CMMI® Version 1.2 and Beyond
CMMI Technology Conference
November 12, 2007

Mike Phillips
Software Engineering Institute
Carnegie Mellon University

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With thanks to Denise Cattan, Sandra Cepeda, Pascal Rabbath, and Gary Wolf for contributions.
CMMI Today
Training

Introduction to CMMI 76,794
Intermediate CMMI 2,622
Understanding CMMI High Maturity Practices 243

Authorized

Introduction to CMMI V1.2 Instructors 433
SCAMPI V1.2 Lead Appraisers 455
SCAMPI B&C V1.2 Team Leads 21
SCAMPI High Maturity Lead Appraisers 127
421K views/month in Q4 2006; over 24K views on 27 Sep 2006

Most downloaded files in Q4 2006

- CMMI-DEV, V1.2
- CMMI V1.2 Overview Presentation
- "Extreme Programming (XP), Six Sigma, & CMMI: How They Can Work Together"
- "CMMI V1.2 Model Changes" Presentation

Average daily page views per quarter

[Bar chart showing increasing page views from 2002 to 2006]
Introduction to the CMM and CMMI Attendees (Cumulative)

- CMM Intro (discon'td. 12/31/05)
- CMMI Intro
- CMMI Intermediate

10-31-07

Software Engineering Institute | Carnegie Mellon
CMMI Version 1.2 and Beyond
Phillips, November 12, 2007
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Number of SCAMPI v1.1/v1.2 Class A Appraisals
Conducted by Quarter
Reported as of 31 October 2007
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
- Bulgaria
- Canada
- Chile
- China
- Colombia
- Costa Rica
- Czech Republic
- Denmark
- Dominic 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
- Poland
- Portugal
- Romania
- Russia
- Singapore
- Slovakia
- South Africa
- Spain
- United Arab Emirates
- United Kingdom
- United States
- Uruguay
- Vietnam
### 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>
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<th>Maturity Level 2 Reported</th>
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<th>Maturity Level 5 Reported</th>
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<td>Yes</td>
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<td>Yes</td>
<td>Viet Nam</td>
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<tr>
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<td>57</td>
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<td>Yes</td>
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</tr>
</tbody>
</table>
Maturity Profile by All Reporting USA and Non-USA Organizations

USA: 100 % = 704
Non-USA: 100 % = 1436
Maturity Profile by Organization Size

Based on the total number of employees within the area of the organization that was appraised

% of Organizations by Size

- 25 or fewer
- 26 to 50
- 51 to 75
- 76 to 100
- 101 to 200
- 201 to 300
- 301 to 500
- 501 to 1000
- 1001 to 2000
- 2000+
- Not Given

CMMI Version 1.2 and Beyond

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The possible options for assessment and surveillance

Current ISO 9001

ISO 9001 IA

SCAMPI ‘A’ &
ISO 9001

(Combined ISO Surveillance using Cat ‘C’ appraisal)

Visit Report

Rating letter & or certificate with scope indicating “... in accordance with Level X”

...continues to demonstrate compliance with ISO 9001:2000

...no behaviours inconsistent with operating at level X

Current CMMI

SCAMPI ‘A’

Rating letter indicating level achieved

(Cat ‘C’ appraisal)
Adoption: What Else Is Happening?

The Addison-Wesley SEI Series Book and

- A Guide to the CMMI
- CMMI: A Framework
- CMMI Assessments
- CMMI Distilled: Second Edition
- CMMI SCAMPI Distilled
- CMMI Survival Guide
- CMMI: Un Itinéraire Fléché
- De kleine CMMI
- Interpreting the CMMI
- Making Process Improvement Work
- Practical Insight into CMMI
- Real Process Improvement Using the CMMI
- Balancing Agility and Discipline
Technical notes and special reports

- Using CMMI-DEV for sourcing
- Interpreting CMMI:
  - for Operational Organizations
  - for COTS Based Systems
  - for Service Organizations
  - for Marketing
- Using CMMI with:
  - TSP/PSP
  - Earned Value Management
  - Product Line Practices
  - Lean Six Sigma
- Supplementing CMMI for Safety Critical Development
- Demonstrating the Impact and Benefits of CMMI (and Web pages at www.sei.cmu.edu/cmmi/results)
## Results Summary

<table>
<thead>
<tr>
<th>Improvements</th>
<th>Median</th>
<th># of data points</th>
<th>Low</th>
<th>High</th>
</tr>
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<tbody>
<tr>
<td>Cost</td>
<td>34%</td>
<td>29</td>
<td>3%</td>
<td>87%</td>
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<tr>
<td>Schedule</td>
<td>50%</td>
<td>22</td>
<td>2%</td>
<td>95%</td>
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<tr>
<td>Productivity</td>
<td>61%</td>
<td>20</td>
<td>11%</td>
<td>329%</td>
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<tr>
<td>Quality</td>
<td>48%</td>
<td>34</td>
<td>2%</td>
<td>132%</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>14%</td>
<td>7</td>
<td>-4%</td>
<td>55%</td>
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<td>Return on Investment</td>
<td>4.0 : 1</td>
<td>22</td>
<td>1.7 : 1</td>
<td>27.7 : 1</td>
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</table>

- N = 30, as of August 2006
- Organizations with results expressed as change over time
Version 1.1 CMMI Product Suite was released January 2002.

- CMMI Web site visits average over 20,000/day
- Over 75,000 people have been trained
- Over 2500 "class A" appraisals have been reported to the SEI

Now we want to continuously improve...
CMMI V1.2 and Beyond
Major Themes for V1.2

Reduce complexity & size
Increase coverage
Increase confidence in appraisal results
Reduced Model Complexity & Size

Eliminated the concepts of advanced practices and common features
Incorporated ISM into SAM; eliminated Supplier Sourcing (SS) addition
Consolidated and simplified the IPPD material
All definitions consolidated in the glossary
Adopted a single book approach (i.e., will no longer provide separate development models)
Report size reduced 15% from either predecessor; PAs reduced 12%
Increased Model Coverage

Added **hardware amplifications**

Added two **work environment practices** (i.e., one in OPD and one in IPM)

Added goal and two practices in OPF to emphasize importance of **project startup**

Updated notes (including examples) where appropriate so that they also address **service development and acquisition of critical elements**

Updated name to **CMMI for Development** (CMMI-DEV) to reflect the expanded coverage
Improved the **Overview** section (Part One)

Improved clarity of how GPs are used

- Moved generic goals and practices to Part Two
- Added explanation of how process areas support the implementation of GPs
- Added GP elaborations for GP 3.2

Improved the **glossary** (e.g., higher level management, bidirectional traceability, subprocess)

Limited the process areas that can be considered *not applicable* to SAM.

