



# Introduction to CMMI

## Version 1.2

Nov 29-30, 2010

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## Method of Instructions

- Most instructions will be lecture type. Recording is not allowed.
- Students can interrupt and ask questions anytime, but must not talk to each other or answer cell phone while in the classroom.
- Students are expected to participate in the class by answering questions.
- Students should be prepared for the quiz at the end of class.

## Audience

- Product developers
- Process implementers
- Anyone interested in learning about CMMI

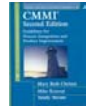
No process improvement experience or knowledge of process improvement models is assumed.

## Schedule

Time	DAY1	Time	DAY2
8:30-9:00 AM	Registration Quality and Process Process Improvement Software Life Cycle Process	8:30-9:00 AM	Registration Process Areas Specific Goals and Practices Generic Goals and Practices
	Lunch		Lunch
PM	CMMI Overview Model Representation Model Structure	PM	Achieving Maturity Levels Achieving Capability Levels SCAMPI

## References

- Technical Report, *CMMI for Development, v1.2* (CMU/SEI-2006-TR-008; ESC-TR-2006-08) is available on the SEI web site:  
<http://www.sei.cmu.edu/cmmi/06tr008.pdf>
- the Addison-Wesley book, *CMMI: Guidelines for Process Integration and Product Improvement, Second Edition*

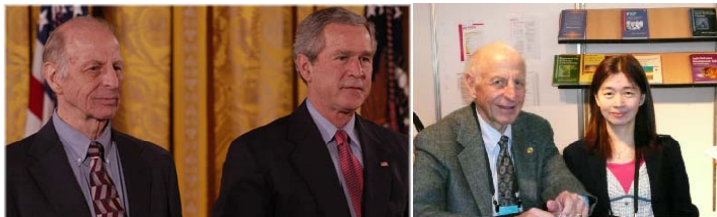


## Module 1

# Quality and Process Improvement

## Why are we here?

- The quality of a software system is governed by the quality of the process used to develop and evolve it. [Watts Humphrey]



## Quality Importance

Why do we need to manage projects toward good software quality?

### Reasons for Project Trouble

- Poor Planning – Unrealistic Costs/Schedule
- Ill Defined Charter Or Contract
- Unstable Problem Definition
- Poor Communications
- Poor Requirements Understanding
- Inexperienced Project Management
- Unrealistic Expectations
- Ineffective/Non-existent Change Control
- Political Pressure
- Shortage Of Skilled People
- ...



# Quality



- Conformance to requirements [Crosby]



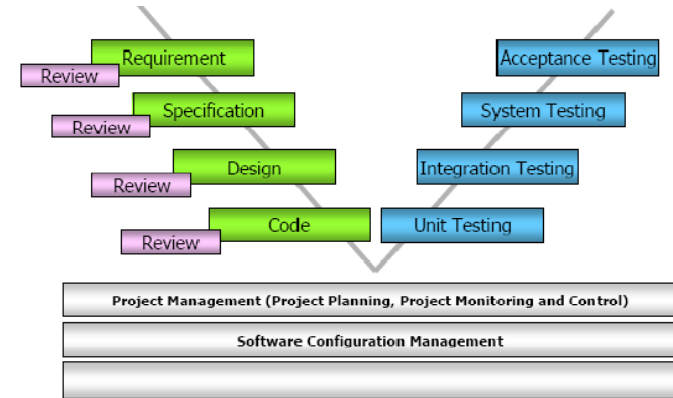
- Fitness for use [Juran]

- [IEEE Std. 610-1990]

(1) *The degree to which a system, component, or process meets specified requirements.*

(2) *The degree to which a system, component, or process meets customer or user needs or expectations.*

# QA & QC



## Quality Management



QC

QA

(ISO 9000)

QC is a part of quality management focused on **fulfilling quality requirements**

(CMMI = ISO 8402 -1994)

QC is the operational techniques and activities that are used to **fulfill requirements for quality**

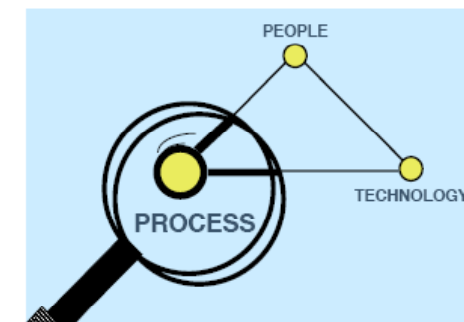
(ISO 9000)

QA is a part of quality management focused on **providing confidence that quality requirements will be fulfilled**

(CMMI)

QA is a planned and systematic means for **assuring management that the defined standards, practices, procedures, and methods of process are applied**

# Quality Leverage Points



Process, people, and technology are the major determinants of product cost, schedule, and *quality*.

## Process

- a sequence of steps performed for a given purpose e.g. Software Process[IEEE]
  - It is **how** you perform your work.
- A process is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/ or people. [SEI]



## Process Management Premise

- The quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it.
- This premise implies a focus on processes as well as on products:
  - This is a long-established premise in manufacturing.
  - Belief in this premise is visible worldwide in quality movements in manufacturing and service industries (e.g., ISO standards).
  - This premise is also applicable to development.

## Immature Process



- Ad hoc; and improvised by practitioners and their management
- Performance highly depends on current practitioners.
- Understanding of current status of a project is limited.
- Likely problems of cost and schedule
- Quality difficult to predict and sacrifice to cost, schedule
- Use of new technology is risky.
- Immature processes result in fighting fires:
  - no time to improve, rather practitioners are constantly reacting.
  - Firefighters get burned or become heroes.

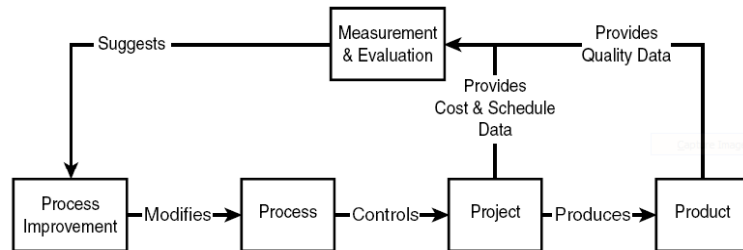
## Improved Process



- Processes are described in the way work is actually done.
- They are supported by management and others.
- They are defined, documented, and continuously improved.
- They are well controlled—process fidelity is evaluated and enforced.
- Use of product and process measurement.
- Technology is introduced in a disciplined manner.

## Software Process Improvement - SPI

- Actions taken to *change* an organization's software process so that they meet the organization's business needs and help it to achieve its *business goals* more effectively. [ISO/IEC Std TR 155-4-9:1998]



## Process Model

- Structured collection of practices that describes the characteristics of effective processes.
- Practices included are those proven by experience to be effective – best practices.
- The model is not the process, e.g. CMMI®
- **Process** - activities that can be recognized as implementations of practices in a model. These activities can be mapped to one or more practices in **process areas** to allow a model to be useful for process improvement and process appraisal. [CMMI Glossary]

## Note

- A CMMI model is **not** a process.
- A CMMI model describes the *characteristics* of effective processes.

**“All models are wrong, but some are useful.”**

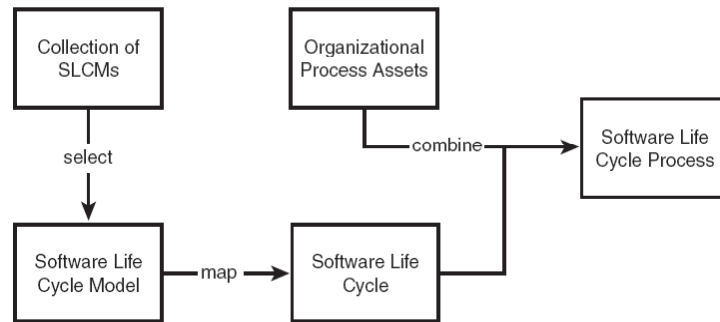
George Box  
(Quality and Statistics Engineer)



## Software Life Cycle Process - SLCP

- IEEE Std. 1074 — Standard for Developing Software Life Cycle Processes
- It describes the process by which a software process architect develops SLCP:
  1. selects a SLCM
  2. maps activities onto the SLCM
  3. combines these with *organizational process assets* to create the SLCP for an individual project

## Developing a Software Life Cycle Process



## Selecting the SLCM

- **Software Life Cycle Model (SLCM):** The framework, selected by each organization, on which to map the activities. [IEEE Std.1074]
- SLCM: Waterfall, Evolutionary, Incremental
- the development organization is free to select the latest process model best suited to its purpose.
- selecting SLCMs on a project-by-project basis

