Advanced Practices Exist Only in the Engineering PAs*
Improving Maturity Levels
(Staged Representation)

ML 1 - Initial - Individual Learning
• Work Is Not Performed or Is Incomplete
• Process Is Unpredictable and Poorly Controlled

ML 2 - Managed - Project Learning
• Process Is Planned
• Process Performance Is Managed Against Plan
• Corrective Actions Are Taken When Necessary
• Process Is Institutionalized for Consistent Performance
• Process Is Retained During Times of Stress

ML 3 - Defined - Organizational Learning
• Project’s Process Is Tailored From Organization’s Standard Processes
• Process Is Qualitatively Understood
• Process Contributes to the Organization’s Assets

ML 4 - Quantitatively Managed - Quantitative Learning and Decision Making
• Process Performance Is Measured
• Process Is Stable
• Causes of Special Variations Are Addressed

ML 5 - Optimizing - Agile, Adaptive Learning
• Defects Are Prevented
• Improvements Are Proactive
• Innovations Are Inserted & Deployed
• Change Is Expected, Not Feared

GP 2.1 - GP 3.2
Applied to All PAs in
ML 2, ML 3, & ML 4

GP 2.1 - GP 3.2
Applied to All PAs in
ML 2 & ML 3

GP 2.1 - GP 2.10
Applied to All PAs in
ML 2

All SP’s for the
ML 2, ML 3,
ML 4, & ML 5
PAs

All SP’s for the
ML 2, ML 3,
ML 4 PAs

All SP’s for the
ML 2 & ML 3
PAs

All SP’s for the
ML 2 PAs
Examples of Uses of Each Representation

Small Company Perspective From AMRDEC SED Pilot in Huntsville, AL

As the pilot proceeded, our emphasis of wanting to embrace CMMI changed from an original desire to “get certified” to a focus of improving in smaller “chunks” in areas identified by business analysis.

The implementation of specific process areas without the overriding goal of Level attainment makes the use of the model more meaningful for our small organization.

We realize now that we can use the CMMI in the areas that naturally add value to our organization and quality to our end products by improving activities where we need them the most.

Consultants From Pilot Sponsored by AMRDEC SED in Huntsville, AL

The Continuous Representation allows small companies to focus on improvements that have the highest payoff for the company.

In General, the Continuous Representation Is Useful When the Organization

- Understands How CMMI Can Address Business Objectives
- Has Identified Specific Improvements Needed
- Has Limited Budget for Process Improvement
- Understands Process Areas Relationships
- Can Benefit From “Quick Wins”
Examples of Uses of Staged Representation

- The Staged Representation Provides an Excellent Path for Organizations
  - Transitioning From SW-CMM to CMMI
  - Doing Business With Government Organizations That Require a Maturity Level for Their Procurements
  - Not Familiar With the Dependencies Among Process Areas
    - Much of the Guess-Work in Process Improvement Is Reduced by the Pre-Defined Set of Process Areas at Each Maturity Level
- Equivalence Staging Allows Comparison of Results From Both Representations
Equivalence Staging – Maturity Level 2

All Process Areas Assigned to Maturity Level 2 Must Achieve Capability Level 2 or Higher
Equivalence Staging – Maturity Level 3

ML 2 & 3 Process Areas

All Process Areas Assigned to Maturity Levels 2 and 3 Must Achieve Capability Level 3 or Higher
Equivalence Staging – Maturity Level 4

ML 2, 3 & 4 Process Areas

All Process Areas Assigned to Maturity Levels 2, 3 and 4 Must Achieve Capability Level 3 or Higher AND Some Must Achieve Capability Level 4
Equivalence Staging – Maturity Level 5

All Process Areas Must Achieve Capability Level 3 or Higher AND Some Must Achieve Capability Level 5
Summary and Recommendations

- The Staged and Continuous Representations Provide Essentially the Same Content But Shown in Different Ways

- Choose the Representation That Provides the Best Fit for Your Organization
  - Business Objectives
  - Culture
  - Legacy

- Mix and Match, As Necessary
  - Continuous Implementation, Staged Appraisal
  - Staged Implementation, Continuous Appraisal
  - Both Staged and Continuous Implementations for Different Parts of Your Organization

Tie Process Improvement to Your Business Goals