CMMI® Version 1.3 and Beyond

SSTC
May 2011

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Software Engineering Institute
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Report Documentation Page

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CMMI Adoption
## CMMI Transition Status
Reported to the SEI as of 3-31-11

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CMMI Adoption

CMMI appraisals are conducted worldwide...

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<tr>
<th>Organization Size (Employees)</th>
<th>Qty</th>
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<td>51-75</td>
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<tr>
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<tr>
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<td>35.2%</td>
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<tr>
<td>Non-USA</td>
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<td>91.8%</td>
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...in small and large organizations and projects

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<td>501-1000</td>
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<tr>
<td>&gt;1000</td>
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<tr>
<td>USA</td>
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</tr>
<tr>
<td>Non-USA</td>
<td>26</td>
<td>2.1%</td>
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...in a wide range of businesses

<table>
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<tr>
<th>Services (72.1%)</th>
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<tr>
<td>• Engineering and Management Services</td>
</tr>
<tr>
<td>• Health Services</td>
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<tr>
<td>• Other Services</td>
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</table>

<table>
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<th>Manufacturing (15.7%)</th>
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<tr>
<td>• Electronic and Electric Equip</td>
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<tr>
<td>• Transportation Equipment</td>
</tr>
<tr>
<td>• Instruments &amp; Related Products</td>
</tr>
<tr>
<td>• Industrial Machinery</td>
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<tr>
<td>• Other Mfg Industries</td>
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<table>
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<tr>
<th>Other (12.2%)</th>
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<td>• Public Administration/Defense</td>
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<tr>
<td>• Transportation, Communication, Utilities</td>
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## CMMI V1.3 Foreign Language Translation Status
Reported to the SEI as of 3-31-11

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<td>Dutch</td>
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<tr>
<td>Japanese</td>
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Number of SCAMPI V1.2, Class A Appraisals Conducted by Year by Representation* Reported as of 3-31-11
*Where Representation is reported

![Chart showing the number of SCAMPI V1.2, Class A Appraisals conducted by year from 2006 to 3/31/2011, with data for Staged and Continuous representations.]
CMMI Model Structure

Incremental Frameworks for Continuous Process Improvement

Benchmark Ratings
- Goals
- Process Areas
- Maturity Levels
- Capability Levels

CMMI-DEV
- Requirements Development
- Supplier Agreement Mgmt
- Technical Solution
- Product Integration
- Verification
- Validation

CMMI-SVC
- Capacity & Availability Management
- Incident Resolution and Prevention
- Supplier Agreement Mgmt
- Service Continuity
- Service Delivery
- Service System Development
- Service System Transition
- Strategic Service Mgmt

CMMI-ACQ
- Agreement Management
- Acquisition Requirements Development
- Acquisition Technical Mgt
- Acquisition Validation
- Acquisition Verification
- Solicitation and Supplier Agreement Development

CMMI Model Foundation (Core Process Areas)
- Requirements Management
- Project Planning
- Project Monitoring & Control
- Measurement & Analysis
- Configuration Management
- Process and Product QA

- Integrated Project Management
- Risk Management
- Decision Analysis & Resolution
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training

- Quantitative Project Mgmt

- Causal Analysis & Resolution
- Org Process Performance
- Org Performance Management

Institutionalization
- Policies
- Plans
- Resources

- Responsibilities
- Training
- Managing Configurations

- Stakeholder Involvement
- Monitoring and Control
- Objective Evaluation

- Management Visibility
- Defined Process
- Improvement Information
CMMI Product Suite, Version 1.3

Version 1.3 focused on but was not limited to the following:

- High Maturity
- Appraisal efficiency
- Consistency across constellations
- Simplify the generic practices

Version 1.3 was change request (CR) driven.
## Comparison of Models

<table>
<thead>
<tr>
<th>Measure</th>
<th>CMMI for Development</th>
<th>CMMI for Acquisition</th>
<th>CMMI for Services</th>
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Achieving Maturity Levels

GG 2 and GG 3
All ML2, ML3, ML4, and ML5 PAs

ML5 Optimizing

- Prevent defects; proactively improve; insert and deploy innovative technology

GG 2 and GG 3
All ML2, ML3, and ML4 PAs

ML4 Quantitatively Managed

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

GG 2 and GG 3
All ML2 and ML3 PAs

ML3 Defined

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

GG 2
All ML2 PAs

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

ML1 Initial

- Processes are ad hoc and chaotic
Visibility into the Team’s Performance

CMMI for Acquisition

- Acquisition Planning
- RFP Prep.
- Solicitation
- Source Selection
- Program Leadership Insight / Oversight
- System Acceptance
- Transition

