

# Evaluating & Improving Process

Azeem Ahmad

Linköping University, Sweden

# Objectives

- Difference between product and process
- Working with CMMI
- Continuous Model (CMMI)
- Benefits of using CMMI

# Product VS Process

- Product = What
  - Prototype
  - Software/hardware
  - Requirements specification
  - Test document
- Process = How
  - Life cycle
  - Methods
    - To assure that product is delivered

# Process Matters

## Characteristics of Effective Processes



simple



enforced



trained



flexible



practiced



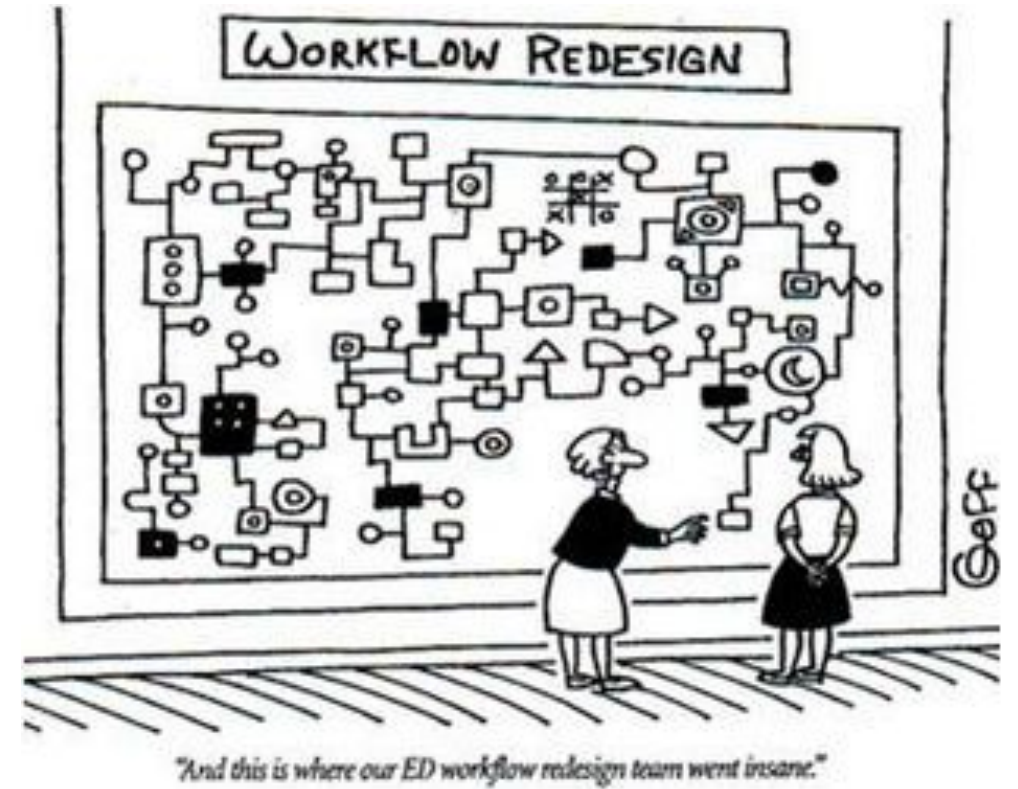
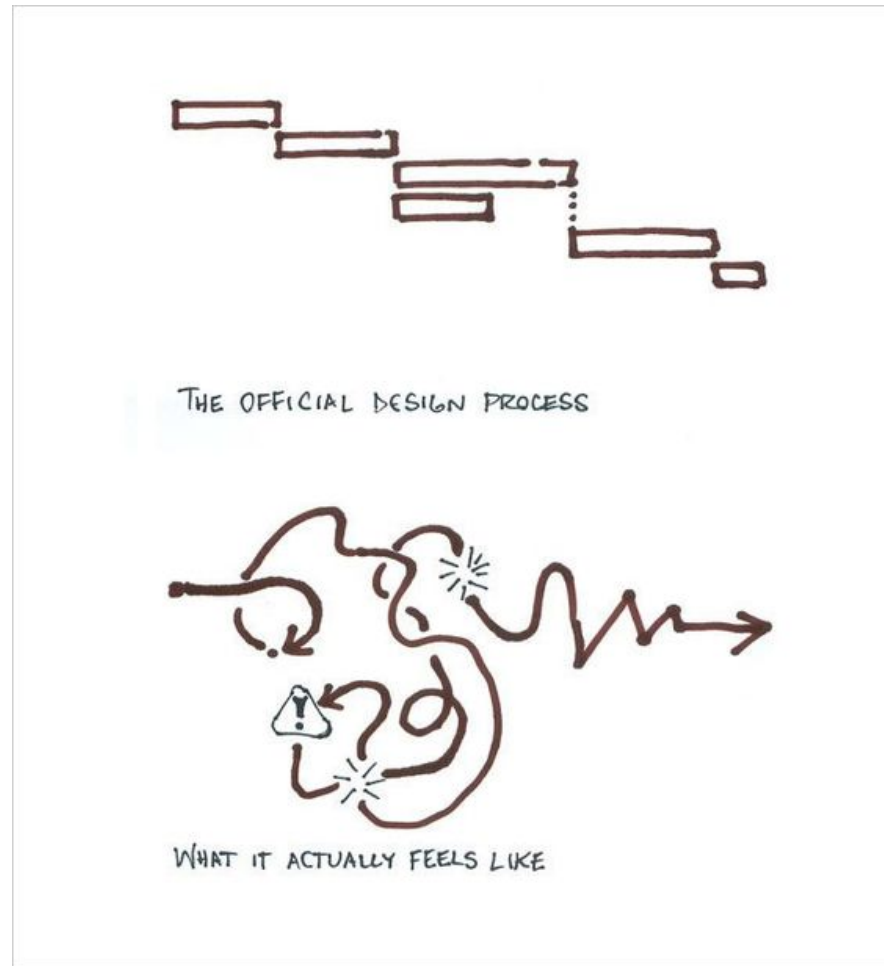
supported

