CMMI® Mini-Tutorial

SuZ Garcia
SEI

For AFRL Technology Maturity Workshop, Sep 2007
# CMMI Mini-Tutorial

**Report Documentation Page**

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

<table>
<thead>
<tr>
<th>1. REPORT DATE</th>
<th>2. REPORT TYPE</th>
<th>3. DATES COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEP 2007</td>
<td></td>
<td>00-00-2007 to 00-00-2007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. TITLE AND SUBTITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMMI Mini-Tutorial</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5a. CONTRACT NUMBER</th>
<th>5b. GRANT NUMBER</th>
<th>5c. PROGRAM ELEMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5d. PROJECT NUMBER</th>
<th>5e. TASK NUMBER</th>
<th>5f. WORK UNIT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. AUTHOR(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnegie Mellon University, Software Engineering Institute, Pittsburgh, PA, 15213</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. PERFORMING ORGANIZATION REPORT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. SPONSOR/MONITOR’S ACRONYM(S)</th>
<th>11. SPONSOR/MONITOR’S REPORT NUMBER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. DISTRIBUTION/AVAILABILITY STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for public release; distribution unlimited</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. SUPPLEMENTARY NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>See also ADM002182. Presented at the AFRL Technology Maturity Conference held in Virginia Beach, VA on 11-13 September 2007.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SUBJECT TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. SECURITY CLASSIFICATION OF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. REPORT</td>
</tr>
<tr>
<td>unclassified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>17. LIMITATION OF ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same as Report (SAR)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>18. NUMBER OF PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19a. NAME OF RESPONSIBLE PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

*Standard Form 298 (Rev. 8-98)*

Prescribed by ANSI Std Z39-18
Why are you here?

What are YOUR questions about CMMI?

…..your answers will help to “tune the soundtrack” to your needs
Why am I here?

In my past:

• CMMs developer
• Technology Transition researcher
• CMMs applier in multiple organizational settings
  — Internal within small company
  — Internal within large company
  — Consultant to other companies

In my present:

• Co-Author (along with Richard Turner) of *CMMI Survival Guide: Just Enough Process Improvement*
• Project team member for IPSS: Improving Processes in Small Settings
• Author of “Will my System Play Nicely with Others? Using CMMI in Systems of Systems Settings”
• Continued interest in relevant use of CMMI
Topics

Why do Organizations Look to CMMI?

What Is CMMI?

- General
- A Bit More about the Model

Who Is Using CMMI?

How Can CMMI Benefit People Evaluating Technology Maturity?
Typical Issues Leading to CMMI Use

Plans are made, but not necessarily followed.

Work is not tracked against the plan; plans are not adjusted.

Requirements are not consistent; changes are not managed.

Estimates are way off; over-commitment is common.

When overruns become apparent, a crisis atmosphere develops.

Defects are discovered in test or, worse yet, by the customer.

Success depends on heroic efforts by competent individuals.

Repeatability is questionable.
What do we do when problems arise?

- Ignorance is bliss
- Denial
- AIIEEE

Not a good method for problem solving
What Happens in a Crisis?

Common responses to crises are

- people work faster and longer
- people are moved from project to project
- projects cut requirements
- projects add more people
- everyone cuts corners
- a hero saves the day
Process Supports Change Along Multiple Dimensions
Why Focus on Process?

It complements a focus on people:

• The experience and training of your work force is not always enough.
• Working harder is not the answer.
• A well-defined process can provide the means to work smarter.
• Shifts the “blame” for problems from people to the process

It complements a focus on technology:

• Technology, by itself, will most likely not be used effectively.
• Technology, in the context of an appropriate process roadmap, can provide the most benefit.

It helps to mitigate some of the risks of the environment:

• Volatile business environments often use process as a stability point
The Premise—and Promise—of Process

The quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it.

