Estimation Concepts in the New CMM

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Objectives

- Review motivation for the new CMM
- Overview new CMM structure
- Identify use of measurement and estimation in the new CMM
- Identify changes from SW-CMM v1.1
What is a CMM?

- **Capability Maturity Model:** A reference model of mature practices in a specified discipline, used to assess a group's capability to perform that discipline
- Over 40 CMMs currently exist in the community
  - SEI CMM for Software (SW-CMM)
  - System Engineering Capability Model (EIA 731)
  - EPIC Systems Engineering CMM (SE-CMM)
  - SW Acq CMM, FAA-iCMM, System Security Engr CMM, ...
- CMMs differ by
  - Discipline (software, systems, acquisition, etc.)
  - Structure (staged versus continuous)
  - How Maturity is Defined (process improvement path)
  - How Capability is Defined (institutionalization)

CMMI, Capability Maturity Model Integration, and CMM are service marks and registered trademarks of Carnegie Mellon University

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A Time for Consolidation

- Users of multiple models benefit from a common structure
- Everyone benefits from combining the best of each model

![Diagram](Diagram.png)
The CMMI Development Team

- U.S. Air Force
- U.S. Navy
- Federal Aviation Administration
- National Security Agency
- Software Engineering Institute (SEI)
- ADP, Inc.
- Boeing
- Computer Sciences Corp.
- Ericsson Canada
- General Dynamics
- Honeywell
- Litton
- Lockheed Martin
- Northrop Grumman
- Pacific Bell
- Raytheon
- Rockwell Collins
- Thomson CSF
- TRW

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CMMI Models

Source Models
- Capability Maturity Model for Software V2, draft C (SW-CMM V2C)
- EIA Interim Standard 731, System Engineering Capability Model (SECM)
- Integrated Product Development Capability Maturity Model, draft V0.99 (IPD-CMM)

- Staged & Continuous representations
  - Volume 1: Normative
  - Volume 2: Informative (examples)
### Process Areas - Staged Representation

<table>
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<tr>
<th>Level 6</th>
<th>Symptoming</th>
<th>Concept Analysis and Resolution (PM)</th>
<th>Dev Process Technology Innovation (PM)</th>
<th>Proc Process Innovation Deployment (PM)</th>
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<td>Level 5</td>
<td>Managing</td>
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<td>Organizational Process Definition (PM)</td>
<td>Integrated Project Management (PM)</td>
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### Common Features for Institutionalization

- **Commitment to Perform** includes practices that ensure the process is established and will endure.
  - Establish an Organizational Policy

- **Ability to Perform** includes practices that establish the necessary conditions for implementing the process completely.
  - Plan the Process
    - Provide Resources
    - Assign Responsibility
    - Train people.

- **Directing Implementation** includes measurement practices that are necessary to collect and analyze data related to the process.
  - Manage Configurations
  - Monitor and Control the Process

- **Verification** includes practices that ensure compliance with the process that has been established.
  - Review Activities and Results with Management
  - Objectively Verify Adherence

(COCOMO-14: Estimation Concepts in the New CMM)
Use of Measurement in the CMMI Models

Some Changes in CMMI Level 2

- Projects still expected to estimate project attributes in planning
  - Size and complexity of work products
  - Models or historical data for converting work products and task attributes to labor hours and cost
- Projects still expected to track actuals versus estimates
- Still expected to institutionalize these practices
  - Corporate policies and procedures
  - Training (estimators, planners, managers, tools)
  - Quality audits, management reviews
- New Measurement and Analysis process area

- Technical and Measurement (PM)
- Organizational and Process (PM)
- Quality and Process (PM)
- Project Planning (PM)
- Project Monitoring and Control (PM)
- Configuration Management (PM)
- Product and Process Quality Assurance (PM)
- Supplier Agreement Management (PM)
- Data Management (PM)
- Measurement and Analysis (PM)
- Requirements Management (Eng)
Measurement & Analysis Process Area

**Purpose**
- Develop and sustain a measurement capability in support of management information needs
- Specifying the objectives of measurement and analysis - Aligned with information needs and business objectives
- Defining the measures to be used, data collection process, storage mechanisms, and the analysis, reporting, and feedback processes
- Implementing the measurement processes
- Providing objective results used in making decisions and taking corrective actions

Measurement & Analysis Goals

**Goal 1.** Align Measurement and Analysis Activities
Measurement objectives and practices are aligned with established information needs and objectives.

**Goal 2.** Provide Measurement Results
Measurement results that address information needs are available.

**Goal 3.** The process is institutionalized as a managed process.
AC 1. Establish Measurement Objectives
   • Establish and maintain measurement objectives.

AC 2. Define Measures
   • Identify and define specific measures to address the high-level measurement objectives.

   Commonly used measures include the following:
   • Estimates and actual measures of work product size (e.g., pages)
   • Estimates and actual measures of effort and cost (e.g., person hours)
   • Quality measures (e.g., number of defects found, severity of defects)
   • Work product inspection coverage
   • Test or verification coverage
   • Reliability measures (e.g., mean time to failure)

AC 3. Define Data Collection and Storage Procedures
   • Define how measures will be obtained (produced and collected) and stored.

AC 4. Define Analysis Procedures
   • Define how measures will be analyzed and reported.

AC 5. Collect Measurement Data
   • Obtain measurement data.

AC 6. Analyze Measurement Data
   • Analyze and interpret measurement data.

AC 7. Store Data and Results
   • Manage and store data, measurement definitions, and results.

AC 8. Communicate Results
   • Report results of measurement and analysis activities to appropriate end users.
Estimation at CMMI Level 3

- Project management establishes measurable thresholds for the project's parameters
  - Exceeding thresholds trigger investigation and action
    - Effort expended exceeds planned value by a predetermined percentage
    - Activities delayed a predetermined amount of time behind the plan
- Set of standard organizational processes
- Organizational Measurement and Reporting
  - Measurement data on processes and work products as they relate to the organization's set of standard processes
  - Levels 4 and 5 continue to build on this repository

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Summary

The new CMM has increased emphasis on measurement & estimation
- Strong estimation practices for planning and tracking at Level 2
- New Measurement and Analysis practices at Level 2
- Project tracking by thresholds and an organizational measurement repository at Level 3
- Builds on accurate cost, effort, and schedule estimation for continued improvement at higher maturity levels