CMMI

Lecturer: Ngo Huy Bien
Software Engineering Department
Faculty of Information Technology
VNUHCM - University of Science
Ho Chi Minh City, Vietnam
nhbien@fit.hcmus.edu.vn

Objectives

➢ To present *what* is CMMI.

➢ To present *why* use CMMI.

➢ To present *CMMI structure*.

References

1. Margaret K. Kulpa and Kent A. Johnson. Interpreting the CMMI: A Process Improvement Approach. 2003.
2. Tim Kasse. Practical Insight into CMMI. 2nd Edition. Artech House. 2008.

Why Use a Process? [1]

- A *process* is a series of steps that help to solve a problem.
- A process *helps* us do things consistently.
- Why do we want to *do things consistently*?
- Are we promoting turning the workers into *robots*?
➢ No. What focusing on process does for your organization is to *reduce redundant work*.

Why is Process *Important*?

- Why not focus on the *product*, or the *people*, or the *technology* used?
  – Give guidelines to the people responsible for doing this work on *how to do* it.
  – Rather than having people work harder, have them work *smarter*.
  – Most of those companies sold quick-fix technologies without any underlying *analysis of the problems* organizations faced.
- Is process the *only answer*?
  – No. Process is *part of the answer*.
  – Process, when *supported* by training, enough money, enough skilled people, proper tools, and management commitment, can help your organization.

Defining Process Steps

- The steps must be defined in such a way as to be *unambiguous* — that is, readily understood and capable of being followed in a consistent manner *by anyone* using the process.

- *Example*: A risk management process
  – Identify the risks
  – Analyze the risks
  – Categorize the seriousness and probability of the r
  – Mitigate the risks

- What is the *problem* with this process?
➢ It is *too general*.
➢ Each manager would have interpreted *how* to do this process differently.
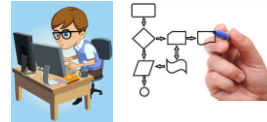
Procedures

- *Clarify how* we do the steps in your process?

- *Identify* the risk.
  - Track the problems they have in delivering products and then find trends.
  - From the list of trends, create a list of the ten most frequently occurring problems on the projects.
- *Categorize* the seriousness and probability of the risk.
  - Define risks as 1 — most critical and most likely to occur; 2 — critical but work may continue; and 3 — not critical, work may continue, fix this problem during the next phase or release.
  - Define *procedures* for how to determine what would put a risk into category 1, 2, or 3.

Procedures vs. Processes

- *Procedures* are step-by-step instructions on how to perform a task.
  - Procedures are a subset of processes.
- The process is *what* to do; the procedures are *how* to do the steps in the process.

Procedure Template

Document Number:		Date:	
		Revision Number	
Description:			
This procedure involves… The activity's primary aim is to…			
Entry Criteria/Inputs:		Exit Criteria/Outputs:	
Roles:			
Role Name: What does s/he do?			
Assets:			
Standards, reference material, deliverables, previous process descriptions…			
Summary of Tasks (list major tasks/process steps):			
Task 1			
Task 2			
Task 3			
Task 4			
Procedure Steps:			
Task 1			
• Detail Step 1			
• Detail Step 2			
• Detail Step 3			
• Detail Step 4			
Task 2			

Our Process Does Not Work!

SUCCESS REPRESENTS THE 1% OF YOUR WORK WHICH RESULTS FROM THE 99% THAT IS CALLED FAILURE.
– Soichiro Honda –

Improve Your Process

How to Improve a Process?

- *Problem*: We cannot keep up with the number of requirements changes.
- *Goal*: To improve our requirements change process.
- *Question*: How can we improve our requirements change process?
- *Metric*:
  - Number of requirements changes submitted, approved, implemented, or
  - cancelled versus the number of original requirements documented.
  - Time it takes to implement a change in requirements.
- ➢ *Solution* (What should we do?): ~~Trial and Error?~~