- a long-established premise in manufacturing
- visible worldwide in quality movements in manufacturing and service industries (e.g., ISO standards).
Common Fallacies

I don’t need process, I have …

• Really good people
• Advanced technology
• An experienced manager

Process …

• Interferes with creativity
• Introduces bureaucracy and regimentation
• Isn’t needed when building prototypes
• Is only useful on large projects
• Hinders agility in fast-moving markets
• Costs too much

There are counterexamples to all of these throughout the process improvement literature, BUT some of these can be problems if your adoption process isn’t tuned to your environment
Topics

Why do Organizations Look to CMMI?

What Is CMMI?

• General
  • A Bit More about the Model

Who Is Using CMMI?

How Can CMMI Benefit People Evaluating Technology Maturity?
What Is CMMI?

Capability Maturity Model Integration (CMMI) is a suite of products used for process improvement.

- Models
- Appraisal Methods
- Training Courses
CMMI Models -1

A framework that describes key elements of effective process.

A guide to evolutionary improvement from ad hoc, immature activities to mature, disciplined processes.

A description of practices for planning, engineering, and managing business processes that can help you achieve business goals related to things such as:

- cost
- schedule
- functionality
- product/service quality
CMMI Models -2

A yardstick against which the maturity of an organization's product development, acquisition, and/or service-related processes can be measured and compared with industry state of the practice.

A basis for planning improvements to your business processes.

CMMI best practices tell you WHAT to do but neither HOW to do it nor WHO should do it.
CMMI Best Practices Are Used for

The development, acquisition, maintenance and delivery of products and services

Software-intensive products and services

Product and service lifecycles from conception through delivery and maintenance

Benchmarking your organization against others in a variety of industries
CMMI Appraisals (SCAMPI<sup>SM</sup>)

Measures an organization’s processes using a CMMI model as a yardstick

Uses a formalized appraisal process

Involves senior management as an appraisal sponsor

Focuses the appraisal on the sponsor’s business objectives

Observes strict confidentiality and non-attribution of data

Focuses on follow-on activities and decision making based on the appraisal results

Three appraisal Classes: A, B, and C
SCAMPI Classes A, B, and C

Approach
SCAMPI C

Institutionalization
SCAMPI A
(Maturity Levels)

Deployment
SCAMPI B
CMMI Adoption Is Not One-Size-Fits-All

Some adopt only CMMI

Some adopt CMMI with or in addition to other approaches, such as

- Six Sigma
- Agile Methods
- TSP/PSP
- ISO 9000/9001
- IEEE Standards
- RUP
- Balanced Scorecard
Costs and Benefits of CMMI

COSTS
- Investments
- Expenses

Process Capability & Organizational Maturity

ROI & Cost-Benefit

BENEFITS
- Process Adherence
- Cost
- Schedule
- Productivity
- Quality
- Customer Satisfaction
Costs May Vary

The cost of CMMI adoption is highly variable depending on many factors, including organization

- size
- culture
- organization
- current processes

Regardless of the investment, we’ve found that organizations experience a respectable return on their investment.
Published Benefits

For more detailed information about CMMI benefits, see the report, *Demonstrating the Impact and Benefits of CMMI: An Update and Preliminary Results*

- SEI special report released in October 2003
- Based on case studies, supplementary materials, and comprehensive literature review
- on the SEI Web site at http://www.sei.cmu.edu/publications/documents/03.reports/03sr009.html
Topics

Why do Organizations Look to CMMI?

What Is CMMI?
- General
- A Bit More about CMMI-DEV v1.2

Who Is Using CMMI?

How Can CMMI Benefit People Evaluating Technology Maturity?
3 Complementary “Constellations”

CMMI-Dev provides guidance for measuring, monitoring and managing development processes.

CMMI-SVC provides guidance for those providing services within organizations and to external customers.

16 Core Process Areas, common to all.

CMMI-ACQ provides guidance to enable informed and decisive acquisition leadership.