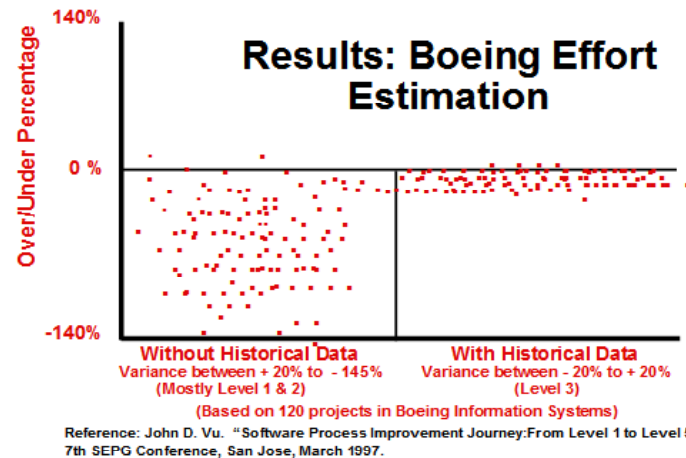
## Mapping onto the SLCM

- **Mapping** means establishing a sequence of the activities specified in IEEE/EIA 12207.0 according to a selected SLCM
- By mapping, the *software life cycle* (SLC) is created.
- **Software Life Cycle (SLC):** The project-specific sequence of Activities that is created by mapping the Activities of IEEE/EIA 12207.0 onto a selected software life cycle model (SLCM).

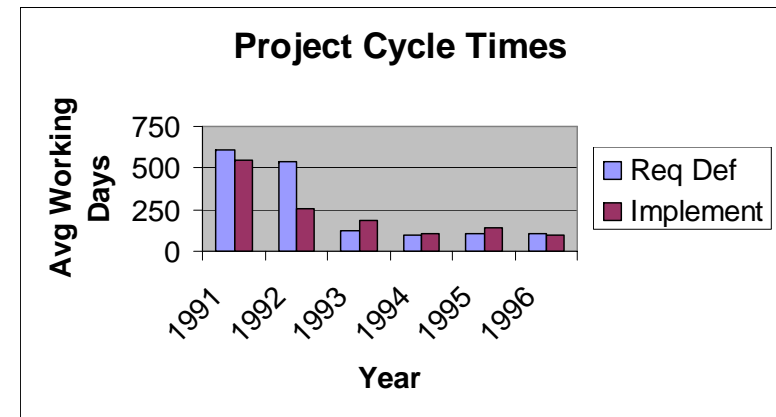
## Establishing the SLCP

- Once the SLC has been developed, the available OPAs are applied to the SLC to establish the SLCP.
- OPAs — Artifacts that help define an organization's software project environment, e.g. policies, standards, procedures, metrics, tools, methodologies, and history of previous projects.
- For each activity in the SLC, its output information must be mapped to *deliverables* reconciled with the OPAs.

## Improved Schedule & Budget Predictability



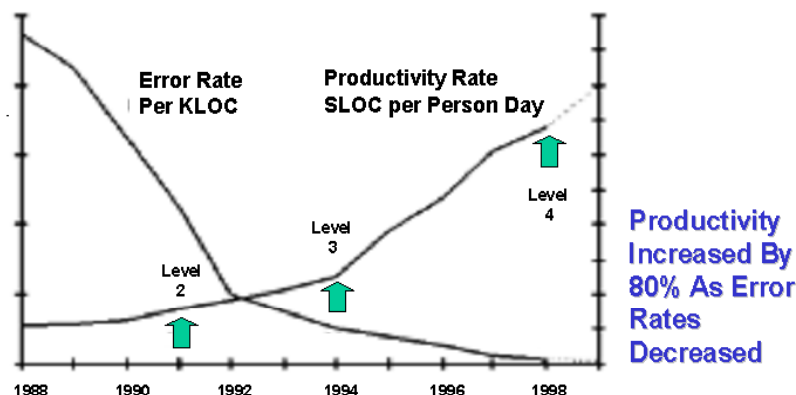
## Improved Cycle Time



Source: Software Engineering Div., Hill AFB, Published in Crosstalk May 1999

## Increased Productivity and Quality

### Productivity Rate and Quality Performance \* For Software Programs



## Principles of Process Change

- Improvement means change
- Sponsored by Senior Management
- Focus on fixing the process, not on blaming people
- Understand current process first
- Improvement is a continuous process
- Improvement requires constancy of investments, rewards, and incentives
- Improvement must be measured and periodically reinforced

## The Bottom Line



- Process improvement should be done to help the business—not for its own sake.
- Improvement means different things to different organizations:
  - What are your business goals?
  - How do you measure progress?
- Improvement is a long-term, strategic effort:
  - What is the expected impact on the bottom line?
  - How will impact be measured?

## Module 2

### Overview

## SEI



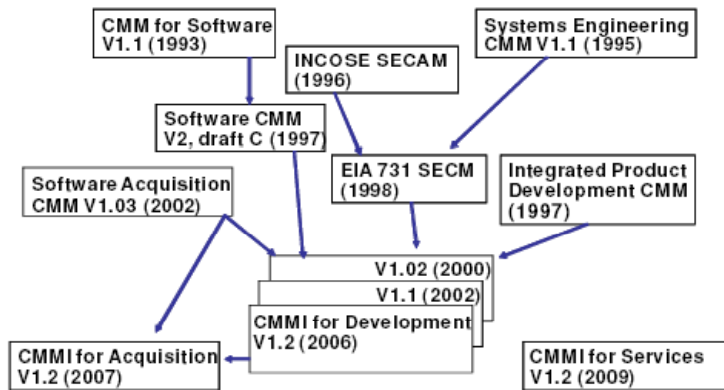
- The SEI was founded in 1984 to advance the state of the practice of software engineering and to serve as a national resource in software engineering and technology. The SEI is a federally funded research and development center sponsored by the United States Department of Defense and operated by Carnegie Mellon University in Pittsburgh. Although the SEI's primary customers are defense contractors, any organization is welcome to take advantage of the many available resources on their Web site:  
<http://www.sei.cmu.edu/cmmi>.

## SEI Trademarks and Service Marks

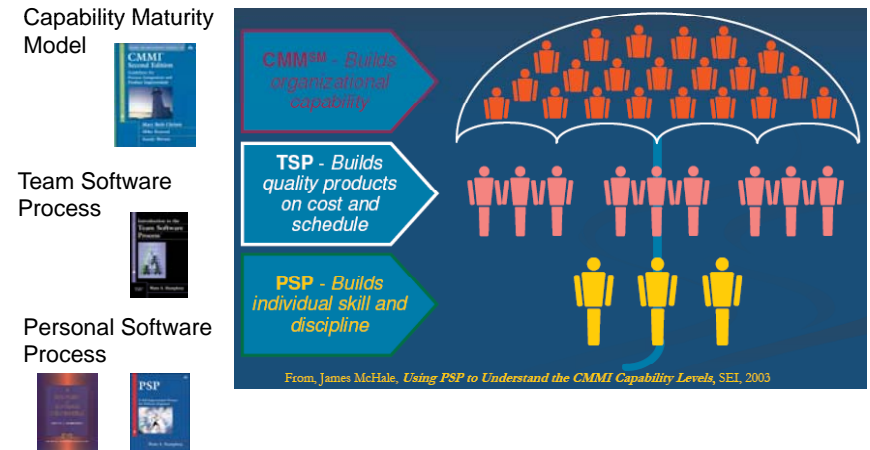
- <sup>SM</sup> CMM Integration, IDEAL, SCAMPI are service marks of Carnegie Mellon University
- <sup>®</sup> Capability Maturity Model, CMM, CMMI are registered in the US Patent & Trademark Office by Carnegie Mellon University
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# Capability Maturity Model