STABLE

Well-defined gates

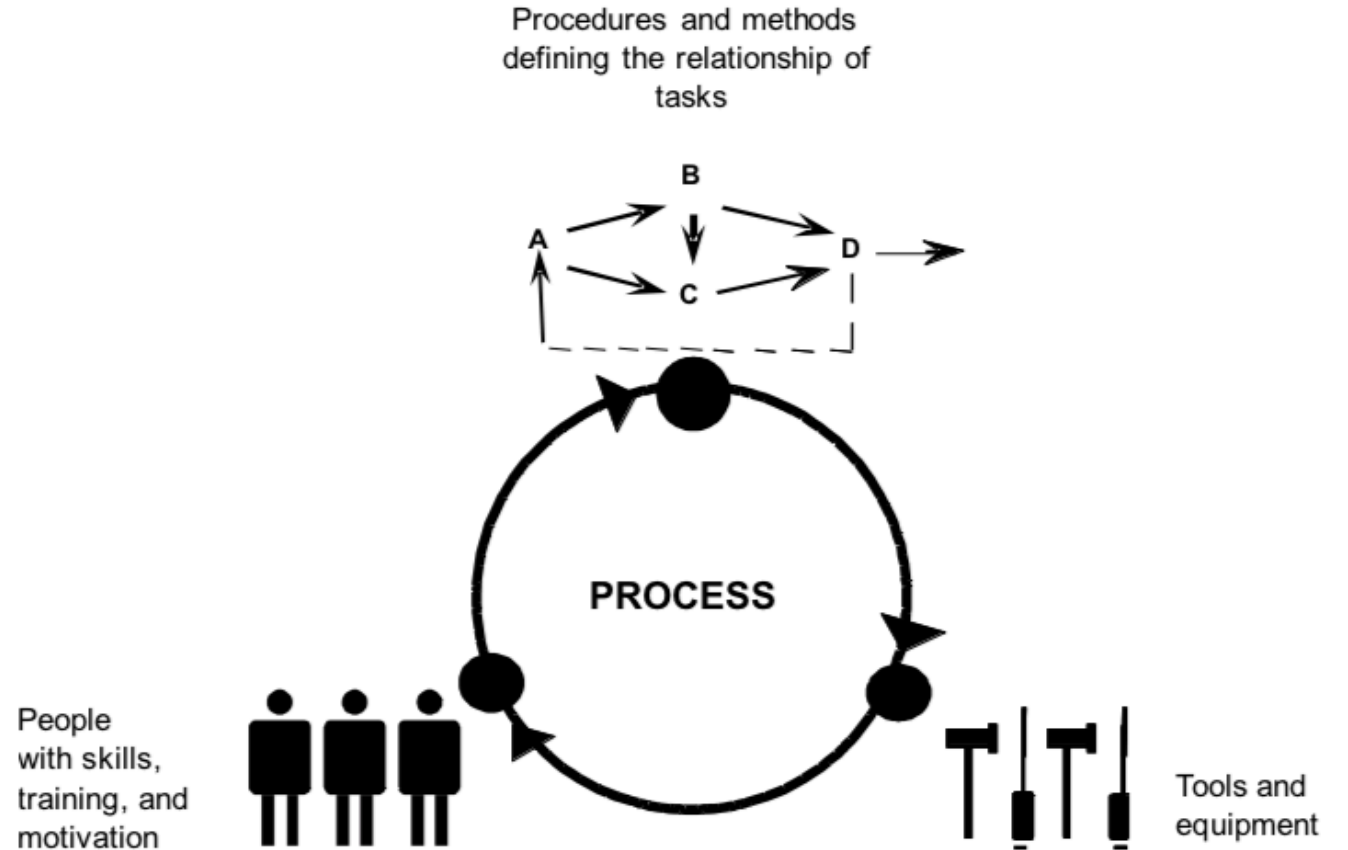


# Process Matters



# Three Critical Dimensions

What holds everything together? It is the processes used in your organization. Processes allow you to align the way you do business