SEI Presentation (Full Color)  Author, Date  © 2007 Carnegie Mellon University
CMMI Model Combinations

CMMI-Dev v 1.2

- IPPD
- Organizational Goal (OPD)
- Project Goal (IPM)

- SE Related Examples
- HW Related Examples

CMMI Core (now includes SS)
Acquirer/Supplier Mismatch Led to CMMI-ACQ

- **Mismatch**
  - Mature acquiring mentors low maturity supplier
  - Outcome not predictable

- **Matched**
  - Acquirer and supplier are both high maturity
  - Highest probability of success

- **Disaster**
  - No discipline
  - No process
  - No product

- **Mismatch**
  - Immature acquiring mentor
  - Mature supplier
  - Customer encourages short cuts.

**Acquirer**
- High
- Low

**Supplier**
- Low
- High

**Technical & Management Skill**
- Low
- High
### Critical Distinctions Among Processes

<table>
<thead>
<tr>
<th>Performed</th>
<th>vs.</th>
<th>Managed</th>
</tr>
</thead>
<tbody>
<tr>
<td>the extent to which the process is planned; performance is managed against the plan; corrective actions are taken when needed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Managed</th>
<th>vs.</th>
<th>Defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>the scope of application of the process descriptions, standards, and procedures (i.e., project vs. organization)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Defined</th>
<th>vs.</th>
<th>Quantitatively Managed</th>
</tr>
</thead>
<tbody>
<tr>
<td>the predictability of process performance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantitatively Managed</th>
<th>vs.</th>
<th>Optimizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>whether the process is continually improved by addressing common causes of process variation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Selected Model Constructs

<table>
<thead>
<tr>
<th>Maturity Levels</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capability Levels</td>
<td><strong>Specific Goals</strong></td>
</tr>
<tr>
<td><strong>Generic Goals</strong></td>
<td>Specific Practices</td>
</tr>
<tr>
<td>Generic Practices</td>
<td></td>
</tr>
</tbody>
</table>
The Heart of a CMM: Generic Goals and Practices

<table>
<thead>
<tr>
<th>Generic Goals</th>
<th>Generic Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG1: Achieve Specific Goals</td>
<td>GP 1.1: Perform Specific 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 |
| GG3: Institutionalize a Defined Process | GP 3.1: Establish a Defined Process  
GP 3.2: Collect Improvement Information |
| GG4: Institutionalize a Quantitatively Managed Process | GP 4.1: Establish Quantitative Objectives for the Process  
GP 4.2: Stabilize Subprocess Performance |
| GG5: Institutionalize an Optimizing Process | GP 5.1: Ensure Continuous Process Improvement  
GP 5.2: Correct Root Causes of Problems |

Adapted from Cepeda Systems & Software Analysis, Inc.
Understanding Levels

Levels are used in CMMI to describe an evolutionary path for an organization that wants to improve the processes it uses to develop and maintain its products and services.

CMMI supports two improvement paths:

- **continuous** - enabling an organization to incrementally improve processes corresponding to an individual process area (or set of process areas) selected by the organization
- **staged** - enabling the organization to improve a set of related processes by incrementally addressing successive predefined sets of process areas
## What Generic Goals Get Applied to (Continuous Representation): Process Areas by Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Process Areas</th>
</tr>
</thead>
</table>
| **Process Management** | Organizational Process Focus  
Organizational Process Definition +IPPD  
Organizational Training  
Organizational Process Performance  
Organizational Innovation and Deployment |
| **Project Management** | Project Planning  
Project Monitoring and Control  
Supplier Agreement Management  
Integrated Project Management +IPPD  
Risk Management  
Quantitative Project Management |
| **Engineering** | Requirements Management  
Requirements Development  
Technical Solution  
Product Integration  
Verification  
Validation |
| **Support** | Configuration Management  
Process and Product Quality Assurance  
Measurement and Analysis  
Decision Analysis and Resolution  
Causal Analysis and Resolution |
### What Generic Goals Get Applied to (Staged Representation): Process Areas by Maturity Level