CMMI for Development

- Plan
- Design
- Develop
- Integrate & Test
- Deliver

CMMI for Services

- Plan
- Design
- Test
- Maintain
- Decommission

Operational Need

Acquirer

Developer

Service Provider
Capability Profiles with Multiple Constellations

![Bar chart showing capability profiles with multiple constellations]
CMMI Appraisal Methods
Common Themes to SCAMPI Improvements

Scoping Appraisals
- Confusion caused by “focus-” and “non-focus” projects
- Minimum scoping rules for a wide range of organization types

Pain Points that Make SCAMPI Difficult to Sustain
- Need to achieve efficiency
- Expanding organizational scope
- True cost of PIIDs

Collecting Data
- Confusion caused by “direct” and “indirect” artifacts
- Data sufficiency

Attaining/Maintaining Appraisal Ratings
- Period of validity
- Multi-constellation appraisals
Appraisal Transition

Once CMMI Version 1.3 is released:

- During a period of one year, organizations may use either V1.2 or V1.3 models for their appraisals until November 30, 2011, except for uses dependent on translated versions of products that are approved in advance.
- SCAMPI A MDD V1.2 may be used until November 30, 2011.
- All appraisals will be valid for 3 years.
CMMI Training
Training Updates

The following courses will be updated for Version 1.3:

- Introduction to CMMI-DEV
- Introduction to CMMI-SVC
- ACQ Supplement for CMMI-DEV
- SVC Supplement for CMMI-DEV
- SCAMPI Team Training & SLAT
- Advanced DEV courses

New courses:

- Development Supplement for CMMI-SVC
Training Transition

The SEI will provide on-line upgrade training:

- Users make the transition by taking the upgrade course.
- Instructors make the transition by taking upgrade course.
- Lead Appraisers make the transition by taking upgrade course and specific SCAMPI method upgrade training.
V1.3 CMMI Model Updates:
Core PAs
V1.3 Changes to GGs, GPs, and GP Elaborations

Positioned generic goals, generic practices, and GP elaborations in one central location as the first section of Part 2 in all three models.

Simplified GG1 to make it more readable.

Renamed GP 2.6 to “Control Work Products.”

Added “selected work products” to the GP 2.9 statement.

Simplified the GP 3.2 statement to replace “collect work products, measures, measurement results, and improvement information” with “collect process related experiences.”

Eliminated GG4 and GG5.
Core PAs: Support Category

Configuration Management
  Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits

CM: Clarified that CM can apply to hardware, equipment, and other tangible assets.

Decision Analysis and Resolution
  Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria

DAR: Added guidance on defining the scope of the decision and communicating results.

Measurement and Analysis
  Develop and sustain a measurement capability used to support management information needs

MA: More clearly distinguished between information needs and objectives, measurement objectives, and business/project objectives. Included a table of examples (as in ACQ) for DEV and SVC.

Process and Product Quality Assurance
  Provide staff and management with objective insight into processes and associated work products

Clarified that PPQA also applies to organization level activities and work products.
Core PAs: Process Management Category

Organizational Process Definition
- Establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams

Converted goal on teaming to a single practice, which is no longer an “addition” for IPPD only.

Organizational Process Focus
- Plan, implement, and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization’s processes and process assets

Simplified SP 3.4 to replace “process-related work products, measures, and improvement information” with “process related experiences”.

Organizational Training
- Develop skills and knowledge of people so they can perform their roles effectively and efficiently

Expanded applicability to training development and delivery methods such as self study, mentoring, and online training.
Core PAs: Project and Work Management
Category -1

Integrated Project Management
Establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization’s set of standard processes.

Project Monitoring and Control
Provide an understanding of the project’s progress so that appropriate corrective actions can be taken when the project’s performance deviates significantly from the plan.

Project Planning
Establish and maintain plans that define project activities.

Simplified SP 1.7 to replace “work products, measures, and documented experiences” with “process related experiences.”
Converted goal on IPPD or Integrated Teaming to a single practice (IPPD no longer an addition).

Added guidance for monitoring risks, data management, stakeholder involvement, project progress, and milestone reviews.

Added guidance on determining project lifecycle and milestones.
Added subpractices on determining data rights and need for configuration control, and determining communication requirements and other continuing resource needs.
Core PAs: Project and Work Management
Category -2

Requirements Management

Manage requirements of the project’s products and product components and to ensure alignment between those requirements and the project’s plans and work products.

Risk Management

Identify potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

Changed the focus of SP 1.5 so that it now reads “Ensure that project plans and work products remain aligned with requirements.”

