CMMI: Specific Goals and Practices
CMMI Process Areas for R&D Projects
Content

Management in Projects

- Project Planning  PP
- Project Monitoring and Control  PMC
- Measurement Analysis  MA

Engineering

- Requirements Development  RD
- Requirements Management  REQM
- Technical Solution  TS
Project Management

Maturity Level 2 PA
- Project Planning (PP)
- Project Monitoring and Control (PMC)
- Measurement and Analysis (MA)

Maturity Level 3 PA
- Integrated Project Management (IPM)
- Risk Management (RSKM)
- Decision Analysis and Resolution (DAR)
**Project Planning (PP) – ML 2**

- The purpose of Project Planning is to establish and maintain plans that define project activities.
- The Project Planning process area involves the following:
  - Developing the project plan
  - Interacting with stakeholders appropriately
  - Getting commitment to the plan
  - Maintaining the plan
- Planning begins with requirements that define the product and project.
**Project Planning:**

**Specific Goals (SG) and Specific Practices (SP)**

- **SG 1 Establish Estimates**
  - SP 1.1 Estimate the Scope of the Project
  - SP 1.2 Establish Estimates of Work Product and Task Attributes
  - SP 1.3 Define Project Life Cycle
  - SP 1.4 Determine Estimates of Effort and Cost

- **SG 2 Develop a Project Plan**
  - SP 2.1 Establish the Budget and Schedule
  - SP 2.2 Identify Project Risks
  - SP 2.3 Plan for Data Management
  - SP 2.4 Plan for Project Resources
  - SP 2.5 Plan for Needed Knowledge and Skills
  - SP 2.6 Plan Stakeholder Involvement
  - SP 2.7 Establish the Project Plan

- **SG 3 Obtain Commitment to the Plan**
  - SP 3.1 Review Plans that Affect the Project
  - SP 3.2 Reconcile Work and Resource Levels
  - SP 3.3 Obtain Plan Commitment
**PP - SG 1: Establish Estimates**

**SP 1.1 Estimate the Scope of the Project**

Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.

- S 1: Develop a WBS based on the product architecture.
- S 2: Identify the work packages in sufficient detail to specify estimates of project tasks, responsibilities, and schedule.
- S 3: Identify work products (or components of work products) that will be externally acquired.
- S 4: Identify work products that will be reused.
PP - SG 1: Establish Estimates (2)

SP 1.2 Establish Estimates of Work Product and Task Attributes
   Establish and maintain estimates of the attributes of the work products and tasks.

- S 1: Determine the technical approach for the project.
- S 2: Use appropriate methods to determine the attributes of the work products and tasks that will be used to estimate the resource requirements.
- S 3: Estimate the attributes of the work products and tasks.
- S 4: Estimate, as appropriate, the labor, machinery, materials, and methods that will be required by the project.
**PP - SG 1: Establish Estimates (3)**

SP 1.3 Define Project Life Cycle
Define the project life-cycle phases upon which to scope the planning effort.

SP 1.4 Determine Estimates of Effort and Cost
Estimate the project effort and cost for the work products and tasks based on estimation rationale.

- S 1: Collect the models or historical data that will be used to transform the attributes of the work products and tasks into estimates of the labor hours and cost.
- S 2: Include supporting infrastructure needs when estimating effort and cost.
- S 3: Estimate effort and cost using models and/or historical data.
PP - SG 2: Develop a Project Plan

SP 2.1 Establish the Budget and Schedule
Establish and maintain the project’s budget and schedule.

- S 1: Identify major milestones.
- S 2: Identify schedule assumptions.
- S 3: Identify constraints.
- S 4: Identify task dependencies.
- S 5: Define the budget and schedule.
- S 6: Establish corrective action criteria.
**PP - SG 2: Develop a Project Plan (2)**

**SP 2.2 Identify Project Risks**
Identify and analyze project risks.
- **S 1:** Identify risks.
- **S 2:** Document the risks.
- **S 3:** Review and obtain agreement with relevant stakeholders on the completeness and correctness of the documented risks.
- **S 4:** Revise the risks as appropriate.