## History of CMMs



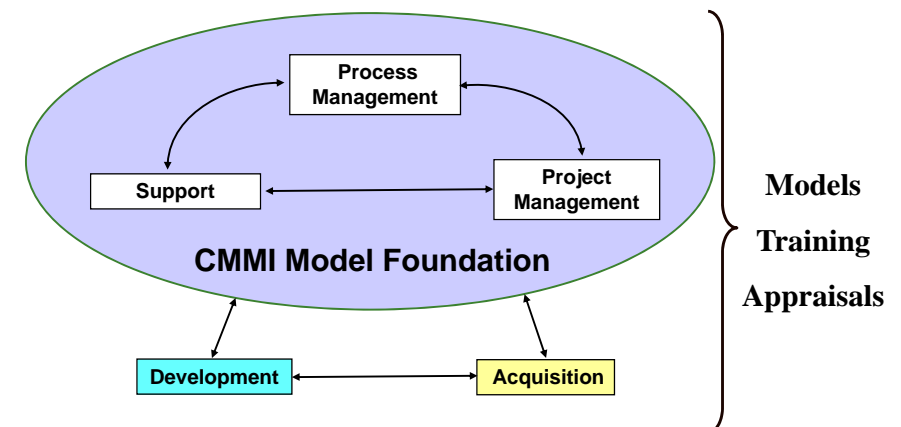
# PSP, TSP, CMM



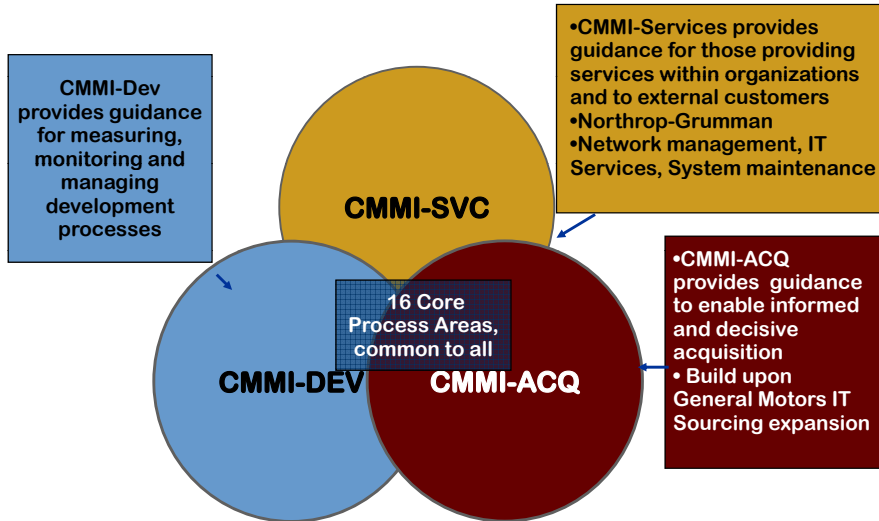
# The CMMI Framework

- The **CMMI Framework** is the structure that organizes the components used in generating the **CMMI Product Suite**:- models, training materials, and appraisal methods.
- A **constellation** is the subset of the CMMI Product Suite relevant to improvement in a particular area of interest. Currently, there are several constellations: *Development, Acquisition, Services*

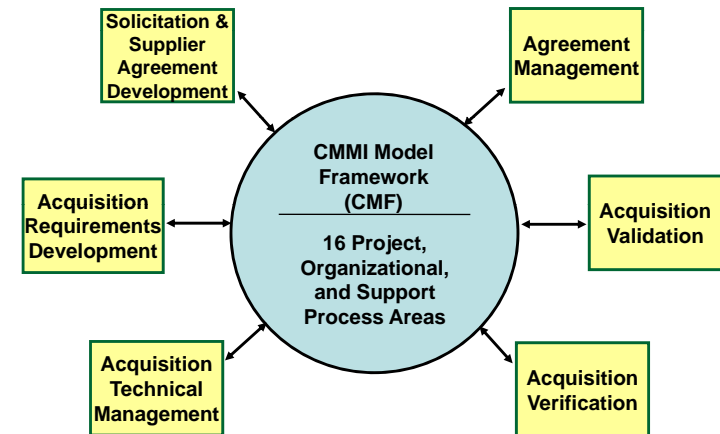
# CMMI Framework Content



### 3 Complementary “Constellations”

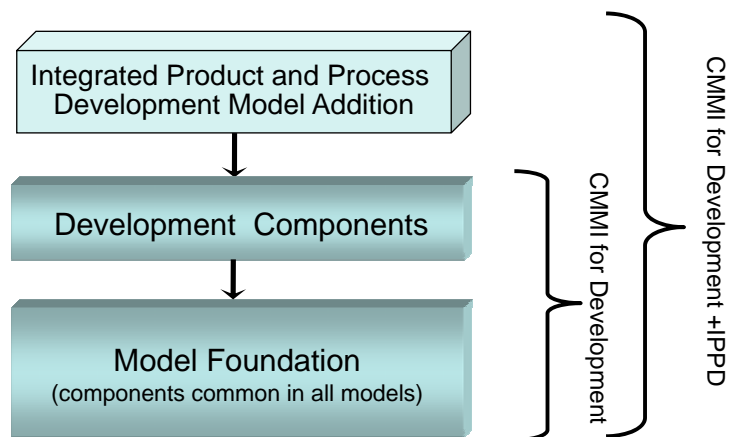


### CMMI-ACQ Acquisition PAs



\*based on initial CMMI-ACQ model developed by General Motors/SEI

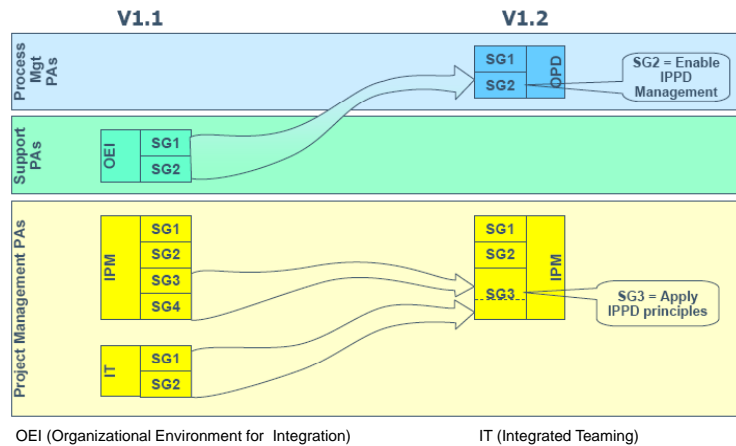
### Development Constellation Models



### Additions

- Additions are model components that extend the scope of a model or emphasizes a particular aspect of its use.
- In CMMI-DEV, there is one group of additions that all apply to IPPD.
- Addition example: Project Planning SP 3.1  
**IPPD Addition**  
*When integrated teams are formed, their integrated work plans are among the plans to review.*

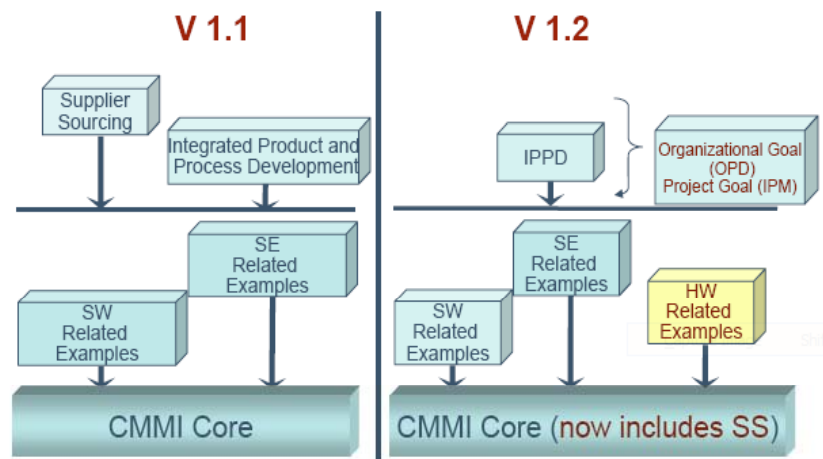
## Integrated Product and Process Development (IPPD) Changes



## Change Highlights of CMMI V1.2

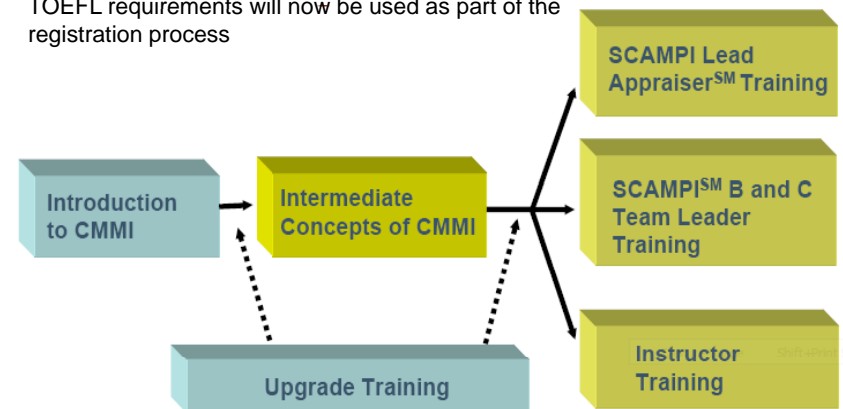
- Change model name to *CMMI for Development*
- Add hardware amplifications
- Eliminate Supplier Sourcing (SS) i.e. integrated ISM with SAM
- Eliminate common features heading and advanced practices
- Add work environment SPs to OPD, IPM
- 22 PAs: ISM, OEI, IT gone
- Glossary improved