Solution: Use a Model

Models

- A *model* is considered a guideline of <u>best practices</u> found by studying other, highly functioning and successful organizations.
  - A model does <u>not</u> contain *the steps* needed or the *sequence of steps* needed to implement a process improvement program.
  - The model used simply says, "this is a *good thing* to do."
- *Why* use a model?
  - Without using a model as your basis of reference, you have nothing around which to *plan your improvement*, and nothing against which to *measure your results*.
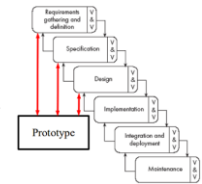
PA: Requirements Management

SG1: Managed Requirements

- SP1.1: Obtain an understanding of requirements
- SP1.2: Obtain commitment to requirements
- SP1.3: Manage requirements changes
- SP1.4: Maintain bi-directional traceability of requirements
- SP1.5: Identify inconsistencies between project work and requirements

Why Don't Create Your Own Model?

- It takes a *long time* and it costs *a lot of money*.
- Most models allow an organization to substitute *alternative practices* for those practices in the chosen model that do not fit the organization.
- *ISO* stands for International Standards Organization.
  - The *ISO 9000/9001* series generates a fundamental quality management framework.
- The *CMM* stands for the Capability Maturity Model.
  - The CMM was created by analyzing the activities of *highly functioning software organizations*; that is, those organizations that consistently delivered software systems to their customers on time, within budget, and that actually worked.

Introduction [2]

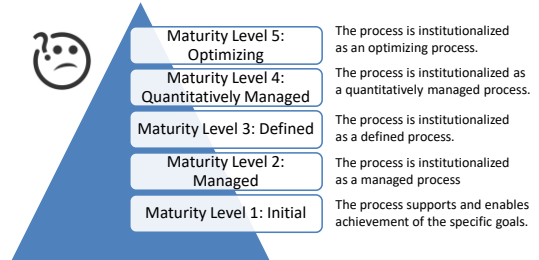|	
Systems engineering	• Covers the development of total systems, which may or may not include software.
Software engineering	• Covers the development of software systems.
Integrated product and process development	• Achieves a timely collaboration of relevant stakeholders throughout the product life cycle to better satisfy customer needs.

Capability Maturity Model Integration

CMMI is a merger of <u>process improvement models</u> for systems engineering, software engineering, integrated product development, and software acquisition.

Goals

Customer's force

Process improvement

Views

The assessment view

The process improvement view
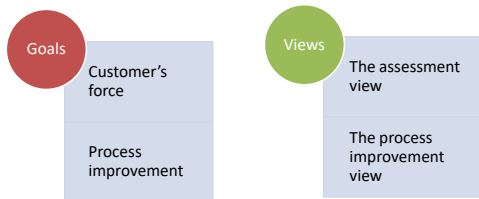
Maturity Levels [1]

A *maturity level* signifies the level of performance that can be expected from an organization.

Maturity Level 5: Optimizing — The process is institutionalized as an optimizing process.

Maturity Level 4: Quantitatively Managed — The process is institutionalized as a quantitatively managed process.

Maturity Level 3: Defined — The process is institutionalized as a defined process.

Maturity Level 2: Managed — The process is institutionalized as a managed process

Maturity Level 1: Initial — The process supports and enables achievement of the specific goals.

CMMI Level 2 Appraisal

CMMI Level 2

PA: Requirements Management [1]

SG1: Managed Requirements

SP1.1: Obtain an understanding of requirements

SP1.2: Obtain commitment to requirements

SP1.3: Manage requirements changes

SP1.4: Maintain bi-directional traceability of requirements

SP1.5: Identify inconsistencies between project work and requirements

PA: Project Planning

SG1: Establish estimates

SP1.1: Estimate the scope of the project

SP1.2: Establish estimates of work product and task attributes

SP1.3: Define project life cycle

SP1.4: Determine estimates of effort and cost

PA: Project Planning

SG2: Develop a project plan

SP2.1: Establish the budget and schedule

SP2.2: Identify project risks

SP2.3: Plan for data management

SP2.4: Plan for project resources

SP2.5: Plan for needed knowledge and skills

SP2.6: Plan stakeholder involvement

SP2.7: Establish the project plan

PA: Project Planning

SG3: Obtain commitment to the plan
- SP3.1: Review plans that affect the project
- SP3.2: Reconcile work and resource levels
- SP3.3: Obtain plan commitment