Included examples related to: architectural risks, use of industry standards to identify risks, FMEA, and consequence monetization.

Provided guidance on maintaining risk parameters through life of the project.
SAM – the Shared PA

SG 1: Establish Supplier Agreements
   SP 1.1 Determine Acquisition Type
   SP 1.2 Select Suppliers
   SP 1.3 Establish Supplier Agreements

SG 2: Satisfy Supplier Agreements
   SP 2.1 Execute the Supplier Agreement
   SP 2.2 Accept the Acquired Product
   SP 2.3 Ensure Transition of Products

Clarified the applicability of SAM practices.

Demoted SP 2.2 and SP 2.3 to subpractices of SP 2.1 and renumbered the remainder of the practices.

Revised SP 2.3 to allow its applicability to times when the product or service is delivered directly to the customer or end user from the supplier.
New Informative Material

Update selected process areas to provide interpretation of practices for organizations with respect to the following topics:

- Agile methods
- Quality attributes (i.e., non functional requirements or “ilities”)
- Allocation of product capabilities to release increments
- Product lines
- System of systems
- Architecture-centric development practices
- Technology maturation
- Customer satisfaction
If function were all that mattered, any monolithic software would do, _but other things matter_...

The important quality attributes and their characterizations are key.

- Performance
- Availability
- Modifiability
- Interoperability
- Availability
- Security
- ...

Business Drivers

Mission Drivers

Software System Drivers
What about Agility?

Agility in acquisition and development, as with operational forces, requires a highly disciplined team.

An agile team
- is trained
- is orchestrated
- has a plan
- knows when they deviate
- can predict the impact of changes
- measures and reports its own performance
- can respond quickly
V1.3 Changes to High Maturity PAs

Many of the most significant changes to CMMI models as part of Version 1.3, are the changes to the high maturity process areas (CAR, OPM, OPP, and QPM).

These process areas are core process areas, but we’ve focused on these four over the others because of their significance in this release.
High Maturity Changes for V1.3

Terminology Confusion

• Common Cause (Statistical versus Quantitative Techniques)
• Process Models and Process Modeling
• Business Objectives
• Subprocesses

Requirements implied versus explicit/ Explanations not central or consistent

• Model/ Audit Criteria/ Presentations (Healthy Ingredients)/ UCHMP

Perceptions

• Customers – ML 5 is expensive – no better than 3
• Industry – ML 5 is NOT RIGHT for every business

High Maturity in ALL constellations

• Examples are focused on Development
High Maturity Restructuring for V1.3

• Insufficient link between process improvement, business objectives, and performance
• Clarify distinction between ML4 and ML5
• Eliminate GG4 and GG5
• Make CAR more relevant for organizational benefit
Combined OID and OPM into One PA

Improvements
Progress toward achieving quality & process performance objectives

Organization

Causal Analysis and Resolution

Improvement Proposals

Organizational Performance Management

Performance issues

Measures, baselines and models
Organizational quality & process performance objectives

Quantitative Project Management

Selected outcomes

Measures, baselines and models
Updated measures, baselines and models (actual performance)

Organizational Process Performance

Root cause solutions

Causal Analysis and Resolution

Customer

Updated measures, baselines and models (actual performance)
Causal Analysis and Resolution

SG 1: Determine Causes of Selected Outcomes
   SP 1.1 Select Outcomes for Analysis
   SP 1.2 Analyze Causes

SG 2: Address Causes of Selected Outcomes
   SP 2.1 Implement Action Proposals
   SP 2.2 Evaluate the Effect of Implemented Actions
   SP 2.3 Record Causal Analysis Data

- Used “outcomes” instead of “defects and problems.”
- Added examples for service organizations and for selecting outcomes for analysis.
- Added subpractices in SP 1.1 for defining the problem, and in SP 2.2 for following up when expected results did not occur.
- Added more information about how PPMs can be used.
- Added emphasis on prevention and reducing recurrence.
Organizational Performance Management

SG 1: Manage Business Performance
SP 1.1 Maintain Business Objectives
SP 1.2 Analyze Process Performance Data
SP 1.3 Identify Potential Areas for Improvement

Renamed the PA to be Organizational Performance Management (OPM).

SG 2: Select Improvements
SP 2.1 Elicit Suggested Improvements
SP 2.2 Analyze Suggested Improvements
SP 2.3 Validate Improvements
SP 2.4 Select and Implement Improvements for Deployment

Added a new goal about managing business performance using statistical and other quantitative techniques.