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td><em>Continuous Process Improvement</em></td>
<td>Organizational Innovation and Deployment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Causal Analysis and Resolution</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td><em>Quantitative Management</em></td>
<td>Organizational Process Performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quantitative Project Management</td>
</tr>
<tr>
<td>3 Defined</td>
<td><em>Process Standardization</em></td>
<td>Requirements Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product Integration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Validation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organizational Process Focus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organizational Process Definition +IPPD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organizational Training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrated Project Management +IPPD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decision Analysis and Resolution</td>
</tr>
<tr>
<td>2 Managed</td>
<td><em>Basic Project Management</em></td>
<td>Requirements Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Monitoring and Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplier Agreement Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurement and Analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Process and Product Quality Assurance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Configuration Management</td>
</tr>
<tr>
<td>1 Initial</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Quality Productivity**

**Risk Rework**
Achieving Capability Levels (CL) for a Process Area

- **CL0** Not performed, incomplete
  - A few GPs or SPs may be implemented

- **CL1** Performed
  - Perform the work

- **CL2** Managed
  - Adhere to policy; follow documented plans and processes, apply adequate resources; assign responsibility and authority; train people, apply configuration management, monitor, control, and evaluate process; identify and involve stakeholders; review with management

- **CL3** Defined
  - Project’s process is tailored from organization’s standard processes; understand process qualitatively; process contributes to the organizations assets

- **CL4** Quantitatively Managed
  - Measure process performance, stabilize process, control charts, deal with causes of special variations

- **CL5** Optimizing
  - Defect prevention, proactive improvement, innovative technology insertion and deployment
Achieving Maturity Levels for an Organizational Unit

- **ML1 (Initial):**
  - Processes are ad hoc and chaotic

- **ML2 (Managed):**
  - Adhere to policy; follow documented plans and processes; apply adequate resources; assign responsibility and authority; train people; apply CM; monitor, control, and evaluate process; identify and involve stakeholders; review with management

- **ML3 (Defined):**
  - Tailor the project's process from organization's standard processes; understand processes qualitatively; ensure that projects contribute to organization assets

- **ML4 (Quantitatively Managed):**
  - Measure process performance; stabilize process and control charts; deal with causes of special variations

- **ML5 (Optimizing):**
  - Prevent defects; proactively improve; insert and deploy innovative technology
Ultimately the Levels are About Learning

- **Learning 1 Individual**
  - Learning occurs within individuals. Sharing learning is idiosyncratic to the individual's preferences.

- **Learning 2 Local/Group**
  - Learning is shared within a local work group, which often leads to local standards (i.e. project standards) being adopted. Learning among groups is idiosyncratic.

- **Learning 3 Organizational**
  - The organization makes explicit and sustained investments in gathering and filtering the learning from groups to make available and support learning across the organization. Much of this learning is qualitative in nature.

- **Learning 4 Quantitative**
  - Both local and organizational learning become more quantitative in nature where appropriate, as an addition to, not replacement of, other learning approaches.

- **Learning 5 Strategic**
  - The operational insights available via the organizational quantitative learning permit the organization to focus on more strategic learning about its business environment.

This is why “skipping” levels doesn’t work; the learning that takes place at each level feeds the one above it.
What’s Inside a Process Area

Process Area (PA)

- Specific Goals (SG)
  - Specific Practices (SP)
    - Typical Work Products
    - Subpractices
  - Subpractices
- Generic Goals (GG)
  - Generic Practices (GP)
    - Generic Practice Elaborations
- Purpose Statement
- Introductory Notes
- Related Process Areas

Legend
- Required
- Expected
- Informative
Topics

Why do Organizations Look to CMMI?

What Is CMMI?

- General
- A Bit More Detail on CMMI-Dev

Who Is Using CMMI?