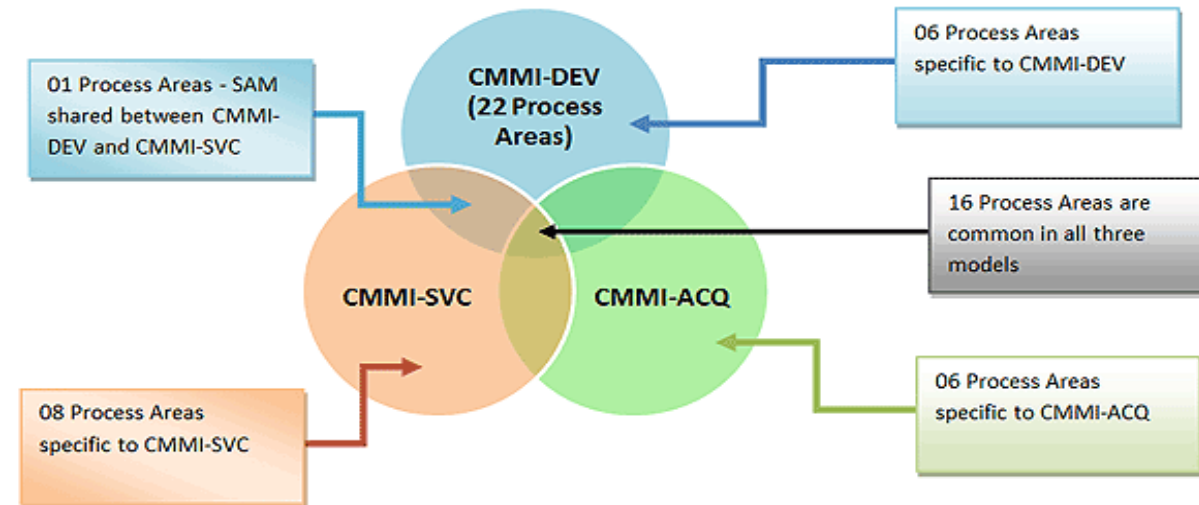


# Capability Maturity Model Integration(CMMI)

- CMMI is a list of good practices (“good” from Industry and SEI) organised by themes (Process Area) related to key or critical activities of project development delivery and service to achieve stakeholder satisfaction.
- **Concept** : you need to master these activities if you want to increase your chance of success and reduce your business risks
- Approach used by organizations TO IMPROVE.
- The CMMI describes WHAT to do, not HOW to do it.
  - Staged (step-by-step) – chose part of lifecycle and develop yourself in that area
  - Continuous Models – develop yourself in all area of lifecycles

# CMMI Models within the Framework

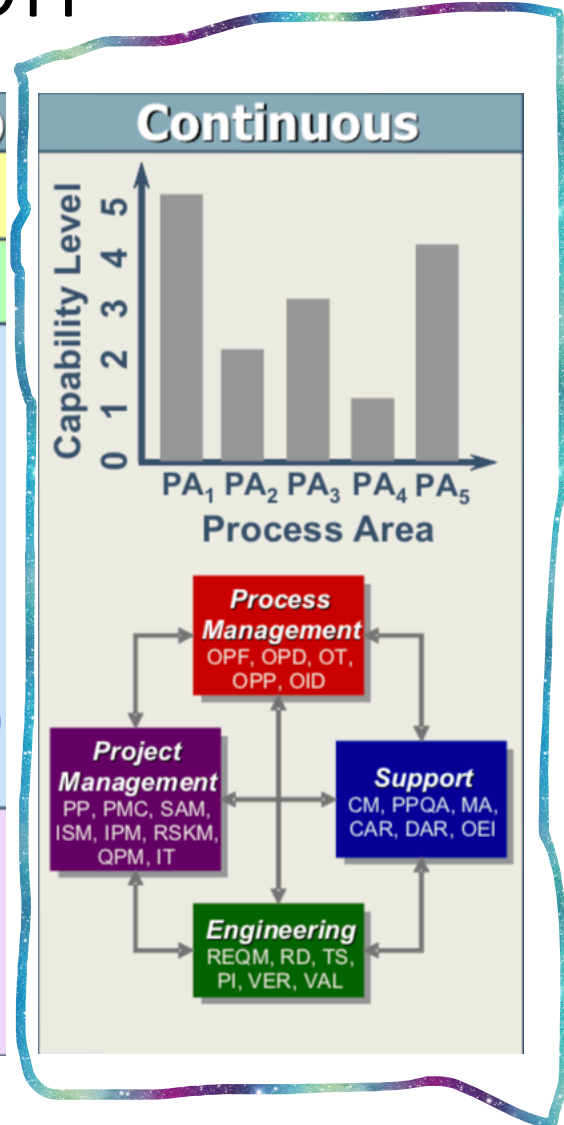