Clarified material throughout the model based on over 1000 change requests
IPPD material is being revised significantly.

- Organization Environment for Integration PA removed and material moved to Organizational Process Definition (OPD) PA.

- Integrated Teaming PA removed and material moved to Integrated Project Management (IPM) PA.

- IPPD goals have been consolidated.
  - Enable IPPD Management in OPD
  - Apply IPPD Principles in IPM

- Overall material condensed and revised to be more consistent with other PAs.
CMMI Model Combinations

V1.1

- Supplier Sourcing
- Integrated Product and Process Development
  - SE Related Examples
  - SW Related Examples
- CMMI Core

V1.2

- IPPD
  - Organizational Goal (OPD)
  - Project Goal (IPM)
- SE Related Examples
- SW Related Examples
- HW Related Examples
- CMMI Core (now includes SS)
## Specific Goal

### Establish Supplier Agreements

1.1 – Determine Acquisition Type  
1.2 – Select Suppliers  
1.3 – Establish Supplier Agreements

### Satisfy Supplier Agreements

2.1 – Execute the Supplier Agreement  
2.2 – Monitor Selected Supplier Processes  
2.3 – Evaluate Selected Supplier Work Products  
2.4 – Accept the Acquired Product  
2.5 – Transition Products

---

V1.1 SP2.1 “Review COTS Products,òwas eliminated. ñIdentify candidate COTS products that satisfy requirementsòis a new subpractice under the Technical Solutions Process Area SP1.1, ñDevelop Alternative Solutions and Selection Criteria.”
## V1.1

**SG 1 – Determine Process Improvement Opportunities**
1.1 – Establish Organizational Process Needs
1.2 – Appraise the Organization’s Processes
1.3 – Identify the Organization’s Process Improvements

**SG 2 – Plan and Implement Process Improvement Activities**
2.1 – Establish Process Action Plans
2.2 – Implement Process Action Plans
2.3 – Deploy Organizational Process Assets
2.4 – Incorporate Process-Related Experiences into the Organizational Process Assets

## V1.2

**SG 1 – Determine Process Improvement Opportunities**
1.1 – Establish Organizational Process Needs
1.2 – Appraise the Organization’s Processes
1.3 – Identify the Organization’s Process Improvements

**SG 2 – Plan and Implement Process Improvement Activities**
2.1 – Establish Process Action Plans
2.2 – Implement Process Action Plans

**SG 3 – Deploy Organizational Process Assets and Incorporate Lessons Learned**
3.1 – Deploy Organizational Process Assets
3.2 – Deploy Standard Processes
3.3 – Monitor Implementation
3.4 – Incorporate Process Related Experiences into the Organizational Process Assets

*New*
Changes for V1.2

Method implementation clarifications

- interviews in "virtual" organizations
- practice characterization rules
- organizational unit sampling options

Appraisal Disclosure Statement (ADS) improvements

- reduce redundancy with other appraisal documents
- improve usability for sponsor and government
- Level 4,5 mapping to business objectives
- require sponsor’s signature on the ADS
- require all team members to show agreement on findings
- Both V1.1 and V1.2 ADS reflect these today

Appraisal team will have responsibility for determination of "applicability" for SAM

Maturity level and capability level validity period is 3 years, given 1 year of V1.2 availability
List of Published SCAMPI Appraisal Results

| ORGANIZATION NAME: | Satyam Computer Services Ltd. |
| SPONSOR NAME: | Nagaraj Chevur |
| LEAD APPRAISER NAME: | Raghavan Nandyal |
| SEI PARTNER: | SITARA Technologies Pvt. Ltd. |
| MATURITY LEVEL ASSIGNED: | 5 |
| APPRAISED ORGANIZATIONAL UNIT: | |
| Entity Name: | SRU GE-GDC |
| Location(s): | Secunderabad, AP, India |
| CMMI MODEL USED: | CMMI-SW/PPD, V1.1, Continuous |
| APPRAISAL METHOD USED: | SCAMPI v1.1 |

MODEL SCOPE & CAPABILITY RATINGS ASSIGNED:

<table>
<thead>
<tr>
<th>Process Management</th>
<th>Project Management</th>
<th>Engineering</th>
<th>Support</th>
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<tr>
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<td>PP</td>
<td>REQM</td>
<td>CM</td>
</tr>
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<td>PMC</td>
<td>RD</td>
<td>PPQA</td>
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<tr>
<td>OT</td>
<td>SAM</td>
<td>TS</td>
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</tr>
<tr>
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<td>IPM</td>
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</tr>
<tr>
<td>QPM</td>
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</tr>
</tbody>
</table>

Capability Level 3
Capability Level 4
Not Applicable
Capability Level 5
Capability Level 6
Major Themes

- Reduce complexity and ambiguity
- Provide additional guidance where needed
- Strengthen appraisal planning and conduct
- Strengthen appraisal reporting
- Define appraisal validity period
- Strengthen lead appraiser requirements
The requirement for instruments (e.g., questionnaires) was removed. Only two types of objective evidence are now required:

- documents
- interviews

The following sections in MDD were revised:

- switched 2.2 Verify and Validate Objective Evidence and 2.3 Document Objective Evidence so that the order of tasks reflects the natural order of conducting an appraisal
- separated Verify Objective Evidence and Validate Preliminary Findings to better describe each process
The use of the term *instantiation* was changed:

- Instantiation is now defined as *the implementation of a model practice used in the appropriate context within the boundaries of an organizational unit.*
- The word *instantiation* for project and organizational-wide entities was replaced with *project* or *support group.*
The rating Not Rated was clarified:

Å Process areas outside of the model scope are rated as Out of Scope. For example, for a maturity level 3 appraisal, maturity level 4 and 5 process areas are rated as Out of Scope.

Å For process areas that have insufficient data to be rated, the rating is Not Rated.

Å Process areas in the model scope, but outside the organizational scope are rated as Not Applicable. The only process area that can be Not Applicable is SAM (as determined by the appraisal team).

The practice characterization tables were revised:

Å clarified the use of virtual versus live interviews
Å changed "face-to-face interviews" to "oral interviews"
Guidance for readiness reviews was revised to include team and logistical readiness.

Additional guidance was provided for using virtual methods (e.g., for interviews and briefings).