## Model Combinations



## SEI Training for CMMI

CMMI v1.2 training begins 2007  
TOEFL requirements will now be used as part of the registration process



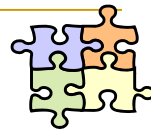
## Module 3

# Model Contents

## Representations

- **Continuous**
  - Based on corporate requirements
  - Greater ability to customize process improvement
  - Focus on process area individually
  - Greater visibilities of process area capabilities
  - Easier migration from EIA/IS 731
  - Easier comparison to ISO/IEC 15504
- **Staged**
  - Proven model- provides a sequence of process improvement events thru a predetermined path
  - Use Maturity Levels to compare against other organizations
  - Easy migration from SW-CMM
  - Provides a simple maturity rating based on results of an appraisal

## Process Area



- A cluster of related practices in an area that, when implemented collectively, satisfy a set of goals considered important for making significant improvement in that area.
- A Process Area (PA) is not a process description.
- 22 PAs are common to both continuous and staged representations (v1.2).
- PAs are organized by
  - maturity level (staged)
  - process area category (continuous): Engineering, Project Management, Process Management, Support.

## Process Areas by Category

Category	Process Areas
<b>Process Management</b>	Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Organizational Process Performance Organizational Innovation and Deployment
<b>Project Management</b>	Project Planning Project Monitoring and Control Supplier Agreement Management Integrated Project Management +IPPD Risk Management Quantitative Project Management
<b>Engineering</b>	Requirements Management Requirements Development Technical Solution Product Integration Verification Validation
<b>Support</b>	Configuration Management Process and Product Quality Assurance Measurement and Analysis Decision Analysis and Resolution Causal Analysis and Resolution

## Process Areas by Maturity Level

Level	Focus	Process Areas	Quality Productivity
5 Optimizing	<i>Continuous Process Improvement</i>	Organizational Innovation and Deployment Causal Analysis and Resolution	
4 Quantitatively Managed	<i>Quantitative Management</i>	Organizational Process Performance Quantitative Project Management	
3 Defined	<i>Process Standardization</i>	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution	
2 Managed	<i>Basic Project Management</i>	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management	
1 Initial			

## Process Management PAs

- Contain the overarching practices related to implementing a successful and mature process improvement program
- Provide capability to document and share best practices, process assets, and learning
- Provide advanced capability to achieve quantitative objectives for quality and process performance

Process Area	Description
Organizational Process Focus (OPF)	Helps organization establish and maintain understanding of its processes and identify, plan, coordinate, and implement improvement
Organizational Process Definition (OPD)	Establishes and maintains organization's set of standard processes and supporting assets
Organizational Training (OT)	Identifies strategic training needs of organization, as well as tactical training needs common across projects and support groups
Organizational Process Performance (OPP)	Derives common, quantitative objectives for quality and process performance from organization's business objectives
Organizational Innovation and Deployment (OID)	Selects and deploys proposed incremental and innovative improvements to improve organization's ability to meet quality and process performance objectives

## Project Management PAs

- Cover the project management activities related to planning, monitoring, and controlling a project
- Provide mechanisms to establish, maintain, and monitor commitments to customers and from suppliers
- Provide mechanisms to establish and maintain collaborative teaming environment
- Provide common method to proactively and quantitatively manage project

Process Area	Description
Project Planning (PP)	Develops and maintains project plan, involves stakeholders appropriately, obtains commitment to the plan
Project Monitoring and Control (PMC)	Monitors activities and takes corrective action, including re-planning
Integrated Project Management (IPM)	Adapts organization's processes to project, and establishes project's shared vision
Risk Management (RSKM)	Develops and implements proactive strategy to continuously identify, assess, prioritize, and handle program risks
Quantitative Project Management (QPM)	Collects project process and product metrics, and analyzes results to identify process improvement opportunities
Supplier Agreement Management (SAM)	Manages the acquisition of products from suppliers for which there exists a formal agreement

## Engineering PAs

- Support product development life cycle activities, from initial requirements development to transition to operational use

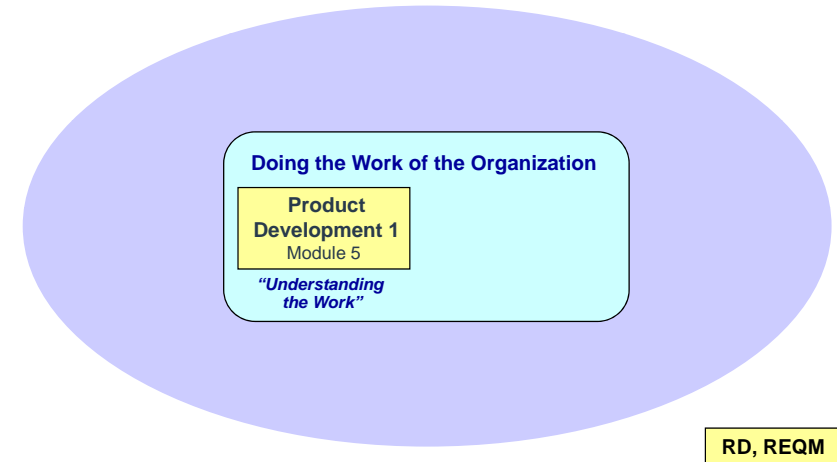
Process Area	Description
Requirements Development (RD)	Collects and harmonizes stakeholder needs to plan, develop, integrate, field, and sustain products, and translates needs into product requirements
Requirements Management (RM)	Ensures that agreed-to requirements are understood and managed
Technical Solution (TS)	Converts requirements into product architecture, design, and development
Product Integration (SI)	Combines product components and ensures interfaces
Verification (VER)	Ensures product meets specifications ("the thing is built right"), and that deficiencies are tracked, re-worked, and re-tested
Validation (VAL)	Ensures product fills intended use when placed in intended environment ("we built the right thing")

# Support PAs

- Provide essential processes to support product development and maintenance
- Support establishment and maintenance of a work environment that facilitates and stimulates integration and manages people to enable and reward integrative behaviors
- Provide support functions used by all process areas during product development

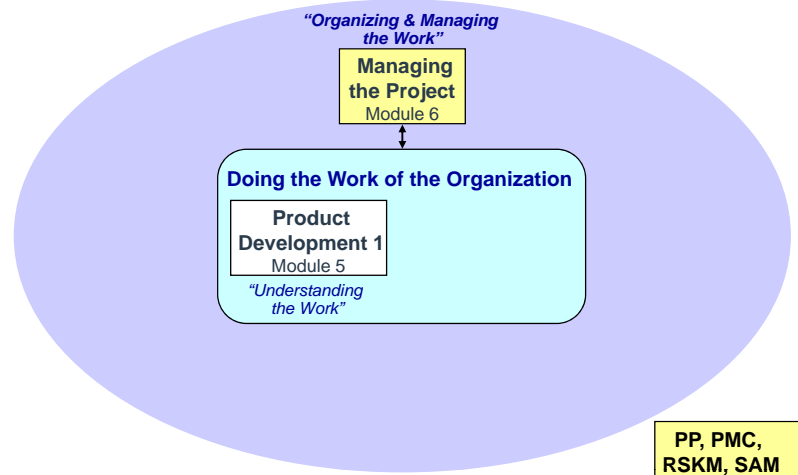
Process Area	Description
Measurement and Analysis (MA)	Establishes metrics program to provide objective results that can be used in making informed decisions, and in taking appropriate corrective actions
Configuration Management (CM)	Establishes and maintains integrity of work products
Process and Product Quality Assurance (PPQA)	Provides practices for objectively evaluating processes, products, and services
Decision Analysis and Resolution (DAR)	Provides structured decision-making process that ensures alternatives are compared against established criteria, and best alternative is selected
Causal Analysis and Resolution (CAR)	Identifies causes of defects and other problems, and takes action to prevent them from occurring in the future