How Can CMMI Benefit People Evaluating Technology Maturity?
CMMI Transition Status
As reported to the SEI as of 6-30-07

Training

Introduction to CMMI – 70,791
Intermediate CMMI – 2,549
Introduction to CMMI Instructor – 504
SCAMPI A Lead Appraiser – 731
SCAMPI B&C-Only Team Lead – 33
Understanding CMMI High Maturity Practices – 120

Authorized

Introduction to CMMI V1.2 Instructors – 400
SCAMPI V1.2 Lead Appraisers – 417
SCAMPI B&C V1.2 Team Leads – 20
Intro to the CMM and CMMI Attendees (Cumulative)
Number of SCAMPI v1.1/v1.2 Class A Appraisals (Conducted by Quarter)

Reported as of 30 June 2007
Organization Size

Based on the total number of employees within the area of the organization that was appraised
Countries where Appraisals have been Performed and Reported to the SEI

Argentina  Australia  Austria  Bahrain  Belarus  Belgium  Brazil  Canada  Chile  China  Colombia  Czech Republic  Denmark  Dominican Republic  Egypt  Finland  France  Germany  Hong Kong  India  Indonesia  Ireland  Israel  Italy  Japan  Korea, Republic of Latvia  Malaysia  Mauritius  Mexico  Morocco  Netherlands  New Zealand  Pakistan  Peru  Philippines  Portugal  Russia  Singapore  Slovakia  South Africa  Spain  Sweden  Switzerland  Taiwan  Thailand  Turkey  United Kingdom  United States  Vietnam

Red country name: New additions with this reporting
## Number of Appraisals and Maturity Levels Reported to the SEI by Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Appraisals</th>
<th>Maturity Level 1 Reported</th>
<th>Maturity Level 2 Reported</th>
<th>Maturity Level 3 Reported</th>
<th>Maturity Level 4 Reported</th>
<th>Maturity Level 5 Reported</th>
<th>Country</th>
<th>Number of Appraisals</th>
<th>Maturity Level 1 Reported</th>
<th>Maturity Level 2 Reported</th>
<th>Maturity Level 3 Reported</th>
<th>Maturity Level 4 Reported</th>
<th>Maturity Level 5 Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>19</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Korea, Republic Of</td>
<td>78</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Australia</td>
<td>23</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Latvia</td>
<td>10 fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Austria</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Malaysia</td>
<td>19</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Bahrain</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Mauritius</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Belarus</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Mexico</td>
<td>15</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Belgium</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Morocco</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Brazil</td>
<td>48</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Netherlands</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada</td>
<td>26</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>New Zealand</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Chile</td>
<td>15</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Pakistan</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>China</td>
<td>240</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Peru</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Colombia</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Philippines</td>
<td>16</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Portugal</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Denmark</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Russia</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Singapore</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Egypt</td>
<td>17</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Slovakia</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Finland</td>
<td>10 or fewer</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>South Africa</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>France</td>
<td>75</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Spain</td>
<td>51</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Germany</td>
<td>55</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Sweden</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Switzerland</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>India</td>
<td>204</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Taiwan</td>
<td>46</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Indonesia</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Thailand</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ireland</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>United Kingdom</td>
<td>48</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Israel</td>
<td>10</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>United States</td>
<td>113</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Italy</td>
<td>10 or fewer</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Viet Nam</td>
<td>10 or fewer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Maturity Profile by All Reporting USA and Non-USA Organizations

USA: 100 % = 590
Non-USA: 100 % = 1122
## Performance Results Summary

<table>
<thead>
<tr>
<th>Improvements</th>
<th>Median</th>
<th># of data points</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>20%</td>
<td>21</td>
<td>3%</td>
<td>87%</td>
</tr>
<tr>
<td>Schedule</td>
<td>37%</td>
<td>19</td>
<td>2%</td>
<td>90%</td>
</tr>
<tr>
<td>Productivity</td>
<td>67%</td>
<td>16</td>
<td>11%</td>
<td>255%</td>
</tr>
<tr>
<td>Quality</td>
<td>50%</td>
<td>18</td>
<td>29%</td>
<td>132%</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>14%</td>
<td>6</td>
<td>-4%</td>
<td>55%</td>
</tr>
<tr>
<td>Return on Investment</td>
<td>4.8 : 1</td>
<td>14</td>
<td>2 : 1</td>
<td>27.7 : 1</td>
</tr>
</tbody>
</table>

- N = 25, as of 15 December 2005
- Organizations with results expressed as change over time
CMMI Books…Including Mine!