Additional guidance was provided for using alternative practices (i.e., Appendix C: Alternative Practice Identification and Characterization Guidance).
Organizational unit sampling was revised to*

- strengthen parameters and limits for organizational sampling (e.g., identifying a minimum number of focus projects)
- include additional criteria for reporting sampling decisions

The Conduct Appraisal Phase must now be complete within 90 days.

Appraisal team members are now required to sign final findings.

*Changes to address sampling were extensive. Refer to the MDD for details.
Appraisal Reporting

The Appraisal Disclosure Statement (ADS) now requires the following information.

Organizational sampling criteria and decisions (e.g., projects included, projects excluded, percentage of organization represented)

Basis for maturity/capability level 4 and 5 appraisal results

- subprocesses statistically managed
- mapping of these subprocesses to quality and process-performance objectives

Signatures of both the lead appraiser and sponsor

- The lead appraiser affirms that the appraisal scope is representative of the organizational unit.
- The sponsor affirms the accuracy of the ADS and authorizes the SEI to conduct any audits deemed necessary.
Define Appraisal Validity Period

V1.2 appraisal results are valid for a maximum of 3 years from the date of the ADS.

V1.1 appraisals will expire on August 31, 2007 or 3 years after the date the appraisal was conducted, whichever is later.
Prior to conducting a v1.2 SCAMPI appraisal, the following must occur:

Å Current candidate and authorized lead appraisers and team leaders must complete CMMI v1.2 Upgrade Training.

Å Candidate and authorized lead appraisers must attend SCAMPI Face-to-Face Training.

Å Those who want to conduct v1.2 SCAMPI level 4 or 5 appraisals must be certified. Certification requirements address the following:

- education, training, and experience in level 4 and 5 concepts
- completion of an oral exam
The SCAMPI A appraisal method was revised based on change requests received to

- reduce complexity and ambiguity
- provide additional guidance where needed
- strengthen appraisal planning and conduct
- strengthen appraisal reporting
- define the appraisal validity period
- strengthen lead appraiser requirements

The changes are intended to make appraisals more accurate, reliable, and efficient.
Introduction to CMMI

Intermediate Concepts of CMMI

Upgrade Training

SCAMPI Lead Appraiser\textsuperscript{SM} Training

SCAMPI\textsuperscript{SM} B and C Team Leader Training

Instructor Training
Changes

The following courses have all been updated to address change requests and CMMI Product Suite v1.2 changes:

- Introduction to CMMI
- Intermediate Concepts of CMMI
- CMMI Instructor Training
- SCAMPI Lead Appraiser Training
- SCAMPI B and C Team Leader Training

CMMI v1.2 Upgrade Training was also developed to help users move from v1.1 to v1.2, an online course with potential SEI Partner assistance.
The construction and format of examinations have changed. v1.1 tests were largely short answer tests that were the same for all students.

For v1.2, tests will be generated from an item bank and now will be multiple choice. CMMI v1.2 Upgrade Training for Instructors, Lead Appraisers, and Team Leaders is the first course to use this approach. The Intermediate Concepts of CMMI and Instructor Training will follow.
This new approach, using an item bank and multiple choice questions, allows multiple versions of examinations that can be constructed more easily:

- The sequence of multiple choice responses can vary from test to test.
- The order of questions can vary from test to test.
- The selection of questions can vary from test to test, but cover the same categories.

This new approach allows the SEI to

- add, modify, and delete questions from the test more easily
- better evaluate the student’s knowledge
Improved architecture will allow post-V1.2 expansion.

- Extensions of the life cycle (Services, Outsourcing/Acquisition) could expand use of a common organizational framework:
  - allows coverage of more of the enterprise or potential partnering organizations
  - adapts model features to fit non-developmental efforts (e.g., CMMI Services, CMMI Acquisition)
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.

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

16 Core Process Areas, common to all.
Acquirer/Supplier Mismatch

- **Mismatch**
  - mature acquirer mentors low maturity supplier
  - outcome not predictable

- **Disaster**
  - no discipline
  - no process
  - no product

- **Matched**
  - acquirer and supplier are both high maturity
  - highest probability of success

- **Mismatch**
  - immature acquirer
  - mature supplier

  - Customer encourages short cuts.
Acquirers cannot ensure that mature processes are applied to their programs.

Acquirers need more internal process focus.

Mismatch
- Mature acquirer mentors low maturity supplier
- Outcome not predictable
- Supplier compromises processes
- Mismatch
- Less mature acquirer derails mature supplier; encourages short cuts
- Matched
- Acquirer and supplier are both high maturity
- Highest probability of success

Technical & Management Skill
- Low
- High

MLs usually apply based upon appraisals of THESE ... but your project is HERE or HERE.
Provide a "process toolbox" for the acquirer

- Include practical guidance on how to recognize the real practitioners
- Encourage the use of capability and maturity profiles vice "single level" approach
- Improve acquisition organizations' understanding of the meaning of high maturity (levels 4 and 5) and equivalent staging
- Include multiple tools and guidance that may be used throughout the acquisition lifecycle
Process Improvement:

- Improve acquisition office operating practices
  - Improve Reviews: documents, PMRs, PDRs, CDRs
  - Improve specific areas: risk mgt, requirements mgt, configuration control, contracting actions (including source selection)
  - Improve communications
  - Create a "strategic rhythm"
  - Facilitate synergy between program segments/organizations, and even among "systems of systems"

Facilitate supplier processes

- Oversight/Insight into supplier processes
- Encourage strategic acquirer-supplier teamwork that may last for years
Market challenges
Moving Organizations from Chaos to Discipline

Random motion ñ lots of energy, not much progress
Directed motion ñ every step brings you closer to the goal

No teamwork ñ individual effort
Coordinated efforts

Frequent conflict
Cooperation

You never know where you will end up
Predictable results

Processes can make the difference for Developers and Acquirers.
What are my capabilities?

Operational Need

What are the key activities you perform when you acquire systems?

- Requirements Management
- Risk Management
- Program Integration
- Configuration Management
- Verification and Validation
- Project Planning

Need to counter these attitudes:

“I'd rather have it wrong than have it late.” – Industry senior manager

“Ad hoc, catch as you can…that’s our motto.”

“We do not work problems until they’re unrecoverable.”
What are my team's capabilities?
What is the CMMI Product Suite?