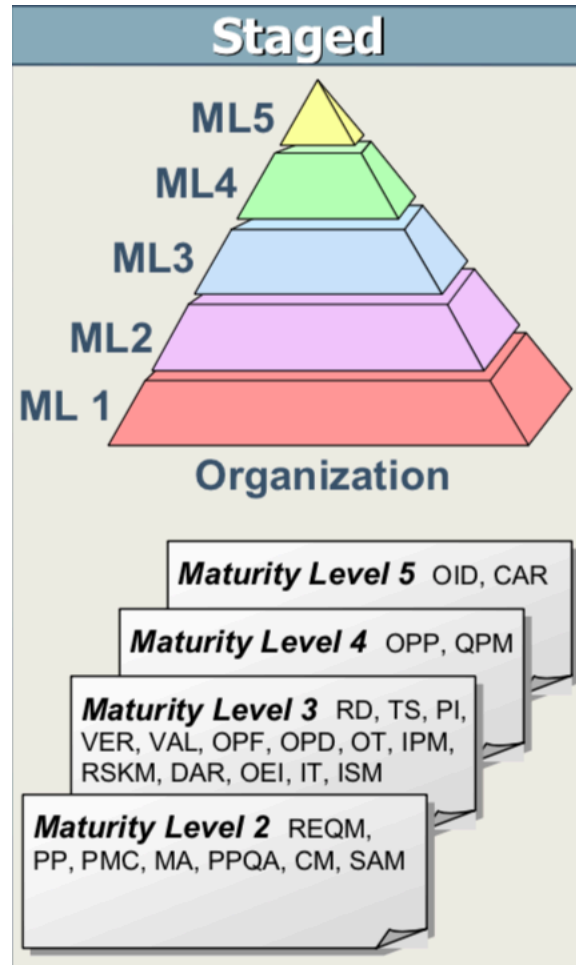
- **CMMI for Acquisition (CMMI-ACQ), v1.3** was released in November 2010.
  - It addresses supply chain management, acquisition, and outsourcing processes in government and industry.
- **CMMI for Services (CMMI-SVC), v1.3** was released in November 2010.
  - It addresses guidance for **delivering services** within an organization and to external customers.
- **CMMI for Development (CMMI-DEV), v1.3** was released in November 2010. It addresses product and service development processes.
  - Development and maintenance of products
  - Can be used for developing complex systems (i.e. healthcare, bridges)
  - Integrates software engineering, system engineering and collaborative teams