# Understanding the Work



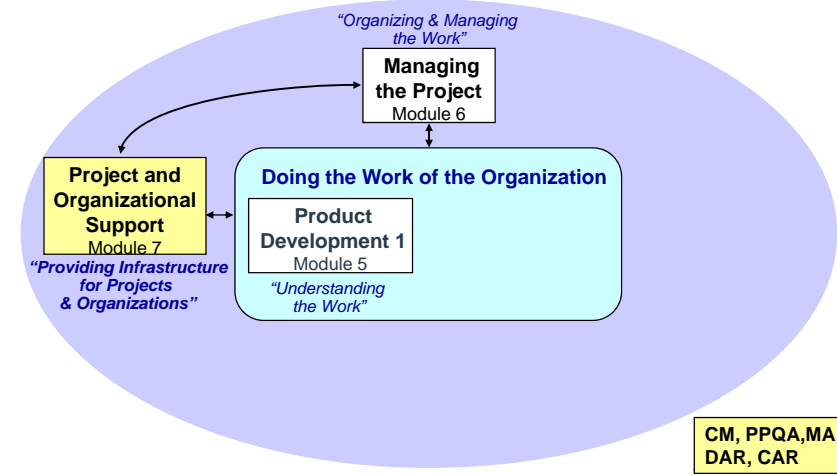
RD, REQM

# Organizing and Managing the Work



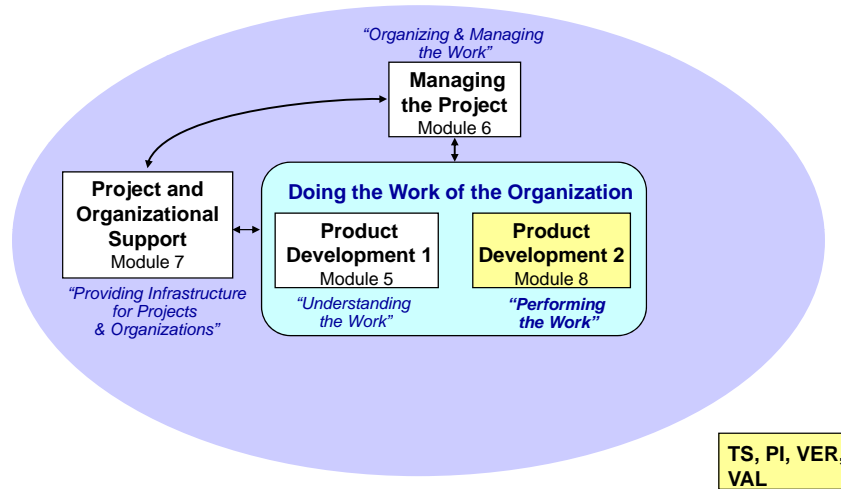
PP, PMC, RSKM, SAM

# Providing Infrastructure

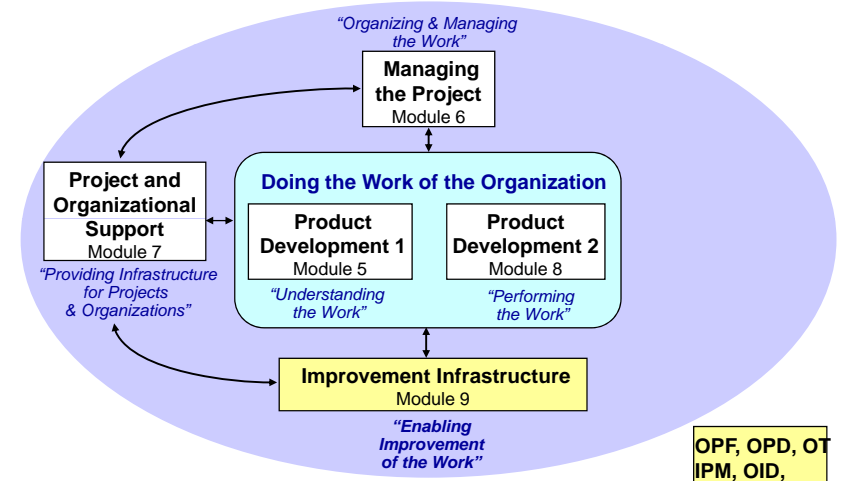


CM, PPQA, MA, DAR, CAR

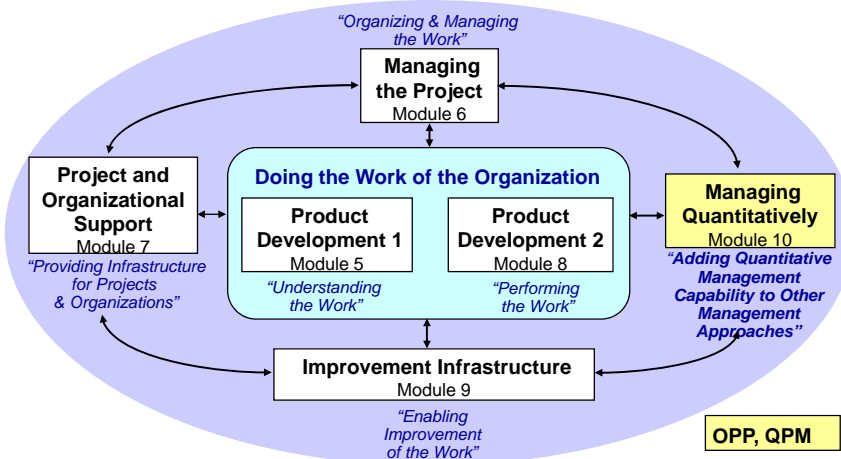
# Performing the Work



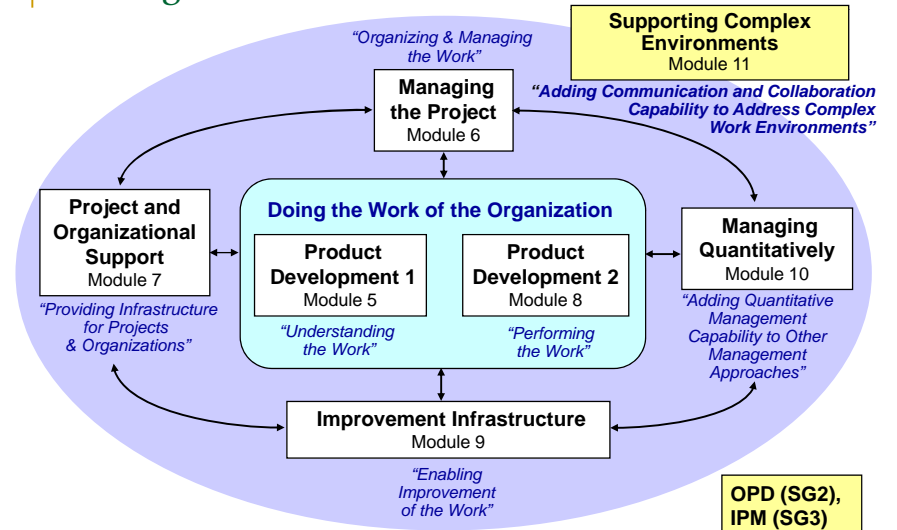
# Enabling Improvement



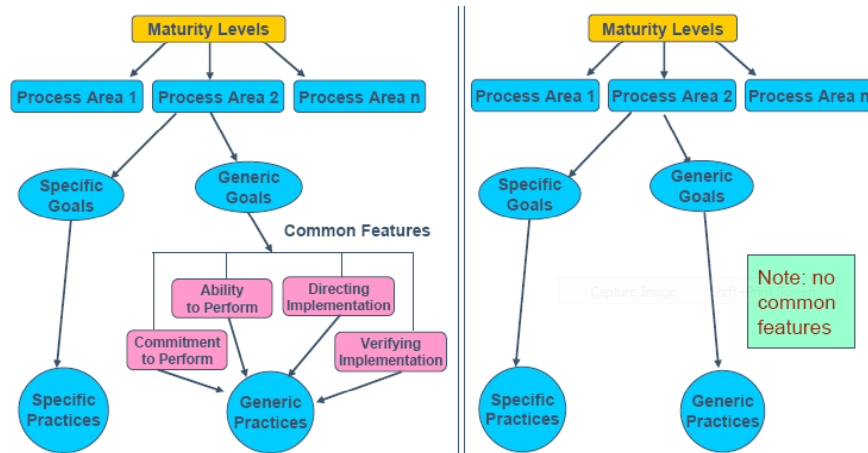
# Adding Quantitative Management



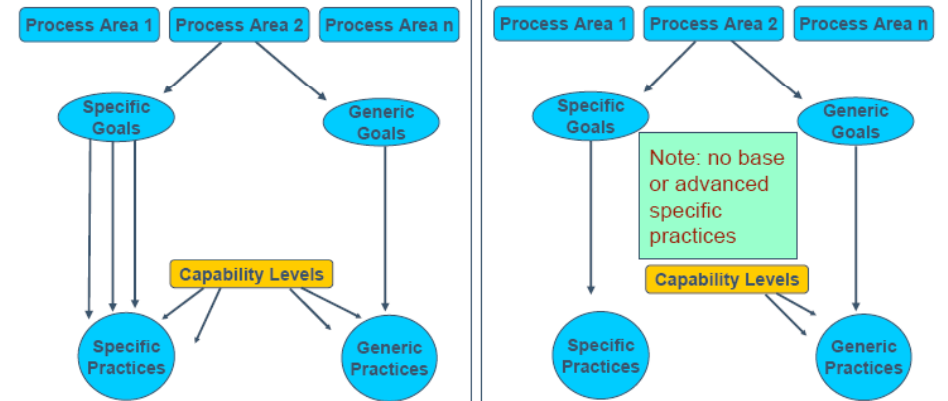
# Adding Communication and Collaboration