The Product Suite consists of:

- CMMI for Development
- Standard CMMI Appraisal Method for Process Improvement™ (SCAMPI™)
- Training and Education
- Licensing Opportunities
- and now CMMI for Acquisition
Model must explicitly apply to the acquisition of a wide range of both products and services (From IT outsourcing to DoD acquisition of a weapon system)

Applicable internationally - recognized references and glossary terms added, e.g., service level measurement

Model must apply to acquisition organizations from commercial industry to government agencies, both large and small
## Advisory Board Membership

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of the Secretary of Defense</td>
<td>Kristen Baldwin</td>
</tr>
<tr>
<td>Navy</td>
<td>Katie Smith</td>
</tr>
<tr>
<td>Air Force</td>
<td>Bob Swarz</td>
</tr>
<tr>
<td>Army</td>
<td>Larry Osiecki</td>
</tr>
<tr>
<td>Defense Contract Management Command</td>
<td>Guy Mercurio</td>
</tr>
<tr>
<td>Missile Defense Agency</td>
<td>Mike Smith</td>
</tr>
<tr>
<td>Government Accounting Office</td>
<td>Madhav Panwar</td>
</tr>
<tr>
<td>General Motors</td>
<td>Rich Frost</td>
</tr>
<tr>
<td>National Defense Industrial Association</td>
<td>Bob Rassa</td>
</tr>
</tbody>
</table>
The initial draft CMMI-ACQ model requirements and design were developed using the CMM for Development v1.2 model as the core.
CQ Key Acquisition Processes

- Solicitation & Supplier Agreement Development
- Agreement Management
- Acquisition Requirements Development
- Acquisition Verification
- Acquisition Technical Management
- Acquisition Validation

Core Processes

*based on initial CMMI-ACQ model developed by General Motors/SEI*
Phased approach will be used for ACQ training

- Initial training for CMMI-ACQ will be face-to-face
  - Assumes the completion of existing Introduction to CMMI training
  - One-day course will address ACQ concepts
    - Pilot offering in November
    - First public offering in December
    - Licensing opportunity will be available

- On-line ACQ upgrade will be developed

- A 3-day Introduction to CMMI course for Acquisition may be developed.

- In FY 08, the Introduction to CMMI course will be revised to accommodate the multiple model approach:
  - 16 CMMI Model Foundation (CMF) process areas will be taught first
  - Additions for the areas of interest (development, acquisition) will be provided to meet audience needs

- Other CMMI courses (e.g., Intermediate and instructor training) will be updated to include ACQ material
in an Acquisition Organization

“Organizing & Managing the Work”

Managing the Project

Doing the Work of the Organization

Product Acquisition 1
ARD, SSAD

Product Acquisition 2
AM, ATM, AVAL, AVER

Improvement Infrastructure

“Enabling Improvement of the Work”

“Understanding the Work”

“Performing the Work”

Managing Quantitatively

“Adding Quantitative Management Capability to Other Management Approaches”

Project and Organizational Support

“Providing Infrastructure for Projects & Organizations”

“Performing the Work”

“Understanding the Work”

“Organizing & Managing the Work”
Approach

- Assure model understanding before allowing benchmark claims
  - Encourage Class B and C appraisals for six months
  - Uncover appraisal issues in a less intense environment
- Allow time to align appraisals with the new certification system for Lead Appraisers (March 08)
- Both Lead Appraisers and Instructors must pass a qualification test for CMMI-ACQ
- CMMI development and governance bodies are considering experience requirements for Lead Appraisers and Instructors
Planned Sequence of Models

CMMI V1.1

CMMI-AM

SA-CMM

CMMI-DEV V1.2

GM IT Sourcing

CMMI-ACQ

CMMI-SVC

CMMI V# ??

To be released November 1

TBD

TBD
V1.2 concentrated on the project or program level acquisition best practices

V2.0 will add more of the enterprise/organization level best practices for acquisition

- Address enterprise level acquisition strategies, e.g., preferred supplier strategies
- Address the Program Executive Office level
- Address incorporation of lessons learned from acquisition project into acquisition management practices

V2.0 will also benefit from change requests issued from lessons learned using the model globally
CMMI V1.2 and Beyond
The Details
### Continuous Representation: PAs 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  
<pre><code>                  | Causal Analysis and Resolution  |
</code></pre>
<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Process Areas</th>
<th>Quality Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td>Continuous Process Improvement</td>
<td>Organizational Innovation and Deployment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Causal Analysis and Resolution</td>
<td></td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td>Quantitative Management</td>
<td>Organizational Process Performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quantitative Project Management</td>
<td></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>
<td></td>
</tr>
<tr>
<td>1 Initial</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Staged Representation: PAs by Maturity Level

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimizing</td>
<td>Causal Analysis and Resolution</td>
</tr>
<tr>
<td></td>
<td>Organizational Innovation and Deployment</td>
</tr>
<tr>
<td>Quantitatively</td>
<td>Quantitative Project Management</td>
</tr>
<tr>
<td>Managed</td>
<td>Organizational Process Performance</td>
</tr>
<tr>
<td>Defined</td>
<td>Organizational Process Focus</td>
</tr>
<tr>
<td></td>
<td>Organizational Process Definition</td>
</tr>
<tr>
<td></td>
<td>Organizational Training</td>
</tr>
<tr>
<td></td>
<td>Integrated Project Management</td>
</tr>
<tr>
<td></td>
<td>Risk Management</td>
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<tr>
<td></td>
<td>Acquisition Technical Management</td>
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<tr>
<td></td>
<td>Acquisition Verification</td>
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<tr>
<td></td>
<td>Acquisition Validation</td>
</tr>
<tr>
<td></td>
<td>Decision Analysis and Resolution</td>
</tr>
<tr>
<td>Managed</td>
<td>Acquisition Requirements Development</td>
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<tr>
<td></td>
<td>Agreement Management</td>
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<tr>
<td></td>
<td>Project Planning</td>
</tr>
<tr>
<td></td>
<td>Project Monitoring and Control</td>
</tr>
<tr>
<td></td>
<td>Requirements Management</td>
</tr>
<tr>
<td></td>
<td>Configuration Management</td>
</tr>
<tr>
<td></td>
<td>Process and Product Quality Assurance</td>
</tr>
<tr>
<td></td>
<td>Measurement and Analysis</td>
</tr>
<tr>
<td></td>
<td>Solicitation and Supplier Agreement Development</td>
</tr>
</tbody>
</table>
Critical Distinctions Among Processes

- **performed** vs. **managed**
  - the extent to which the process is planned; performance is managed against the plan; corrective actions are taken when needed