PA: Process and Product Quality Assurance

SG1: Objectively evaluate processes and work products
- SP1.1: Objectively evaluate processes
- SP1.2: Objectively evaluate work products and services

SG2: Provide objective insight
- SP2.1: Communicate and ensure resolution of noncompliance issues
- SP2.2: Establish records

PA: Configuration Management

SG1: Establish baselines
- SP1.1: Identify configuration items
- SP1.2: Establish a configuration management system
- SP1.3: Create or release baselines

SG2: Track and control changes
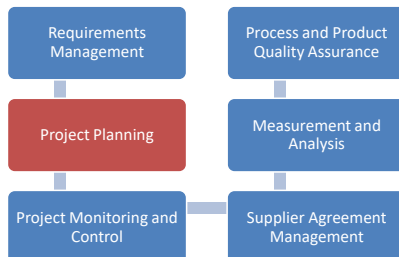- SP2.1: Track change requests
- SP2.2: Control configuration items

SG3: Establish integrity
- SP3.1: Establish configuration management records
- SP3.2: Perform configuration audits

Process Areas (PAs)

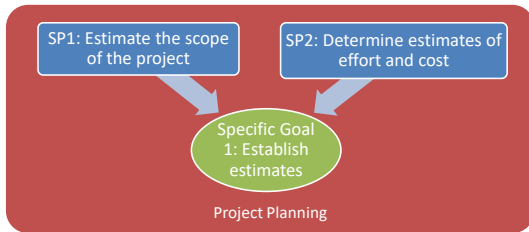A *process area* is a group of practices performed collectively to achieve a specific goal.

- Requirements Management
- Process and Product Quality Assurance
- Project Planning
- Measurement and Analysis
- Project Monitoring and Control
- Supplier Agreement Management

Process Area Groups

Group	Areas
Process Management	• Organizational Process Focus, Definition, Training...
Project Management	• Project Planning, Monitoring, Control...
Engineering	• Requirements Management, Development, Technical Solution, Product Integration...
Support	• Configuration Management, Process and Product Quality Assurance...

Specific Goals

- *Specific goals* (SG): activities that relate to the specific PA under study.
- *Practices* are activities that must be performed to satisfy the goals for each PA. Each practice relates to only *one goal*.

SP1: Estimate the scope of the project

SP2: Determine estimates of effort and cost

Specific Goal 1: Establish estimates

Project Planning

Generic Goals

- *Generic goals* (GG): goals that are common to multiple PAs throughout the model; they help determine whether the PA has been institutionalized.
- *Generic practices* (GP): are associated with the generic goals for institutionalization.

GP1: Plan the process

GP2: Provide resources

GP3: Assign responsibility

Generic Goal 2: Institutionalize a Managed Process

Generic Practices Functions (I)

- *Commitment to Perform (CO)* is shown through
  - senior management commitment and
  - written policies.

- *Ability to Perform (AB)* is shown through
  - training personnel in their duties,
  - providing adequate resources and funding,
  - assigning responsibility,
  - planning the process, and
  - establishing a tailored and defined process.

Generic Practices Functions (II)

- *Directing Implementation (DI)* is demonstrated by
  - managing configurations,
  - identifying and involving relevant stakeholders,
  - monitoring and controlling the process, and
  - collecting improvement information.

- *Verifying Implementation (VE)* is demonstrated via
  - objectively evaluating adherence (both process and product adherence to organizational policies, procedures, and standards) and by
  - reviewing status with higher-level management.

Common Features

Common features group together the generic practices within a PA, according to the function that the practices fulfill.

Commitment to Perform (CO)

Ability to Perform (AB)

Directing Implementation (DI)

Verifying Implementation (VE)
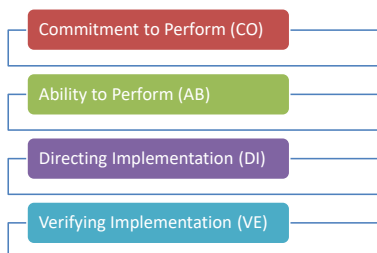
CMMI Other Terms

- *Typical Work Products*: each process area gives examples of typical
  - documents,
  - deliverables, or
  - other outputs produced within the process area.