**SP 2.3 Plan for Data Management**
Plan for the management of project data.
- **S 1:** Establish requirements and procedures to ensure privacy and security of the data.
- **S 2:** Establish a mechanism to archive data and to access archived data.
- **S 3:** Determine the project data to be identified, collected, and distributed.
**PP - SG 2: Develop a Project Plan (3)**

**SP 2.4 Plan for Project Resources**
Plan for necessary resources to perform the project.
- S 1: Determine process requirements.
- S 2: Determine staffing requirements.
- S 3: Determine facilities, equipment, and component requirements.

**SP 2.5 Plan for Needed Knowledge and Skills**
Plan for knowledge and skills needed to perform the project.
- S 1: Identify the knowledge and skills needed to perform the project.
- S 2: Assess the knowledge and skills available.
- S 3: Select mechanisms for providing needed knowledge and skills.
- S 4: Incorporate selected mechanisms in the project plan.
PP - SG 2: Develop a Project Plan (4)

- SP 2.6 Plan Stakeholder Involvement
  Plan the involvement of identified stakeholders.

- SP 2.7 Establish the Project Plan
  Establish and maintain the overall project plan content.
**PP - SG 3: Obtain Commitment to the Plan**

- **SP 3.1 Review Plans that Affect the Project**
  Review all plans that affect the project to understand project commitments.

- **SP 3.2 Reconcile Work and Resource Levels**
  Reconcile the project plan to reflect available and estimated resources.

- **SP 3.3 Obtain Plan Commitment**
  Obtain commitment from relevant stakeholders responsible for performing and supporting plan execution.
  - S 1: Identify needed support and negotiate commitments with relevant stakeholders.
  - S 2: Document all organizational commitments, both full and provisional, ensuring appropriate level of signatories.
  - S 3: Review internal commitments with senior management as appropriate.
  - S 4: Review external commitments with senior management as appropriate.
  - S 5: Identify commitments on interfaces between elements in the project, and with other projects and organizational units, so they can be monitored.
<table>
<thead>
<tr>
<th>Capability Level</th>
<th>Generic Goals</th>
<th>Generic Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Achieve Specific Goals</td>
<td>GP 1.1 Perform Base Practices</td>
</tr>
<tr>
<td>2</td>
<td>Institutionalize a Managed Process</td>
<td>GP 2.1 Establish an Organizational Policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.2 Plan the Process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.3 Provide Resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.4 Assign Responsibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.5 Train People</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.6 Manage Configurations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.7 Identify and Involve Relevant Stakeholders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.8 Monitor and Control the Process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.9 Objectively Evaluate Adherence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP 2.10 Review Status with Higher Level Mgmt</td>
</tr>
</tbody>
</table>
Project Monitoring and Control (PMC) – ML 2

The purpose of Project Monitoring and Control is to 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.

The project’s documented plan is the basis for monitoring.

Corrective Actions:

• Additional mitigation actions within the current plan
• Re-planning
• Establish new agreements
Project Monitoring and Control: Specific Goals (SG) and Specific Practices (SP)

SG 1 Monitor Project against Plan
- SP 1.1 Monitor Project Planning Parameters
- SP 1.2 Monitor Commitments
- SP 1.3 Monitor Project Risks
- SP 1.4 Monitor Data Management
- SP 1.5 Monitor Stakeholder Involvement
- SP 1.6 Conduct Progress Reviews
- SP 1.7 Conduct Milestone Reviews

SG 2 Manage Corrective Actions to Closure
- SP 2.1 Analyze Issues
- SP 2.2 Take Corrective Actions
- SP 2.3 Manage Corrective Actions
Measurement and Analysis (MA) – ML 2

The purpose of Measurement and Analysis is to develop a **measurement capability** that is used to **support management information needs**.

Activities in general:

- Specify objectives of measurements and measurements itself to fulfill information needs.
- Implement collection, storage, analysis and reporting of data.
- Provide objective results for making informed decisions and corrective actions.