- **managed** vs. **defined**
  - the scope of application of the process descriptions, standards, and procedures (i.e., project vs. organization)

- **defined** vs. **quantitatively managed**
  - the predictability of process performance

- **quantitatively managed** vs. **optimizing**
  - whether the process is continually improved by addressing common causes of process variation
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
Achieving Capability Levels (CL) for a Process Area

<table>
<thead>
<tr>
<th>GP1.1 through GP5.2</th>
<th>CL5 Optimizing</th>
<th>Defect prevention, proactive improvement, innovative technology insertion and deployment</th>
</tr>
</thead>
<tbody>
<tr>
<td>All SPs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP1.1 through GP4.2</td>
<td>CL4 Quantitatively Managed</td>
<td>Measure process performance, stabilize process, control charts, deal with causes of special variations</td>
</tr>
<tr>
<td>All SPs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP1.1 through GP3.2</td>
<td>CL3 Defined</td>
<td>Project's process is tailored from organization's standard processes; understand process qualitatively; process contributes to the organizations assets</td>
</tr>
<tr>
<td>All SPs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP1.1 through GP2.10</td>
<td>CL2 Managed</td>
<td>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</td>
</tr>
<tr>
<td>All SPs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP1.1</td>
<td>CL1 Performed</td>
<td>Perform the work</td>
</tr>
<tr>
<td>All SPs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A few GPs or SPs may be implemented</td>
<td>CL0</td>
<td>Not performed, incomplete</td>
</tr>
</tbody>
</table>
Achieving Maturity Levels

ML1
Initial

Processes are ad hoc and chaotic

ML2
Managed

GP2.1 through GP2.10
All ML2 PAs

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

GP2.1 through GP3.2
All ML2, ML3, and ML4 PAs

Tailor the project’s process from organization’s standard processes; understand processes qualitatively; ensure that projects contribute to organization assets

ML4
Quantitatively Managed

GP2.1 through GP3.2
All ML2, ML3, and ML4 PAs

Measure process performance; stabilize process and control charts; deal with causes of special variations

ML5
Optimizing

GP2.1 through GP3.2
All ML2, ML3, ML4, and ML5 PAs

Prevent defects; proactively improve; insert and deploy innovative technology

GP2.1 through GP2.10
All ML2 PAs
Process Area (PA)

Specific Goals (SG)

- Specific Practices (SP)
  - Typical Work Products
  - Subpractices

Generic Goals (GG)

- Generic Practices (GP)
  - Subpractices
  - Generic Practice Elaborations

Legend:
- Required
- Expected
- Informative
### 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>
<tr>
<td>GG2: Institutionalize a Managed Process</td>
<td>GP 2.1: Establish an Organizational Policy</td>
</tr>
<tr>
<td></td>
<td>GP 2.2: Plan the Process</td>
</tr>
<tr>
<td></td>
<td>GP 2.3: Provide Resources</td>
</tr>
<tr>
<td></td>
<td>GP 2.4: Assign Responsibility</td>
</tr>
<tr>
<td></td>
<td>GP 2.5: Train People</td>
</tr>
<tr>
<td></td>
<td>GP 2.6: Manage Configurations</td>
</tr>
<tr>
<td></td>
<td>GP 2.7: Identify and Involve Relevant Stakeholders</td>
</tr>
<tr>
<td></td>
<td>GP 2.8: Monitor and Control the Process</td>
</tr>
<tr>
<td></td>
<td>GP 2.9: Objectively Evaluate Adherence</td>
</tr>
<tr>
<td></td>
<td>GP 2.10: Review Status with Higher Level Management</td>
</tr>
<tr>
<td>GG3: Institutionalize a Defined Process</td>
<td>GP 3.1: Establish a Defined Process</td>
</tr>
<tr>
<td></td>
<td>GP 3.2: Collect Improvement Information</td>
</tr>
<tr>
<td>GG4: Institutionalize a Quantitatively Managed Process</td>
<td>GP 4.1: Establish Quantitative Objectives for the Process</td>
</tr>
<tr>
<td></td>
<td>GP 4.2: Stabilize Subprocess Performance</td>
</tr>
<tr>
<td>GG5: Institutionalize an Optimizing Process</td>
<td>GP 5.1: Ensure Continuous Process Improvement</td>
</tr>
<tr>
<td></td>
<td>GP 5.2: Correct Root Causes of Problems</td>
</tr>
</tbody>
</table>

Adapted from Cepeda Systems & Software Analysis, Inc.
Process Definition Inputs

- Strategic Plans, Goals, Objectives
- Policies
- Process Descriptions, Procedures, Instructions
- Asset Library
- Measurement Repository

Process Needs

Process Architecture

Process Scope
Area Category Topics

Process Management
Support
Project Management
Engineering
Acquisition
## Specific Goal

Establish Organizational Process Assets

## Specific Practice

1.1 – Establish Standard Processes
1.2 – Establish Lifecycle Model Descriptions
1.3 – Establish Tailoring Criteria and Guidelines
1.4 – Establish the Organization’s Measurement Repository
1.5 – Establish the Organization’s Process Asset Library
1.6 – Establish Work Environment Standards

*Added “and work environment standards” to the purpose statement.
*Added SP 1.6 “Establish Work Environment Standards.” (This practice is new to CMMI.)
**Specific Goal**: Enable IPPD Management

**Specific Practice**

- 2.1 – Establish Empowerment Mechanisms
- 2.2 – Establish Rules and Guidelines for Integrated Teams
- 2.3 – Balance Team and Home Organization Responsibilities

- Added an IPPD Addition to OPD (SG2 Enable IPPD Management and its practices).

- To emphasize the IPPD Addition, the name the process area is now Organizational Process Definition +IPPD or OPD +IPPD.
### Specific Goal

Determine Process Improvement Opportunities

### Specific Practice

1.1 – Establish Organizational Process Needs

1.2 – Appraise the Organization’s Processes

1.3 – Identify the Organization’s Process Improvements

Modified the purpose statement to emphasize deployment.