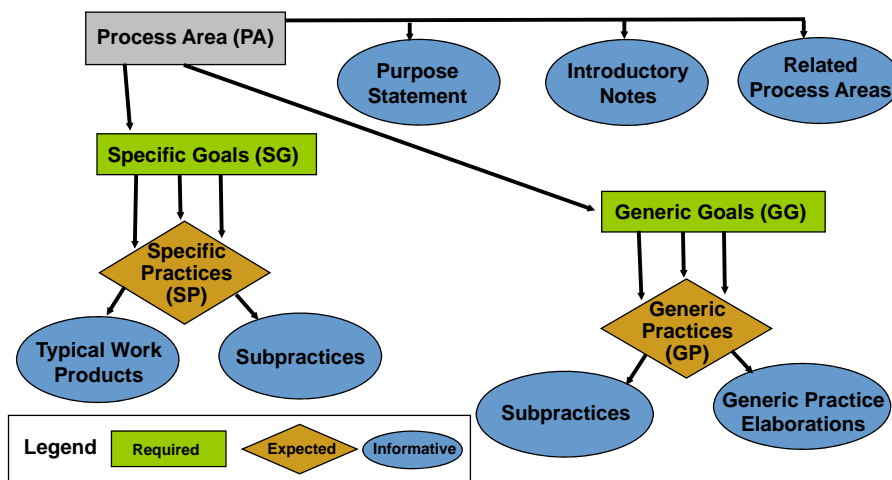
## Model Structure (Staged)



## Model Structure (Continuous)



## Process Area Components



## Required/ Expected/ Informative

- Required
  - Essential to achieving process improvement in a given PA
  - Used in appraisals to determine organizational maturity
- Expected
  - Guide model users and help appraisers
  - Explain what will typically be done to cover the scope of the process and its goals
  - Allow acceptable alternatives
- Informative
  - Provide details about the models

## Amplifications<sub>1</sub>

- **Amplifications** are informative material relevant to a particular discipline.
- Certain disciplines found in some organizations are explicitly identified in the models. Those disciplines are
  - Systems Engineering (SE)
  - Software Engineering (SW)
  - Hardware Engineering (HW)

## Amplifications<sub>2</sub>

- Amplification Example:-
- Project Planning SP 2.7

### ***For Hardware Engineering***

*For hardware, the planning document is often referred to as a hardware development plan. Development activities in preparation for production may be included in the hardware development plan or defined in a separate production plan.*

## References

- **References** are pointers to additional or more detailed information in related process areas and can accompany nearly any other model component.
- PPQA Example:  
*Refer to the Project Planning process area for more information about identifying processes and associated work products that will be objectively evaluated.*

## Typical Work Products

- This section lists sample output from a specific practice.
- **Typical work products** are samples of specific practices' outputs and are not a complete list.
- Examples from PPQA SP1.1: Objectively evaluate processes
  - Evaluation reports
  - Noncompliance reports
  - Corrective actions

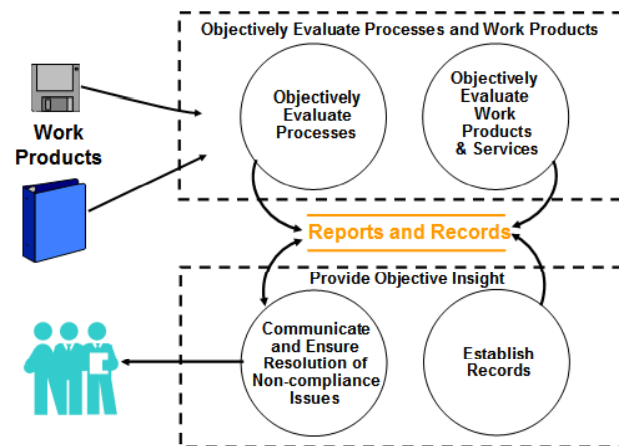
## Subpractices

- **Subpractices** are detailed descriptions that provide guidance for interpreting and implementing a specific or generic practice.
- Example from PPQA SP 2.1:  
*Communicate and Ensure Resolution of Noncompliance Issues*  
3. Escalate noncompliance issues that cannot be resolved within the project to the appropriate level of management designated to receive and act on noncompliance issues.

## Glossary

- **CMMI Glossary** defines the basic terms used in CMMI models.
- It was designed to document the meaning of words and terms that should have the widest use and understanding by users of CMMI products.  
**Objectively Evaluate** . . . To review activities and work products against criteria which minimize subjectivity and bias by the reviewer. An example of an objective evaluation is an audit against requirements, standards, or procedures by an independent quality assurance function. (See also “audit.”)

## Specific Goals and Practices- PPQA



## Specific Practice- SP

- **Specific practices** describe the activities expected to result in achievement of the specific goals of a process area.
- Example: OPD Process Area  
**SP 1.1 Establish Standard Processes**  
*Establish and maintain the organization's set of standard processes.*
- **Specific practices** are of the form **SP x.y** where
  - **x** is the same number as the goal to which the specific practice maps.
  - **y** is the sequence number of the specific practice under the specific goal.

## Institutionalization

- important concept in process improvement
- ensure processes are defined, documented, and understood
- process is ingrained in the way the work is performed: “That’s the way we do things around here.”
- organizational culture conveys the process.
- organization builds an infrastructure that contains effective, usable, and consistently applied processes.
- enable organizational learning to improve processes
- ensure PAs are *effective, repeatable, and long lasting*
- Institutionalized processes endure after the people who originally defined them have gone.

## Generic Goal- GG

- describe the characteristics that must be present to institutionalize the processes that implement a process area.
- Achievement of a generic goal in a process area signifies improved control in planning and implementing the processes associated with that process area.
- called *generic* because the same goal statement appears in multiple process areas.
- Generic goals are numbered starting with the prefix **GG** (e.g., GG 2). The number corresponds to the *capability level* of the GG.

## Generic Practice- GP

- activities that ensure the processes associated with the process area will be effective, repeatable, and lasting
- called *generic* because the same practice appears in multiple process areas
- **example:**
  - **GP 2.5: Train People**  
*Train the people performing or supporting the <x> process as needed.*
  - 2 corresponds to the number of the generic goal.
  - 5 corresponds to the sequence number of the generic practice.

## Generic Practice Elaborations

- appear after the generic practice to provide guidance on how the generic practice may be applied in the context of a process area.
- **Example GP 2.5 Train People in MA**  
*Elaboration:*

Examples of training topics include the following:

- Statistical techniques
- Data collection, analysis, and reporting processes
- Development of goal-related measurements e.g. Goal-Question-Metric

## GGs and GPs

- GG 1 Achieve Specific Goals
  - GP 1.1 Perform Specific Practices
- GG 2 Institutionalize a Managed Process
  - GP 2.1 Establish an Organizational Policy
  - GP 2.2 Plan the Process
  - GP 2.3 Provide Resources
  - GP 2.4 Assign Responsibility
  - GP 2.5 Train People
  - GP 2.6 Manage Configurations
  - GP 2.7 Identify and Involve Relevant Stakeholders
  - GP 2.8 Monitor and Control the Process
  - GP 2.9 Objectively Evaluate Adherence
  - GP 2.10 Review Status with Higher Level Management
- GG 3 Institutionalize a Defined Process
  - GP 3.1 Establish a Defined Process
  - GP 3.2 Collect Improvement Information
- GG 4 Institutionalize a Quantitatively Managed Process
  - GP 4.1 Establish Quantitative Objectives for the Process
  - GP 4.2 Stabilize Subprocess Performance
- GG 5 Institutionalize an Optimizing Process
  - GP 5.1 Ensure Continuous Process Improvement
  - GP 5.2 Correct Root Causes of Problems

## GG1: Performed Process

- A *performed* process is a process that accomplishes the work necessary to produce work products.
- The specific goals of the process area are satisfied.
- The definition, planning, monitoring, and controlling of the process may be incomplete.
- The process may be inconsistently implemented.