# Staged and Continuous Representation

Approximately same contents but organized in different way

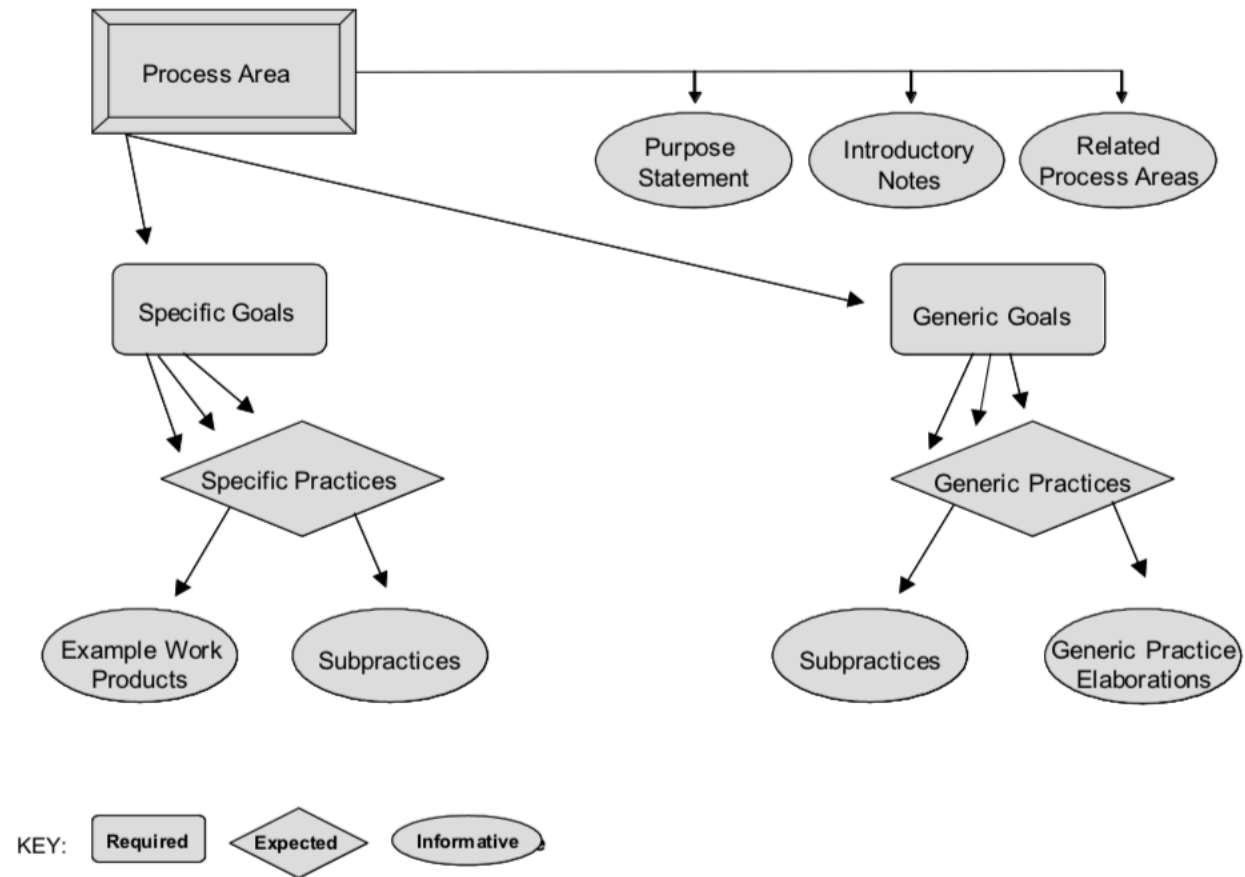


Check "Software Quality Management" lecture on <https://www.ida.liu.se/~TDDC88/theory/lectures.shtml> for CMMI staged model

# Continuous CMMI

- Allows you to select the order of improvement that best meets the organization's business objectives and mitigates the organization's areas of risk.
- Allows improvements of different processes to be performed at different rates

# Continuous CMMI Structure



# Continuous CMMI

- Capability Levels
  - Belong to a continuous representation, and applies to an organization's process improvement achievement in individual process areas. These levels are a means for incrementally improving the process corresponding to a given process area. There are six capability levels, numbered 0 through 5.

<b>Comparison of Capability and Maturity Levels</b>		
<b>Level</b>	<b>Continuous Capability Levels</b>	<b>Staged Maturity Levels</b>
<b>Level 0</b>	<b>Incomplete</b>	<b>N/A</b>
<b>Level 1</b>	<b>Performed</b>	<b>Initial</b>
<b>Level 2</b>	<b>Managed</b>	<b>Managed</b>
<b>Level 3</b>	<b>Defined</b>	<b>Defined</b>
<b>Level 4</b>	<b>NA</b>	<b>Quantitatively Managed</b>
<b>Level 5</b>	<b>NA</b>	<b>Optimizing</b>

# CMMI Capability Levels

## 3: Defined

Critical distinction between a “managed” and “defined” is the scope of application of the process descriptions, standards, and procedures.

Defined Process that is tailored from the organization’s tailoring guidelines, and contributes work products, measures, and other process-improvement information to the organizational process assets.

## 2: Managed

Critical distinction between a “performed” and “managed” is the extent to which the process is managed.

Managed Process that is also planned and executed in accordance with policy, employs skilled people have adequate resources to product controlled outputs, involves relevant stakeholders; is monitored, controlled, and reviewed; and is evaluated for adherence to its process description.

## 1: Performed

Critical distinction between “incomplete” and “performed” is that a performed process satisfies all of the specific goals of the process area.

Performed Process that satisfies the specific goals for the process area

## 0: Incomplete

An incomplete process that is either not performed for partially performed. One or more of the specific goals of the process are not satisfied.

# CMMI Capability Levels

## 5: Optimizing

Critical distinction between a “Quantitatively” and “Optimizing” is that the optimizing process is continuously improved by addressing common causes of process variation.