ASP 1.2 Appraise the organization’s processes periodically and as needed to maintain an understanding of their strengths and weaknesses. uses organization’s processes instead of processes of the organization.
## Process Focus -2

<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan and Implement Process Improvements</td>
<td>2.1 – Establish Process Action Plans</td>
</tr>
<tr>
<td></td>
<td>2.2 – Implement Process Action Plans</td>
</tr>
</tbody>
</table>

- Modified SG2 from “Plan and Implement Process Improvement Activities” to “Plan and Implement Process Improvements.”
- Moved to a new SG3 and modified what were SP 2.3 and SP 2.4 in v1.1.
### Process Focus -3

<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deploy Organizational Process Assets and Incorporate Lessons Learned</td>
<td>3.1 – Deploy Organizational Process Assets</td>
</tr>
<tr>
<td></td>
<td>3.2 – Deploy Standard Processes</td>
</tr>
<tr>
<td></td>
<td>3.3 – Monitor Implementation</td>
</tr>
<tr>
<td></td>
<td>3.4 – Incorporate Process-Related Experiences into the Organizational Process Assets</td>
</tr>
</tbody>
</table>

ÂAdded new SG3, "Deploy Organizational Process Assets and Incorporate Lessons Learned."

ÂMoved what were SP 2.3 and SP 2.4 in v1.1 to the new SG3 as SP 3.1 and SP 3.4.

ÂAdded two new SPs: SP 3.2 "Deploy Standard Processes," and SP 3.3 "Monitor Implementation."
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.

Note relationship with

Â Organizational Training ↔ GP 2.5
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.

Note relationship with

Â Organizational Innovation and Deployment ↔ GP 5.1
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.

Note relationship with

Â Organizational Process Performance ↔ GP 4.1
OPP Context

Select Processes

Establish Process-Performance Models

Selected Subprocesses from Org. Std. Processes

Organizational Process-Performance Baselines

Organization’s Quality and Process-Performance Objectives

Establish Quality and Process-Performance Objectives

Establish Process-Performance Measures

MA

QPM

The shaded SPs interrelate and may need to be performed iteratively.
Area Category Topics

Process Management
Support
Project Management
Engineering
Acquisition
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.

Note relationship with

Å Configuration Management ↔ GP 2.6
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.
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.

Note relationship with

Â Process and Product Quality Assurance ↔ GP 2.9
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.
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.

Note relationship with

Å Causal Analysis and Resolution ↔ GP 5.2
Area Category Topics

Process Management
Support
Project Management
Engineering
Acquisition
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.

Note relationship with

Å Project Planning ↔ GP 2.2, GP 2.7
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.

Note relationship with

Â Project Monitoring and Control  ↔  GP 2.8
### Specific Goal

| Establish Supplier Agreements | \[
|-------------------------------|-------------------------------------------------
| 1.1 – Determine Acquisition Type | 2.1 – Execute the Supplier Agreement |
| 1.2 – Select Suppliers         | 2.2 – Monitor Selected Supplier Processes |
| 1.3 – Establish Supplier Agreements | 2.3 – Evaluate Selected Supplier Work Products |
|                               | 2.4 – Accept the Acquired Product |
|                               | 2.5 – Transition Products |

1. V1.1 SAM SP2.1 “Review COTS Products,ò was eliminated. òIdentify candidate COTS products that satisfy requirementsò is a new subpractice under the Technical Solutions Process Area SP1.1, òDevelop Alternative Solutions and Selection Criteria.ò

2. SP2.2 and SP2.3 were added because ISM was eliminated.

3. The purpose of SAM was also updated.
<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the Project’s Defined Process</td>
<td>1.1 – Establish the Project’s Defined Process</td>
</tr>
<tr>
<td></td>
<td>1.2 – Use Organizational Process Assets for Planning Project Activities</td>
</tr>
<tr>
<td></td>
<td>1.3 – Establish the Project’s Work Environment</td>
</tr>
<tr>
<td></td>
<td>1.4 – Integrate Plans</td>
</tr>
<tr>
<td></td>
<td>1.5 – Manage the Project Using the Integrated Plans</td>
</tr>
<tr>
<td></td>
<td>1.6 – Contribute to the Organizational Process Assets</td>
</tr>
</tbody>
</table>

- Modified SP 1.1 from “Establish and maintain the project’s defined process” to “Establish and maintain the project’s defined process from project startup through the life of the project.”
- Added SP 1.3 “Establish the Project’s Work Environment.” (This practice is new to CMMI.)
### Specific Goal

**Coordinate and Collaborate with Relevant Stakeholders**

- 2.1 – Manage Stakeholder Involvement
- 2.2 – Manage Dependencies
- 2.3 – Resolve Coordination Issues

**Apply IPPD Principles**

- 3.1 – Establish the Project’s Shared Vision
- 3.2 – Establish the Integrated Team Structure
- 3.3 – Allocate Requirements to Integrated Teams
- 3.4 – Establish Integrated Teams
- 3.5 – Ensure Collaboration among Interfacing Teams

Reduced the IPPD Addition to one goal (SG3 “Apply IPPD Principles”) and its practices.

To emphasize the IPPD Addition, the name of this process area is now “Integrated Project Management +IPPD” or “IPM +IPPD.”
IPM SP 1.6 Establish and maintain integrated teams.

The project is managed using integrated teams that reflect the organizational rules and guidelines for team structuring and forming. The project's shared vision is established prior to establishing the team structure, which may be based on the WBS. For small acquirer organizations, the whole organization and the relevant external stakeholders can be treated as an integrated team.

Integrated team members must understand the standards for work and participate according to those standards.

Structuring the integrated teams involves defining the number of teams, the type of each team, and how each team relates with the others in the structure. Forming the integrated teams involves chartering each team, assigning team members and team leaders, and providing resources to each team to accomplish its work.
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.
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.

Note relationship with

Â Quantitative Project Management ↔ GP 4.1, GP 4.2
Area Category Topics

Process Management
Support
Project Management
Engineering
Acquisition
Specific Goal | Specific Practice
--- | ---
Manage Requirements | 1.1 – Obtain an Understanding of Requirements
 | 1.2 – Obtain Commitment to Requirements
 | 1.3 – Manage Requirements Changes
 | 1.4 – Maintain Bidirectional Traceability of Requirements
 | 1.5 – Identify Inconsistencies Between Project Work and Requirements

V1.2 REQM SP 1.4 practice statement now reads, "Maintain bidirectional traceability among the requirements and work products." Project plans are no longer mentioned in this SP statement. The description of bidirectional traceability is improved as is its definition in the glossary.
<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop Customer Requirements</td>
<td>1.1 – Elicit Needs</td>
</tr>
<tr>
<td></td>
<td>1.2 – Develop the Customer Requirements</td>
</tr>
<tr>
<td>Develop Product Requirements</td>
<td>2.1 – Establish Product and Product Component Requirements</td>
</tr>
<tr>
<td></td>
<td>2.2 – Allocate Product Component Requirements</td>
</tr>
<tr>
<td></td>
<td>2.3 – Identify Interface Requirements</td>
</tr>
</tbody>
</table>