MA is needed in projects for:

- Objective planning and estimation.
- Tracking of actuals against the plan.
- Identifying and resolving process-related issues.
**Measurement and Analysis:**

**Specific Goals (SG) and Specific Practices (SP)**

- **SG 1 Align Measurement and Analysis Activities**
  - **SP 1.1** Establish Measurement Objectives
  - **SP 1.2** Specify Measures
  - **SP 1.3** Specify Data Collection and Storage Procedures
  - **SP 1.4** Specify Analysis Procedures

- **SG 2 Provide Measurement Results**
  - **SP 2.1** Collect Measurement Data
  - **SP 2.2** Analyze Measurement Data
  - **SP 2.3** Store Data and Results
  - **SP 2.4** Communicate Results
CMMI: Advanced Project Management

- **IPM**: Integr. Project Management
- **RSKM**: Risk Management
- **ISM**: Integrated Supplier Mgmt.
- **IT**: Integrated Teaming
- **QPM**: Quantitative Project Mgmt.

**Process Management process areas**
- Process Performance objectives, baselines, models
- Statistical Mgmt Data
- Organization’s standard processes and supporting assets
- Lessons Learned, Planning and Performance Data

**Engineering and Support process areas**
- Product architecture for structuring teams
- Project's defined process
- Coordination, commitments, issues to resolve

**IT**
- Integrated work environment and people practices
- Integrated team management for performing engineering processes
- Project performance data
- Project's defined process

**ISM**
- Monitoring data as part of supplier agreement
- Configuration management, verification, and integration data

**QPM**
- Quantitative objectives
- Subprocesses to statistically manage
- Identified risks
- Risk exposure due to unstable processes

**RSKM**
- Risk taxonomies & parameters
- Risk status
- Risk mitigation plans
- Corrective action

05.12.2005  Slide 20
Example of a CMMI Assessment for Project Management
### Status of Process Improvement

<table>
<thead>
<tr>
<th></th>
<th>Decision</th>
<th>Definition</th>
<th>Piloting</th>
<th>Release</th>
<th>In Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Supplier Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not evaluated</td>
</tr>
<tr>
<td><strong>Quality Assurance and Peer Reviews</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Configuration and Change Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key:**
- Blue: current status
Interviewees’ view

😊 The employees are motivated to improve processes.
😊 The organization-wide thought is not yet existing and needs improvement.
😊 Rollout of new processes needs to be improved.
😊 The communication between the different teams requires improvement. Expectations between product management and development are differing and require harmonization.
😊 Processes are well-defined but in practice time pressure does not allow to follow them.
😊 Employees are involved in too many projects at a time.
😊 Process does not yet allow appropriate tailoring possibilities.
Status of Project Management (I)

Project Planning:

- Roles and responsibilities for project management are defined and assigned at an early project stage on all project levels. Project management activities are planned and estimated on a high level but not in detailed work packages.

- The Project Plan (PP) is the central planning document of a project. A detailed template with annotations is provided and in use. Additionally, support tools are either provided (e.g. reporting tool) or individually defined (e.g. resource planning tool).

- Further planning instruments are the integration plan with dates for synchronizations, test plan and the risk matrix.

- Rough planning is done on product level providing a planning framework regarding milestones, costs and resources. Detailed planning is done in the different subprojects individually. The planning results of the subprojects are discussed and harmonized in a workshop with management and the core team.

- Effort estimates are based on individual estimates and expert opinions. Estimates are documented and tracked. No size estimation, no experience data is in use.
Improvement Actions for Project Management (I)

Project Planning:

- Use provided tool support in the planning phase.