CMMI: A Framework…
CMMI Assessments
CMMI Distilled: Second Edition
CMMI SCAMPI Distilled
CMMI Survival Guide
CMMI: Un Itinéraire Fléché: Second Edition
De kleine CMMI
Interpreting the CMMI
Making Process Improvement Work
Practical Insight into CMMI
Real Process Improvement Using the CMMI
How About SEI Publications?

Technical notes and special reports:

- Interpreting CMMI:
  - for Operational Organizations
  - for COTS Based Systems
  - for Service Organizations
  - for Business Development

- Using CMMI with:
  - Team Software Process (TSP)
  - Earned Value Management
  - Product Line Practices
  - Six Sigma

- Supplementing CMMI for Safety Critical Development ("+Safe")

- Demonstrating the Impact and Benefits of CMMI (and Web pages – http://www.sei.cmu.edu/cmmi/results)

- Tutorial: Will My System Play Nicely with Others? CMMI in a SoS Context
Topics

Why do Organizations Look to CMMI?

What Is CMMI?
  - General
  - A Bit More Detail on CMMI-Dev

Who Is Using CMMI?

How Can CMMI Benefit People Evaluating Technology Maturity?
DoD Technology Readiness Levels

A scale from 1 to 9 used to assess technology maturity*

1. Basic principles observed and reported.
2. Technology concept and/or application formulated.
3. Analytical and experimental critical function and/or characteristic proof of concept.
4. Component and/or breadboard validation in laboratory environment.
5. Component and/or breadboard validation in relevant environment.
6. System/subsystem model or prototype demonstration in a relevant environment.
7. System prototype demonstration in an operational environment.
8. Actual system completed and qualified through test and demonstration.
9. Actual system proven through successful mission operations.

*DoD Interim Defense Acquisition Guidebook, October 30, 2002
TRL Readiness Fundamentals in the Hardware/Systems Context

For hardware/systems, TRLs 1-9 depict the following general progression in readiness:

- **The environment** in which the technology can function becomes more representative of the final operational environment
  - from paper studies through laboratory setup, simulated environments, to mission operations

- **The completeness** of the technology increases
  - from basic properties through breadboard components, integrated components, prototype, to final form
Technology Maturity ≠ Process Maturity

Technology maturity scales such as TRLs measure the progress of a technology towards a narrower and narrower production and operational context, culminating in use within a specific operating environment.

Process maturity scales (within the process improvement community termed Capability Maturity, even though it really should be Process Capability Maturity) such as capability levels and maturity levels measure the progress of an environment (typically an organization) toward a more measurable project and organizational process context.

The process capabilities achieved can be applied in multiple relevant project contexts.
TRL Stages Where *Process Capability Maturity* Might be Helpful

A scale from 1 to 9 used to assess technology maturity*

1. Basic principles observed and reported.
2. Technology concept and/or application formulated.
3. Analytical and experimental critical function and/or characteristic proof of concept.
4. Component and/or breadboard validation in laboratory environment.
5. Component and/or breadboard validation in relevant environment.
6. System/subsystem model or prototype demonstration in a relevant environment.
7. System prototype demonstration in an operational environment.
8. Actual system completed and qualified through test and demonstration.
9. Actual system proven through successful mission operations.

*DoD Interim Defense Acquisition Guidebook, October 30, 2002
Useful Approaches to Using CMMI

1: Apply selected CMMI-DEV ideas to the processes that you use in managing the evolution of technology.
   - Do you manage technology evolution projects? Could you use guidance in *Project Planning* and *Project Monitoring & Control*?
   - Do you need to manage risks? Could you use guidance in *Risk Management*?
   - Etc…

2: Encourage projects over which you have oversight to consider using CMMI-DEV as a guide for relevant processes at relevant points.