- Former base practice "Collect Stakeholder Needs" is eliminated and former advanced practice, "Elicit Needs" is kept.
- Informative text is added to the introductory notes about applying RD to maintenance projects.
### Specific Goal
Analyze and Validate Requirements

### Specific Practice

<table>
<thead>
<tr>
<th>Practice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 – Establish Operational Concepts and Scenarios</td>
<td></td>
</tr>
<tr>
<td>3.2 – Establish a Definition of Required Functionality</td>
<td></td>
</tr>
<tr>
<td>3.3 – Analyze Requirements</td>
<td></td>
</tr>
<tr>
<td>3.4 – Analyze Requirements to Achieve Balance</td>
<td></td>
</tr>
<tr>
<td>3.5 – Validate Requirements</td>
<td></td>
</tr>
</tbody>
</table>

Material from V1.1 TS SP 1.2, “Evolve Operational Concepts and Scenarios,” is incorporated into RD SP 3.1.

Material from V1.1 RD SP 3.5-1, “Validate Requirements,” and RD SP 3.5-2, “Validate Requirements with Comprehensive Methods,” were consolidated into a single practice.
### Specific Goal
Select Product-Component Solutions

### Specific Practice

1.1 – Develop Alternative Solutions and Selection Criteria
1.2 – Select Product-Component Solutions

**V1.1 TS SP 1.1-1, Develop Alternative Solutions and Selection Criteria, and TS SP 1.1-2, Develop Detailed Alternative Solutions and Selection Criteria** are consolidated into a single practice.

**Identify candidate COTS products that satisfy requirements** is a new subpractice under SP1.1.

**V1.1 TS SP 1.2 Evolve Operational Concepts and Scenarios** incorporated into RD SP 3.1, Establish Operational Concepts and Scenarios.
<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop the Design</td>
<td>2.1 – Design the Product or Product Component</td>
</tr>
<tr>
<td></td>
<td>2.2 – Establish a Technical Data Package</td>
</tr>
<tr>
<td></td>
<td>2.3 – Design Interfaces Using Criteria</td>
</tr>
<tr>
<td></td>
<td>2.4 – Perform Make, Buy, or Reuse Analyses</td>
</tr>
<tr>
<td>Implement the Product Design</td>
<td>3.1 – Implement the Design</td>
</tr>
<tr>
<td></td>
<td>3.2 – Develop Product Support Documentation</td>
</tr>
</tbody>
</table>

**Appendix**

V1.1 TS SP 2.3-1, “Establish Interface Descriptions,” and TS SP 2.3-3, “Design Interfaces Using Criteria,” are consolidated into a single practice.
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.
<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare for Verification</td>
<td>1.1 – Select Work Products for Verification</td>
</tr>
<tr>
<td></td>
<td>1.2 – Establish the Verification Environment</td>
</tr>
<tr>
<td></td>
<td>1.3 – Establish Verification Procedures and Criteria</td>
</tr>
<tr>
<td>Perform Peer Reviews</td>
<td>2.1 – Prepare for Peer Reviews</td>
</tr>
<tr>
<td></td>
<td>2.2 – Conduct Peer Reviews</td>
</tr>
<tr>
<td></td>
<td>2.3 – Analyze Peer Review Data</td>
</tr>
</tbody>
</table>

No changes to SG1, SG2, or their practices.
<table>
<thead>
<tr>
<th>Specific Goal</th>
<th>Specific Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify Selected Work Products</td>
<td>3.1 – Perform Verification</td>
</tr>
<tr>
<td></td>
<td>3.2 – Analyze Verification Results</td>
</tr>
</tbody>
</table>

The phrase "and identify corrective action" was deleted from both the title and statement of SP 3.2 "Analyze Verification Results. (Corrective action is handled in PMC SG2, "Manage Corrective Action to Closure.")
### Specific Goal

**Prepare for Validation**

1. Select Products for Validation
2. Establish the Validation Environment
3. Establish Validation Procedures and Criteria

**Validate Product or Product Components**

1. Perform Validation
2. Analyze Validation Results

---

Notes were added to VAL to stress that validation activities are performed incrementally and involve relevant stakeholders.

The phrase “and identify issues” was deleted from the statement of SP 2.2 “Analyze Validation Results” to maintain parallelism with VER SP 3.2 “Analyze Verification Results.”
Area Category Topics

Process Management
Support
Project Management
Engineering
Acquisition
Requirements Development - Goals

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

SG 2: Develop Contractual Requirements
Customer requirements are refined and elaborated to develop contractual requirements.

SG 3: Analyze and Validate Requirements
The requirements are analyzed and validated.
Supplier Agreement Development - Goals

SG 1: Prepare for Solicitation and Supplier Agreement Development

Preparation for solicitation and supplier agreement is performed.

SG 2: Select Suppliers

Suppliers are selected based on an evaluation of their ability to meet the specified requirements and established criteria.

SG 3: Establish Supplier Agreements

Supplier agreements are established and maintained.
Technical Management - Goals

SG 1: Evaluate Technical Solutions
Supplier technical solutions are evaluated to confirm that contractual requirements continue to be met.

SG 2: Perform Interface Management
Selected interfaces are managed.
Agreement Management - Context

- Manage Supplier Agreements
- Execute the Supplier Agreement
  - Revised Supplier Agreement
  - Escalated Issues Resolutions
  - Approval Reports
    - Discrepancy Reports
    - Acceptance Reports
  - Approved Payment Invoices
Acquisition Verification - Specific Goals

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.
Acquisition Validation - Goals

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

SG 2: Validate Selected Products and Product Components
Selected products and product components are validated to ensure that they are suitable for use in their intended operating environment.
The key additions to the CMF include the following:

- Acquisition Strategy
- Transition to Operations and Support
- Integrated Product and Process Development (Teaming)

There are informative materials unique to the Acquisition Constellation in every process area.
Acquisition strategy - Planning begins with the acquisition strategy that provides the framework for the acquisition project and its plans.

PP SP 1.1 Establish and maintain the acquisition strategy.