SP 2.1 Elicit Suggested Improvements
SP 2.2 Analyze Suggested Improvements
SP 2.3 Validate Improvements
SP 2.4 Select and Implement Improvements for Deployment

Provided more information about how improvements can be selected for deployment.

More explicitly described and discussed using process performance models.

SG 3: Deploy Improvements
SP 3.1 Plan the Deployment
SP 3.2 Manage the Deployment
SP 3.3 Evaluate Improvement Effects

Clarified that not all improvement validations include piloting.
Organizational Process Performance

SG 1: Establish Performance Baselines and Models

- SP 1.1 Establish Quality and Process Performance Objectives
- SP 1.2 Select Processes
- SP 1.3 Establish Process Performance Measures
- SP 1.4 Analyze Process Performance and Establish Process Performance Baselines
- SP 1.5 Establish Process Performance Models

Re-ordered SPs, moving the old SP 1.3 (Establish Quality and Process Performance Objectives) to SP 1.1

Revised SP 1.4 to include process performance analysis and assessment of subprocess stability.

Revised SP 1.5 to note that under certain circumstances, projects may need to create their own process performance models.

Clarified the relationship of OPP to other high maturity process areas.
Quantitative Project Management

SG 1: Prepare for Quantitative Management
SP 1.1 Establish the Project’s Objectives
SP 1.2 Compose the Defined Process
SP 1.3 Select Subprocesses and Attributes
SP 1.4 Select Measures and Analytic Techniques

Restructured QPM so that SG1 focuses on preparation and SG2 focuses on managing the project.

SP 1.2 Compose the Defined Process

Added guidance about using process performance baselines and process performance models.

SG 2: Quantitatively Manage the Project
SP 2.1 Monitor the Performance of Selected Subprocesses
SP 2.2 Manage Project Performance
SP 2.3 Perform Root Cause Analysis

Define quantitative management in the glossary to include statistical management and use that definition for use of the terms throughout QPM.

Removal of the practice about applying statistical methods to understand variation to reduce the over-emphasis on control charts.

Added new practices about managing performance and performing root cause analysis.
CMMI for Development
CMMI for Development Model

- Development-specific PAs
- Shared PA (SAM)
- Core PAs that are present in all CMMI models.

CMMI-DEV

CMMI

CMMI-SVC

CMMI-ACQ
Development-Specific PAs

Requirements
Development

Technical
Solution

Product
Integration

Supplier
Agreement
Management
(Shared with
SVC)

Validation

Verification

CMMI Model
Framework
(CMF)

16 Project,
Organizational,
and Support
Process Areas

Phillips – April 2011
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# CMMI-DEV PAs by Maturity Level

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Process Areas</th>
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<tbody>
<tr>
<td>5 Optimizing</td>
<td>Causal Analysis and Resolution Organizational Performance Management</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td>Organizational Process Performance Quantitative Project Management</td>
</tr>
<tr>
<td>3 Defined</td>
<td>Decision Analysis and Resolution Integrated Project Management Organizational Process Definition Organizational Training Organizational Process Focus Product Integration Requirements Development Risk Management Technical Solution Validation Verification</td>
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<tr>
<td>2 Managed</td>
<td>Configuration Management Measurement and Analysis Project Monitoring and Control Project Planning Process and Product Quality Assurance Requirements Management Supplier Agreement Management</td>
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For the V1.3 release, there were no changes that affected the DEV PAs’ positioning by maturity level.
# CMMI-DEV PAs by Category

## Process Management
- Organizational Process Definition (OPD)
- Organizational Process Focus (OPF)
- Organizational Performance Management (OPM)
- Organizational Process Performance (OPP)
- Organizational Training (OT)

## Project Management
- Integrated Project Management (IPM)
- Project Monitoring and Control (PMC)
- Project Planning (PP)
- Quantitative Project Management (QPM)
- Requirements Management (REQM)
- Risk Management (RSKM)
- (+) Supplier Agreement Management (SAM)

## Support
- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Measurement and Analysis (MA)
- Process and Product Quality Assurance (PPQA)

For the V1.3 release, REQM was moved from “Engineering” to “Project Management.”

## Engineering
- Product Integration (PI)
- Requirements Development (RD)
- Technical Solution (TS)
- Validation (VAL)
- Verification (VER)
Product Integration

SG 1: Prepare for Product Integration
- SP 1.1 Establish an Integration Strategy
- SP 1.2 Establish the Product Integration Environment
- SP 1.3 Establish Product Integration Procedures and Criteria

SG 2: Ensure Interface Compatibility
- SP 2.1 Review Interface Descriptions for Completeness
- SP 2.2 Manage Interfaces

SG 3: Assemble Product Components and Deliver the Product
- SP 3.1 Confirm Readiness of Product Components for Integration
- SP 3.2 Assemble Product Components
- SP 3.3 Evaluate Assembled Product Components
- SP 3.4 Package and Deliver the Product or Product Component

Revised the purpose statement to ensure proper behavior instead of proper function, thereby more explicitly including quality attributes and required functionality.