3: Use ideas from the soon-to-be-released CMMI-ACQ for guidance in processes used in overseeing other technology developers.

*NOTE THERE IS NO MENTION OF MATURITY LEVELS IN ANY OF THE ABOVE STATEMENTS*
What I would NOT Recommend…

Please don’t try to tie a particular *process* maturity level to a particular *technology* maturity level!

ML X $\rightarrow$ TRL Y
Where to Start in Adopting CMMI into Your Organization

Ask someone you trust to learn more about CMMI and report back to you. Ways to learn more include the SEI Web site, *Introduction to CMMI* training, and written publications.

Talk to others who have adopted CMMI to see how they did it. Early adopters that have agreed to talk to potential adopters are listed on the SEI Web site.

Participate in Discussion Groups and Bulletin Boards or attend a conference to learn from others who have adopted CMMI. A list of a few such forums is at www.sei.cmu.edu/cmmi/adoption/knowledge-exchange.html
For More Information About CMMI

Go to CMMI Web site:

http://www.sei.cmu.edu/cmmi
http://seir.sei.cmu.edu

Contact SEI Customer Relations:

Customer Relations
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213-3890
FAX: (412) 268-5800

customer-relations@sei.cmu.edu
Backup Slides

Titles and Specific Goals for the CMMI-DEV 1.2 Process Areas
Causal Analysis and Resolution Goals

SG 1: Determine Causes of Defects
Root causes of defects and other problems are systematically determined.

SG 2: Address Causes of Defects
Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

The process area also has generic goals to support institutionalization.
Configuration Management Goals

SG 1: Establish Baselines
Baselines of identified work products are established.

SG 2: Track and Control Changes
Changes to the work products under configuration management are tracked and controlled.

SG 3: Establish Integrity
Integrity of baselines is established and maintained.

The process area also has generic goals to support institutionalization.
Decision Analysis and Resolution Goals

SG 1: Evaluate Alternatives
Decisions are based on an evaluation of alternatives using established criteria.

The process area also has generic goals to support institutionalization.
IPM (+IPPD Addition)

SG 1: Use the Project’s Defined Process
The project is conducted using a defined process that is tailored from the organization’s set of standard processes.

SG 2: Coordinate and Collaborate with Relevant Stakeholders
Coordination and collaboration of the project with the relevant stakeholders is conducted.

**IPPD Addition:**

SG 3: Apply IPPD Principles
The project is managed using IPPD principles.

The process area also has generic goals to support institutionalization.
Measurement and Analysis Goals

SG 1: Align Measurement and Analysis Activities
Measurement objectives and activities are aligned with identified information needs and objectives.

SG 2: Provide Measurement Results
Measurement results that address identified information needs and objectives are provided.

The process area also has generic goals to support institutionalization.
Organizational Innovation and Deployment Goals

SG 1: Select Improvements
Process and technology improvements that contribute to meeting quality and process-performance objectives are selected.

SG 2: Deploy Improvements
Measurable improvements to the organization’s processes and technologies are continually and systematically deployed.

The process area also has generic goals to support institutionalization.
Organizational Process Definition + IPPD

SG 1: Establish Organizational Process Assets
A set of organizational process assets is established and maintained.

*IPPD Addition:*

SG 2: Enable IPPD Management
Organizational rules and guidelines, which govern the operation of integrated teams, are provided.

The process area also has generic goals to support institutionalization.
Organizational Process Focus

SG 1: Determine Process Improvement Opportunities
Strengths, weaknesses, and improvement opportunities for the organization’s processes are identified periodically and as needed.

SG 2: Plan and Implement Process Improvements
Process actions that address improvements to the organization’s processes and process assets are planned and implemented.

SG 3: Deploy Organizational Process Assets and Incorporate Lessons Learned
The organizational process assets are deployed across the organization, and process-related experiences are incorporated into the organizational process assets.