## GG 2: Managed Process

- A *managed* process is a *performed* process that is planned and executed in accordance with policy; employs skilled people who have adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.
- Processes normally belong to the project and are enforced by the project manager.

## GG 3: Defined Process

- A *defined process* is a *managed* process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines.
- Processes owned by the organization
- Process definitions are tailored and incorporated into the project's defined processes throughout the organization.
- A defined process clearly states the following:
  - Purpose
  - Inputs
  - Entry criteria
  - Activities
  - Roles
  - Measures
  - Verification steps
  - Outputs
  - Exit criteria

## GG 4: Quantitatively Managed Process

- A *quantitatively managed* process is a *defined* process that is controlled using statistical and other quantitative techniques.
- Quantitative management is tied to the organization's strategic goals for product quality, service quality, and process performance.
- Product quality, service quality, and process performance attributes are measurable and controlled throughout the project.
- Achieving necessary quality and process performance objectives requires *stabilizing the processes that contribute most to the achievement of the objectives and reducing process variation*.

## GG 5: Optimizing Process

- An *optimizing process* is a quantitatively managed process that is improved based on an understanding of the common causes of variation inherent in the process.
- The focus is on continually improving the range of process performance through both incremental and innovative technological improvements.

## 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

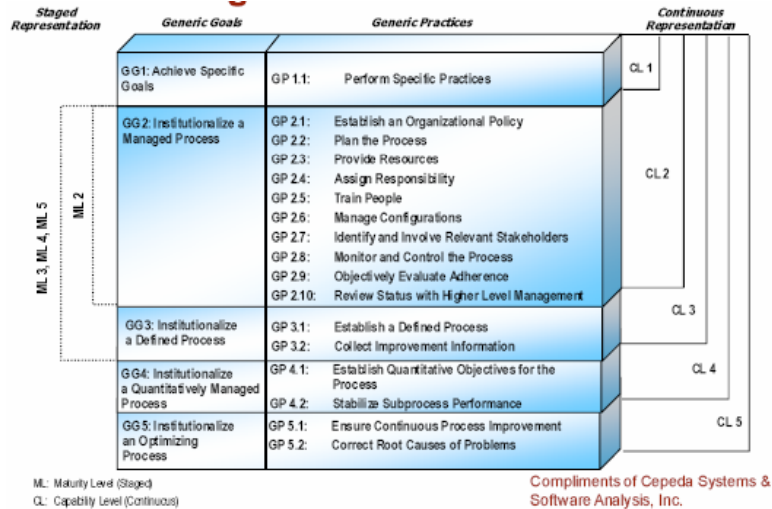
## Generic Goals and Institutionalization

degree of institutionalization is embodied in GGs and expressed in the names of the processes associated with each goal as indicated in the table below:

<u>Generic Goal &amp; Title</u>	<u>Progression of Processes</u>
GG1: Achieve Specific Goals	Performed Process
GG2: Institutionalize a Managed Process *	Managed Process
GG3: Institutionalize a Defined Process *	Defined Process
GG4: Institutionalize a Quantitatively Managed Process	Quantitatively Managed Process
GG5: Institutionalize an Optimizing Process	Optimizing Process

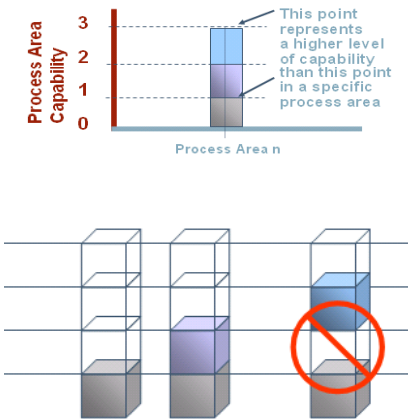
\* These are the only generic goals used in the staged representation.

# Achieving a Level



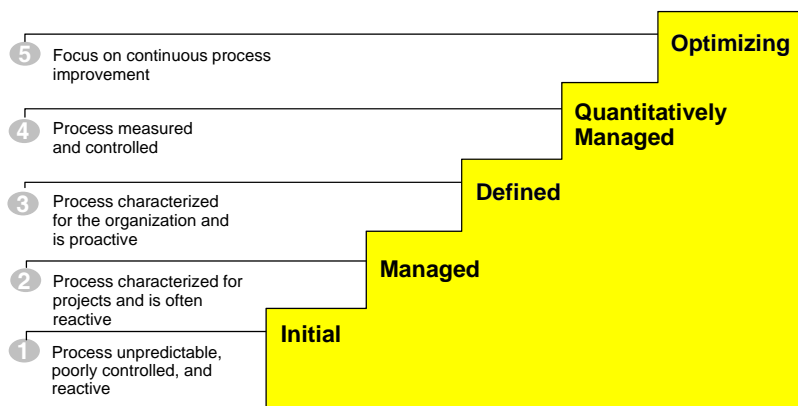
# Capability Level- CL

- Achievement of process improvement within an individual process area.
- Six capability levels
- A capability level is defined by the appropriate specific and generic practices for a process area.
- CLs are cumulative, i.e. a higher capability level includes the practices of the lower levels.



# Maturity Level- ML

- Maturity Levels are well-defined evolutionary plateaus on the path to becoming a mature organization.
- Each level is a layer in the foundation for continuous process improvement.

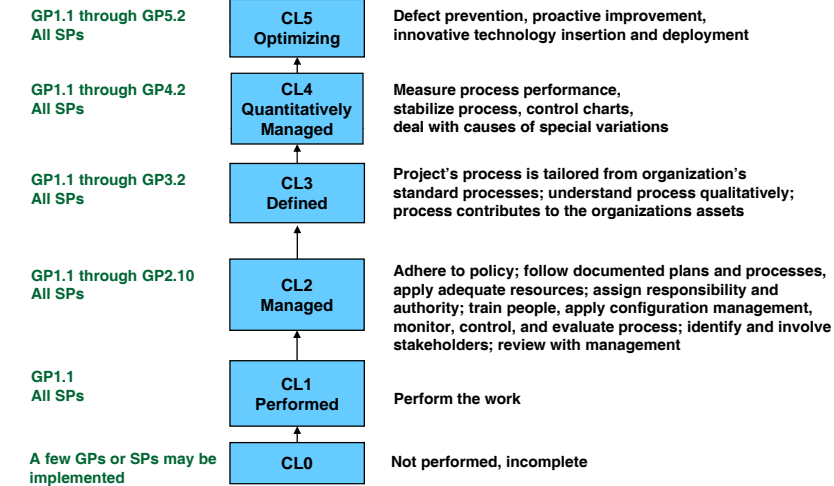


# Capability vs. Maturity Levels

	Continuous	Staged
Level	Capability Levels	Maturity Levels
0	Incomplete	N/A
1	Performed	Initial
2	Managed	Managed
3	Defined	Defined
4	Quantitatively Managed	Quantitatively Managed
5	Optimizing	Optimizing

# Achieving Capability Levels for a Process

## Area



# REQM - Capability Levels 1 & 2

## Specific practices

- SP1.1: Obtain an Understanding of Requirements
- SP1.2: Obtain Commitment to Requirements
- SP1.3: Manage Requirements Changes
- SP1.4: Maintain Bidirectional Traceability of Requirements
- SP1.5: Identify Inconsistencies Between Project Work and Requirements

## Generic practices (CL1)

- GP1.1: Perform Specific Practices

## Specific practices

- SP1.1: Obtain an Understanding of Requirements
- SP1.2: Obtain Commitment to Requirements
- SP1.3: Manage Requirements Changes
- SP1.4: Maintain Bidirectional Traceability of Requirements
- SP1.5: Identify Inconsistencies Between Project Work and Requirements

## Generic practices (CL2)

- GP1.1: Perform Specific Practices
- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status with Higher Level Management

# REQM - Capability Level 3

## Specific practices

- SP1.1: Obtain an Understanding of Requirements
- SP1.2: Obtain Commitment to Requirements
- SP1.3: Manage Requirements Changes
- SP1.4: Maintain Bidirectional Traceability of Requirements
- SP1.5: Identify Inconsistencies Between Project Work and Requirements