- Define a suitable estimation process using size estimates and experience data and provide sufficient support (template, tool).
Status of Project Management (II)

Project Monitoring and Control:

- Project tracking is performed on a regular basis using team meetings on the different project levels with protocols, agenda and action-item-lists. Costs, deadlines and work progress as well as risks are tracked.
- Project reporting is done on a monthly basis to management and within the team using a standardized reporting tool.
- Measures for detailed project tracking are partly defined and in use. However, status of quality and functional progress are missing.
- Historic data as well as threshold values for project controlling are not available.
- Milestone decision reviews assure overall project & progress tracking.
- Risk management is well defined and in use. Risks are identified and evaluated on a regular basis. Countermeasures are defined and tracked.
**Improvement Actions for Project Management (II)**

**Project Monitoring and Control:**

- Define a comprehensive set of project measures and include them in the project reporting tool to be able to identify deviations as early as possible.

- Establish a post-project analysis phase to be able to learn from experiences.

- Provide experience data for project planning and historical project data for controlling on an organizational level.

- Define a process for resource management on organizational level to avoid resource overloads and/or bottlenecks.
Content

Management in Projects

- Project Management PP
- Project Monitoring and Control PMC
- Measurement Analysis MA

Engineering

- Requirements Development RD
- Requirements Management REQM
- Technical Solution TS
- Product Integration PI
- Verification & Validation VER, VAL
CMMI: Engineering

RD: Requirements Development
REQM: Requirements Management
TS: Technical Solution
PI: Product Integration
VER: Verification
VAL: Validation


Requirements Development (RD) – ML 3

The purpose of Requirements Development is to analyze and produce Requirements. Requirements are the basis for design.

Two types of requirements:
- Customer requirements.
- Product and product-component requirements

Activities for requirements development:
- Elicit, analyze, validate customer needs, expectations, constraints.
- Collect and coordinate stakeholder needs
- Establish product / product-component requirements consistent with customer requirements.
Customer vs. Product Requirements

- Customer Requirements = „Needs“
  - Customer Desire
  - Expressed in customer’s terms (non-technical description)

- Product Requirements = „functional / non-funct. Req.“
  - Technical parameters

- Design

- Elicit Customer, Market Needs, Stakeholder Involvement

- Analyze Requirements
  - Functional & Performance Expectations
  - Safety, security, affordability, …

- Develop Operational Concept and consider
  - Constraints and techn. Limits
  - Cost and Cost drivers
  - Time and Schedule
  - Risks
  - Regulations, laws
  - Make or Buy
Requirements Development:
Specific Practices and Goals

**SG 1 Develop Customer Requirements**
- SP 1.1 Elicit Needs
- SP 1.2 Develop the 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 Allocate 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
- SP 3.3 Analyze Requirements
- SP 3.4 Analyze Requirements to Achieve Balance
- SP 3.5 Analyze Requirements with comprehensive Methods
Definition of Features and Architecture
– ML 2 Requirements Management
– ML 3 Technical Solution

The purpose of Definition of Features and Architecture is to convert requirements into HW/SW features that can be implemented and tested.

The conversion is a decomposition into a set of interrelated components that interact.

Architecture and detailed design is derived.

All working products are kept consistent (maintained).

Requirements changes are systematically managed.
Specific Goals and Specific Practices
(SIEMENS interpretation of CMMI) (1/2)

- Institutionalization of Definition of Features and Architecture Process
  - Roles, responsibilities for activities towards Definition of Features and Architecture defined
  - Provide sufficient and appropriate skills for activities
  - Estimate, plan and track activities

- Product Architecture
  - Develop alternative architectures and document your selection (criteria)
  - Establish and maintain product architecture (preliminary and detailed design)
  - Design and maintain (internal) Interfaces
  - Establish a technical data package (development docu) and user documentation

- Derivation and Analysis of SW/HW Features
  - SW, HW, mechanics analyzed documented and validated

- Bi-directional Requirements Traceability
  - Market/customer with HW/SW features
  - HW/ SW features with architecture, design, and implementation
Specific Goals and Specific Practices (SIEMENS interpretation)

Safety and Security

- Analyzed and documented as requirements and features
- Considered in architecture and design
- With a methodical procedure implemented

Intellectual Property Rights

- Analyze third-party patents for possible infringements
- Identify potential for own patents