The process area also has generic goals to support institutionalization.
Organizational Process Performance Goals

SG 1: Establish Performance Baselines and Models
Baselines and models that characterize the expected process performance of the organization’s set of standard processes are established and maintained.

The process area also has generic goals to support institutionalization.
Organizational Training Goals

SG 1: Establish an Organizational Training Capability
A training capability that supports the organization’s management and technical roles is established and maintained.

SG 2: Provide Necessary Training
Training necessary for individuals to perform their roles effectively is provided.

The process area also has generic goals to support institutionalization.
Product Integration Goals

SG 1: Prepare for Product Integration
Preparation for product integration is conducted.

SG 2: Ensure Interface Compatibility
The product component interfaces, both internal and external, are compatible.

SG 3: Assemble Product Components and Deliver the Product
Verified product components are assembled and the integrated, verified, and validated product is delivered.

The process area also has generic goals to support institutionalization.
Project Monitoring and Control Goals

SG 1: Monitor Project Against Plan
Actual performance and progress of the project are monitored against the project plan.

SG 2: Manage Corrective Action to Closure
Corrective actions are managed to closure when the project’s performance or results deviate significantly from the plan.

The process area also has generic goals to support institutionalization.
Project Planning Goals

SG 1: Establish Estimates
Estimates of project planning parameters are established and maintained.

SG 2: Develop a Project Plan
A project plan is established and maintained as the basis for managing the project.

SG 3: Obtain Commitment to the Plan
Commitments to the project plan are established and maintained.

The process area also has generic goals to support institutionalization.
Process and Product Quality Assurance

Goals

SG 1: Objectively Evaluate Processes and Work Products
Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively evaluated.

SG 2: Provide Objective Insight
Noncompliance issues are objectively tracked and communicated, and resolution is ensured.

The process area also has generic goals to support institutionalization.
Quantitative Project Management Goals

SG 1: Quantitatively Manage the Project
The project is quantitatively managed using quality and process-performance objectives.

SG 2: Statistically Manage Subprocess Performance
The performance of selected subprocesses within the project’s defined process is statistically managed.

The process area also has generic goals to support institutionalization.
Requirements Development

SG 1: Develop Customer Requirements
Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.

SG 2: Develop Product Requirements
Customer requirements are refined and elaborated to develop product and product component requirements.

SG 3: Analyze and Validate Requirements
The requirements are analyzed and validated, and a definition of required functionality is developed.

The process area also has generic goals to support institutionalization.
Requirements Management

SG 1: Manage Requirements
Requirements are managed and inconsistencies with project plans and work products are identified.

The process area also has generic goals to support institutionalization.
Risk Management Goals

SG 1: Prepare for Risk Management
Preparation for risk management is conducted.

SG 2: Identify and Analyze Risks
Risks are identified and analyzed to determine their relative importance.

SG 3: Mitigate Risks
Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.

The process area also has generic goals to support institutionalization.
Supplier Agreement Management

SG 1: Establish Supplier Agreements
Agreements with the suppliers are established and maintained.

SG 2: Satisfy Supplier Agreements
Agreements with the suppliers are satisfied by both the project and the supplier.

The process area also has generic goals to support institutionalization.
Technical Solution

SG 1: Select Product Component Solutions
Product or product component solutions are selected from alternative solutions.

SG 2: Develop the Design
Product or product components designs are developed.

SG 3: Implement the Product Design
Product components, and associated support documentation, are implemented from their designs.

The process area also has generic goals to support institutionalization.
Validation

SG 1: Prepare for Validation
Preparation for validation is conducted.

SG 2: Validate Product or Product Components
The product or product components are validated to ensure that they are suitable for use in their intended operating environment.

The process area also has generic goals to support institutionalization.
Verification

SG 1: Prepare for Verification
Preparation for verification is conducted.

SG 2: Perform Peer Reviews
Peer reviews are performed on selected work products.

SG 3: Verify Selected Work Products
Selected work products are verified against their specified requirements.

The process area also has generic goals to support institutionalization.