The strategy has the following attributes:

- used to focus on specifying customer and contractual requirements that express customer value in the Acquisition Requirements Development process area practices.
- is the business and technical management framework for planning, executing, and managing agreements for a project.
- relates to the objectives for the acquisition, the constraints, availability of resources and technologies, consideration of acquisition methods, potential supplier agreement types, terms and conditions, accommodation of business considerations, considerations of risk, and support for the acquired product over its lifecycle.
- reflects the entire scope of the project.
- encompasses the work to be performed by the acquirer and the work to be performed by the supplier, or in some cases multiple suppliers, for the full lifecycle of the product.
Transition to operations and support includes the approach for introducing and maintaining the readiness, sustainment, and operational capability of the product(s) delivered by the supplier.

- **PP SP 2.7** - Plan for transition to lifecycle operations and support for the product.
- **PMC SP 1.8** - Monitor the transition to operations and support.

Typically, the supplier has a role in integrating and packaging the products and prepares for the transition to operations and support, including support for business user acceptance. The acquirer monitors supplier activities.
Integrated Teams - OPD

Integrated Teams - The project is managed using integrated teams (IPM SP 1.6) that reflect the organizational rules and guidelines (OPD SP 1.7) for team structuring and forming.

OPD SP 1.7 Establish and maintain organizational rules and guidelines for the structure and operation of integrated teams.

- In an acquisition organization, integrated teams are useful not just in the acquirer’s organization, but between the acquirer and supplier, and among the acquirer, supplier and other relevant stakeholders as appropriate. Integrated teaming may be especially important in a system of systems environment.

- Operating rules and guidelines for integrated teams define and control how teams are created and how they interact to accomplish objectives.
For more information about CMMI

- http://www.sei.cmu.edu/cmmi/ (main CMMI site)

Other Web sites of interest include

- http://seir.sei.cmu.edu/seir/ (Software Engineering Information Repository)
- http://dtic.mil/ndia (annual CMMI Technology Conferences)
- http://seir.sei.cmu.edu/pars (publicly released SCAMPI appraisal summaries)
- https://bscw.sei.cmu.edu/pub/bscw.cgi/0/79783

Or, contact

SEI Customer Relations
Phone: 412 / 268-5800
Email: customer-relations@sei.cmu.edu
Objectives

- Should Flow-Down to Critical Subprocesses

High-Level Business Objectives
(e.g., balanced scorecard)

Subordinate Business Objectives
(e.g., $ buckets, % performance)

High-Level Processes

Subordinate Processes
(e.g., a vital subprocess to be statistically managed)
Process-performance baselines are built from project data.

Projects use the organization's process-performance baselines in managing quality and performance results.
What Are Process Performance Baselines (PPBs)?

PPBs are derived by analyzing the collected measures to establish a distribution and range of results that characterize the expected performance for selected processes when used on any individual project in the organization.
Hypothesis Testing and PPBs

- To determine whether a process change (improvement or degradation) has occurred by comparing the before and after baselines.

- To determine whether or not a new sample of data representing the current process behavior is consistent with previous process behavior (e.g., a historical baseline).

- To determine whether or not stratification or segmentation of the data is appropriate by comparing a baseline from each segment or strata layer to other segments or strata layers.

- To enable benchmark comparisons between projects or organizations.
Why Use Process-Performance Models (PPMs)?

The organization uses PPMs

- for estimating, analyzing, and predicting the process performance of processes in the organization's set of standard processes.
- to assess the (potential) return on investment of process improvement activities.

Projects use PPMs

- for estimating, analyzing, and predicting the performance of their defined processes.
- for selecting which processes to include in the project's defined process.
The essential ingredients of process-performance models include the following:

- The models relate the behavior or circumstance of a process or subprocess to an outcome.
- The models predict future outcomes based on possible or actual changes to factors (e.g., support "what-if" analysis).
- The models use factors from one or more subprocesses to conduct the prediction. These factors are preferably controllable so that projects may take action to influence outcomes.
- The models are statistical or probabilistic in nature rather than deterministic (e.g., the models account for statistical variation like QPM does; the models depict uncertainty in the factors and predict the uncertainty or range of values in the outcome).
Essential Ingredients of PPMs -2

- High maturity organizations generally possess a collection of process-performance models that go beyond earned value measures that predict cost and schedule variance.

- Specifically, the models predict quality and performance outcomes from factors related to one or more subprocesses involved in the development, maintenance, service, or acquisition processes performed by the projects. Example outcomes include the following:
  - schedule, effort, or cost variance
  - reliability of delivery to the customer
  - defect identification and removal rates
  - customer satisfaction
  - success indicators identified by the organization or project
  - a combination of these outcomes
Subprocesses to Be Modeled – Examples

- **Lifecycle phase subprocesses**
  Consider lifecycle phases such as the following: requirements, architecture, design, code, and test. Example subprocesses include requirements elicitation, requirements allocation, architecture selection, and design, code and test review. Example attributes of these subprocesses include cycle time, quality performance or defect density, productivity, staff attributes, and risk indices.

- **Keep in mind attributes such as downtime of parts of the project environment (e.g., computing resources, test equipment, and specialized tools and compilers).**

- **Inspection and peer review subprocesses**
  Consider subprocesses that are important to understand quality and therefore are important to your business such as preparation, meeting conduct and review. Example attributes of these subprocesses include preparation times, review rates, and defect densities.

- **Other subprocesses**
  Consider subprocesses (e.g., supplier agreement development, supplier monitoring, customer interaction, partner development) that involve responding to inquiries or actions related to key interfaces with suppliers, customers, and...
Olympic swimmers use process-performance models to evaluate their overall race time. With years of experience, they have identified several key subprocesses that dominate the overall race time:

- the time off the blocks at the start of the race
- the time it takes to complete a turn at the end of the pool

By controlling and managing these times, Olympic swimmers have attained world class performance.
Many changes were made to the CMMI models to improve quality. The major changes include:

- Name changed to CMMI for Development
- Both representations in one document
- Amplifications improved; added hardware amplifications
- Common features and advanced practices eliminated
- SS addition eliminated; ISM brought into SAM
- Guidelines for "not applicable" process areas clarified
- Overview and glossary improved
- Work environment material added to OPD and IPM
- IPPD material simplified and consolidated
- Process deployment strengthened in IPM and OPF
Interaction Between OPD and IPM

OPD

- Organization’s Set of Standard Processes
- Process Architectures
- Tailoring Guidelines
- Lifecycle Model Descriptions
- Work Environment Standards
- Organizational Assets
- Organization’s Measurement Repository
- Organization’s Process Asset Library

IPM

- Project A’s Defined Process
- Project A’s Project Plan
- Project B’s Defined Process
- Project B’s Project Plan
- Project C’s Defined Process
- Project C’s Project Plan

Project Environment