## Generic practices (CL3)

- GP1.1: Perform Specific Practices
- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status w/Higher Level Management
- GP3.1: Establish a Defined Process
- GP3.2: Collect Improvement Information

# REQM - Capability Levels 4 & 5

## Specific practices

- All the specific practices

## Generic practices (CL4)

- All the CL1 & CL2 & CL3 generic practices plus (+)
- GP4.1: Establish Quantitative Objectives for the Process
- GP4.2: Stabilize Subprocess Performance

## Specific practices

- All the specific practices

## Generic practices (CL5)

- All the CL1 & CL2 & CL3 & CL4 generic practices plus (+)
- GP5.1: Ensure Continuous Process Improvement
- GP5.2: Correct Root Causes of Problems

# Achieving Maturity Levels

## ■ To achieve a maturity level

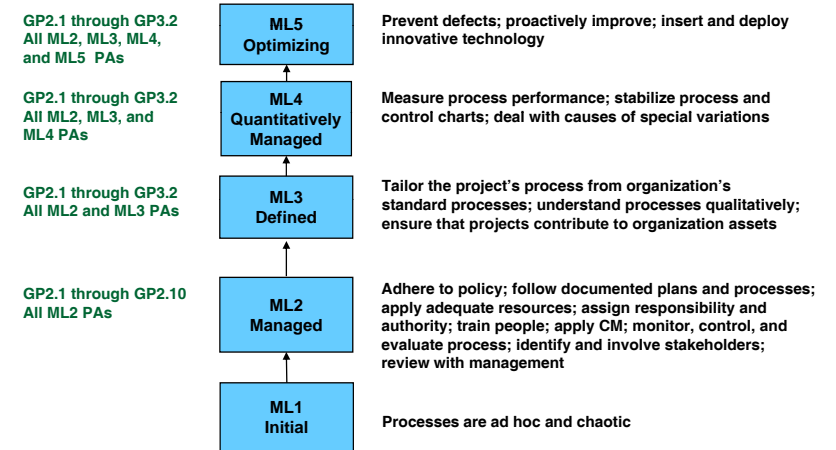
- All process areas at that level and all levels below it must be satisfied or determined to be not applicable.

## ■ And to achieve a maturity level 3 or higher

- The generic goal 3 for each applicable maturity level 2 PA must also be rated satisfied for maturity level 3 or higher.

■ *Note: A process area is satisfied if and only if all of the process area's relevant specific and generic goals are rated as satisfied.*

# Achieving Maturity Levels (ML)



# REQM - Maturity Levels 1 & 2

## Specific practices

None

## Generic practices (ML1)

None

## Specific practices

- SP1.1: Obtain an Understanding of Requirements
- SP1.2: Obtain Commitment to Requirements
- SP1.3: Manage Requirements Changes
- SP1.4: Maintain Bidirectional Traceability of Requirements
- SP1.5: Identify Inconsistencies Between Project Work and Requirements

## Generic practices (ML2)

- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status with Higher Level Management

An organization moves to maturity level 2 by

- implementing REQM specific and generic practices (GP2.1 - 2.10)
- implementing the **other six process areas at maturity level 2**: Configuration Management, Measurement and Analysis, Process and Product Quality Assurance, Project Monitoring and Control, Project Planning, and Supplier Agreement Management

# REQM - Maturity Level 3

## Specific practices

- SP1.1: Obtain an Understanding of Requirements
- SP1.2: Obtain Commitment to Requirements
- SP1.3: Manage Requirements Changes
- SP1.4: Maintain Bidirectional Traceability of Requirements
- SP1.5: Identify Inconsistencies Between Project Work and Requirements

## Generic practices (ML3)

- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status with Higher Level Management
- GP3.1: Establish a Defined Process
- GP3.2: Collect Improvement Information

The organization moves to maturity level 3 by

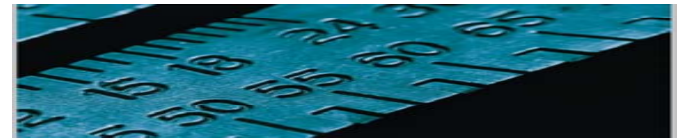
- achieving maturity level 2
- applying generic practices 3.1 and 3.2 to all seven process areas at maturity level 2 (including REQM)
- implementing all **eleven process areas at maturity level 3**: Decision Analysis and Resolution, Integrated Project Management +IPPD, Organizational Process Definition +IPPD, Organizational Process Focus, Organizational Training, Product Integration, Requirements Development, Risk Management, Technical Solution, Validation, and Verification (this implementation addresses all the specific practices for each process area plus the above twelve generic practices)

## REQM - Maturity Levels 4 & 5

- The **organization** moves to maturity level 4 by
  - achieving maturity level 3
  - implementing **both process areas** at maturity level 4: Organizational Process Performance and Quantitative Project Management
    - this includes selecting appropriate subprocesses (that are critical contributors to achieving business objectives) in the PAs already implemented (e.g., REQM) and applying statistical management to these
- The **organization** moves to maturity level 5 by
  - achieving maturity level 4
  - implementing **both process areas** at maturity level 5: Causal Analysis and Resolution and Organizational Innovation and Deployment
    - these involve identifying and removing defects and identifying, piloting, and deploying proposed innovations in the PAs already implemented (e.g., REQM)

## Module 4

### Appraisal Method



## SCAMPI

- **Standard CMMI Appraisal Method for Process Improvement**
- SCAMPI is designed to provide benchmark quality ratings relative to Capability Maturity Model Integration (CMMI®) models.
- [www.sei.cmu.edu/cmmi/appraisals/](http://www.sei.cmu.edu/cmmi/appraisals/)

## Practice Implementation Indicator-PII



- based on the presumption that the conduct of an activity or the implementation of a practice will result in “footprints” which are attributable to the activity or practice

## PII Types

### ■ Direct Artifacts

- Tangible outputs resulting directly from implementation of a practice (e.g., typical work products)

### ■ Indirect Artifact

- Artifacts that are a side-effect or indicative of performing a practice (e.g., meeting minutes, reviews, logs, and reports)

### ■ Affirmation

- Oral or written statements confirming or supporting implementation of the practice (e.g., interviews, and questionnaires)

## Practice Implementation Indicator Description (PIID) Requirements Management (REQM) PA

Goal ID	REQM SG 1. Requirements are managed and inconsistencies with project plans and work products are identified.		
Practice ID	REQM SP 1.1-1 <i>Develop an understanding with the requirements providers on the meaning of the requirements.</i>		
PII Type	Example Direct Artifacts	Example Indirect Artifacts	Affirmations
Example Evidence (Look For / Listen For)	<p>[1. An agreed-to set of (product and/or product component) requirements.]</p> <ul style="list-style-type: none"> <li>Requirements documents in a mutually acceptably form and format (text, Objects, Data-flow diagrams, etc.).</li> </ul> <p>[2. Defined criteria for evaluation and acceptance of requirements]</p>	<ul style="list-style-type: none"> <li>A list or characterization of requirements providers authorized to provide direction.</li> <li>Results of analyses against requirements criteria</li> <li>Evidence of clarification reviews with requirements providers (e.g., analysis reports, minutes, clarifications, review logs, requirements updates) resulting in identified requirements issue.</li> <li>Action items issued to track resolution of requirements issues</li> <li>Agreement of the requirement by the requirements providers</li> </ul>	
Organizational Implementation Evidence			
Appraisal Team Notes			
Assessment Considerations	<ul style="list-style-type: none"> <li>Does proof exist that the requirements do indeed meet the established acceptance criteria at each stage of confirmation of understanding?</li> </ul>		

## Appraisal Method Classes

Characteristics	Class A	Class B	Class C
Amount of Objective Evidence Gathered (relative)	High	Medium	Low
Ratings Generated	Yes	No	No
Resource Needs (relative)	High	Medium	Low
Team Size (relative)	Large	Medium	Small
Appraisal Team Leader Requirements	Lead appraiser	Lead appraiser or person trained and experienced	Person trained and experienced

Extracted from Appraisal Requirements for CMMI, Version 1.2 (ARC)

## Appraisal Validity Period

- V1.2 appraisal results are valid for a **maximum of 3 years** from the date of the Appraisal Disclosure Statement (ADS).
- “Not applicable” PAs for maturity levels will be significantly constrained.
- Only SAM can be declared not applicable.
- Rationale for declaring SAM to be “not applicable” must be provided in the Appraisal Disclosure Statement.
- V1.1 appraisals will expire on August 31, 2007 or 3 years after the date the appraisal was conducted, whichever is later.