Changed emphasis on integration sequence to an emphasis on integration strategy.

Described an integration strategy and how it relates to an integration sequence.
Requirements Development

SG 1: Develop Customer Requirements
   SP 1.1 Elicit Needs
   SP 1.2 Transform Stakeholder Needs into Customer Requirements

SG 2: Develop Product Requirements
   SP 2.1 Establish Product and Product Component Requirements
   SP 2.2 Allocate Product Component Requirements
   SP 2.3 Identify Interface Requirements

SG 3: Analyze and Validate Requirements
   SP 3.1 Establish Operational Concepts and Scenarios
   SP 3.2 Establish a Definition of Required Functionality and Quality Attributes
   SP 3.3 Analyze Requirements
   SP 3.4 Analyze Requirements to Achieve Balance
   SP 3.5 Validate Requirements

SP 1.2 revised to add that customer requirements should be prioritized based on their criticality to the customer and other stakeholders.

Broadened emphasis from “operational scenarios” to a more balanced “scenarios (operational, sustainment, and development).”

Added a focus on architectural requirements.

Because “Quality attributes” needs to be considered in addition to “functionality,” SG3 and SP 3.2 were revised.

Added informative material that requirements can be monitored through development based on their criticality to the customer.
CMMI and Other Models and Standards
CMMI Planned Elements: Multi-Model

Improving interfaces is of interest to both government and industry....
CMMI and the People CMM

CMMI (DEV, ACQ, SVC) improves the **capability** of organizations’ processes within specific domains.

The People CMM improves the **capability** of organizations’ workforces through enhanced management and human capital. *(The People CMM defines **capability** as the **level** of **knowledge**, **skills**, and **process abilities** available within each workforce competency of the organization to build its products or deliver its services.)*

![Diagram showing the relationship between People CMM, CMMI-DEV, ACQ, SVC, Workforce capability, Process capability, and Performance](image-url)
Late Discovery of System-Level Problems

Where faults are introduced
Where faults are found
The estimated nominal cost for fault removal

Requirements Engineering
System Design
Software Architectural Design
Component Software Design
Code Development
Integration Test
Unit Test
System Test
Acceptance Test

Sources:

CMMI V1.3 and Beyond
Phillips – April 2011
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Alignment of processes and improvement activities with specific business objectives
• Business challenges are complex, often not monolithic, and require the ‘right’ combination of capability, targeted to business needs.

A Multi-Model approach is well suited to this environment.
• The different CMMI constellations (DEV, ACQ, SVC) can allow Orgs to achieve ratings appropriate to the type of work they do.
• P-CMM can support the development and retention of a world-class workforce.
• Multi-model improvement will create an Enterprise “profile” of qualifications to enhance offerings to customers, based on their need, and the ability of the Org to deliver real value.
Create an Org-specific “constellation”

• Using the Org capability profile, identify an integrated set of process areas from the different models and constellations that can be used to create a unique model for the enterprise.

• As needed, create specific models for each Org that fit their specific process needs

• Within some of the Orgs, if the process diversity is great enough, it may be beneficial to create specific models for sub-organizations of the Org.
Example for Org 1

Org 1 is assumed to be:

- Primarily software development
- With:
  - Helpdesk service
  - Some procurement
Example for Org 2

Org 2 is assumed to be:

- Primarily acquisition
- With:
  - Helpdesk service
  - Some software development
Example for Org 3

Org 3 is assumed to be:

- Primarily services
- With:
  - Some software development
  - Some procurement
A Tale of Three Orgs

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Multi-Model Improvement Strategy

At the Enterprise Level

• Define Multi-Model Improvement for the Org.
• Define overall objectives.
• What does Success Look Like?
• How do we sell to our customers?
• Benefits of Multi-Model Improvement

At the Org Level

• Identify what models or process areas make sense for each Org
• Ensure alignment of PI objectives within each Org with overall Enterprise strategic objectives
  — Leverage other improvement initiatives wherever possible
• Identify areas of commonality and build on them
• Document the standard process architecture
• Revise and update PAL structure to minimize redundancy
  — Use existing resources to maximize value out of investment
• Use P-CMM practices to foster the organizational culture of change and improvement
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