- *Sub-practices*: lower-level practices that provide more information about the practice.
  - For example, the Practice may be to write a project plan.
  - The sub-practice would offer information as to what should go into the project plan itself.

CMMI Other Terms (cont.)

- *Discipline Amplifications*: simple guidance offered to direct the user as to which discipline is more relevant for specific practices, or to offer some guidance in applying the PA to the discipline.
  - The disciplines are Systems Engineering, Software Engineering, Supplier Sourcing, and Integrated Product and Process Development (IPPD).

- *Elaborations*: more information and examples concerning generic practices.

- …

The Five-Level Model [2]

Level	Process Characteristics	Process Areas	
5 Optimizing	Focus is on quantitative continuous process improvement	Causal Analysis and Resolution Organizational Innovation and Deployment	
4 Quantitatively Managed	Process is measured and controlled	Quantitative Project Management Organizational Process Performance	
3 Defined	Process is characterized for the organization and is proactive	Requirements Development Technical Solution Product Integration Verification Validation Decision Analysis & Resolution	Organizational Process Focus Organization Process Definition Organizational Training Integrated Project Management Risk Management
2 Managed	Process is characterized for projects and is often reactive	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management	Product and Process Quality Assurance Configuration Management Measurement & Analysis
1 Initial	Process is unpredictable, poorly controlled, and reactive		

Maturity Level/Key Challenges

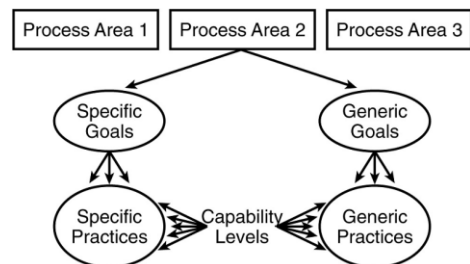| Level	Characteristic	Key Challenges	Result
5 Optimizing	Improvement fed back into process	Still human intensive process Maintain organization at optimizing level	Productivity & Quality
4 Managed	(quantitative) Measured process	Changing technology Problem analysis Problem prevention	
3 Defined	(qualitative) Process defined and institutionalized	Process measurement Process analysis Quantitative quality plans	
2 Repeatable	(intuitive) Process dependent on individuals	Training Technical practices • reviews, testing Process focus • standards, process groups	
1 Initial	(ad hoc/chaotic)	Project Management Project Planning Configuration management Software quality assurance	Risk

Staged Representation
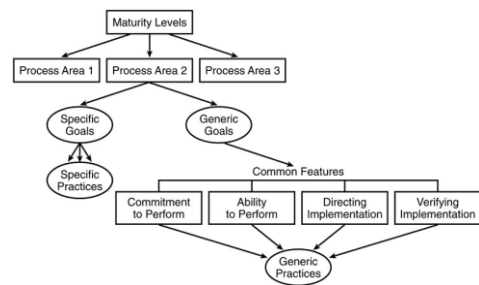
Capability Levels

Capability levels focus on maturing the organization's ability to perform, control, and improve its performance in a process area.

- Capability Level 5: Optimizing
- Capability Level 4: Quantitatively Managed
- Capability Level 3: Defined
- Capability Level 2: Managed
- Capability Level 1: Performed
- Capability Level 0: Incomplete
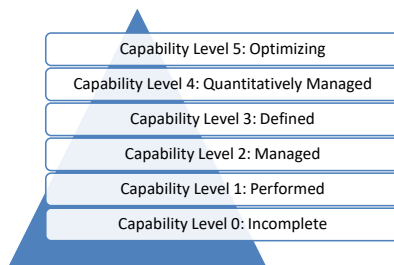
Continuous Representation

Appraisals using the CMMI

ISO 21500

- ISO 21500 is the standard that governs *project management*.
- This standard builds on a *number of existing standards*, and is applicable to organizations of all sizes and natures.
- *Benefits* of the ISO 21500 Standard for project management include:
  – a higher level of quality management
  – encouraging transfer of knowledge between projects and organizations for improved project delivery
  – Facilitating efficient tendering processes through the use of consistent project management terminology
  – enabling the flexibility of project management employees and their ability to work on international projects
  – providing a framework as the basis for certification programs
  – providing universal project management principles and processes

Thank You for Your Time