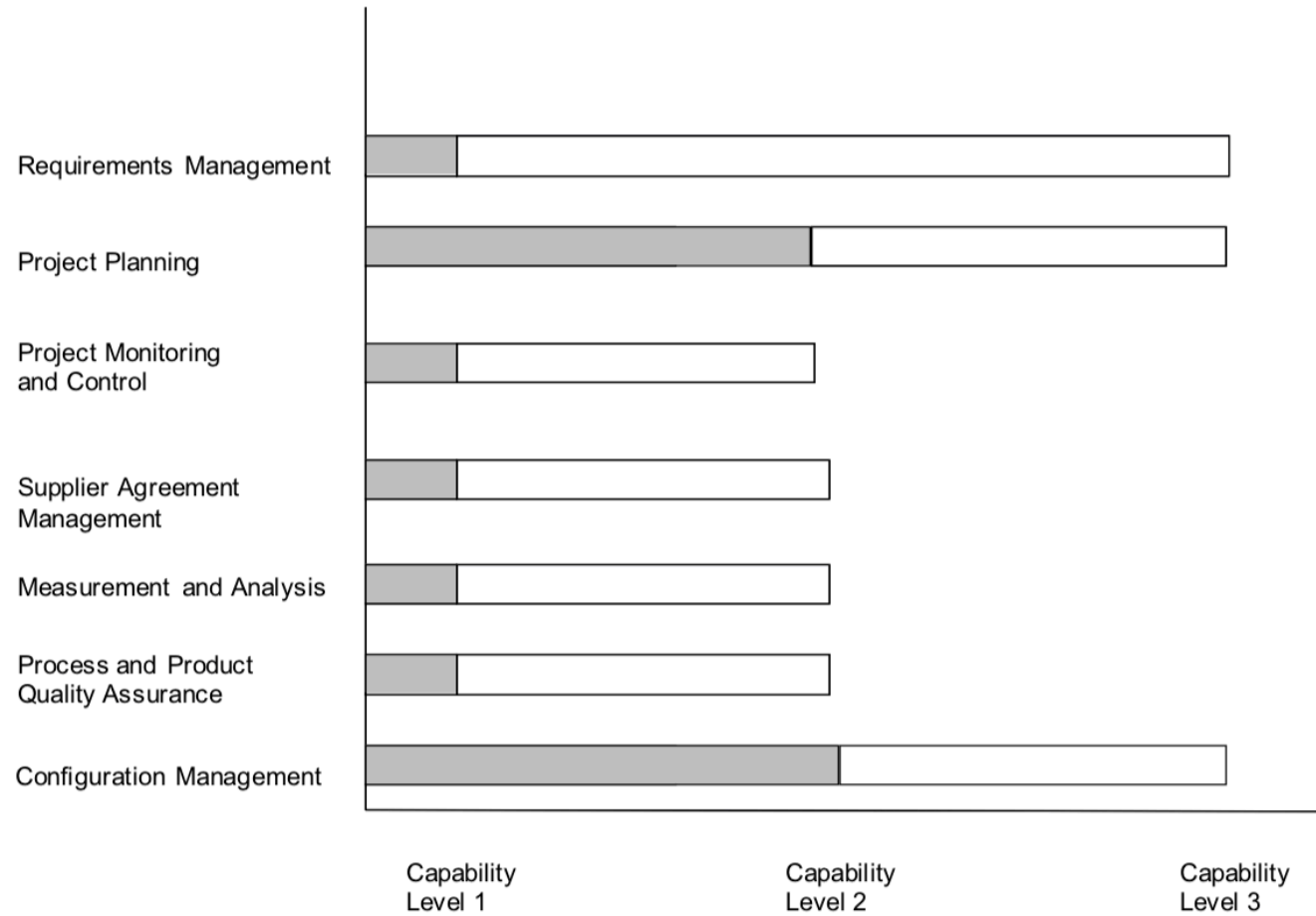
A quantitatively managed process that is changed and adapted to meet relevant current and projected business objectives. A process that focuses on continually improving the process performance through both incremental and innovative technological improvements.

## 4: Quantitatively Managed

Critical distinction between “Defined” and “Quantitatively” is the predictability of the process performance. The term “Quantitatively Managed” implies using appropriate statistical and other quantitative techniques to manage the performance of one or more critical subprocesses of a process so that the future performance of the process can be predicted.

Quantitatively Managed Process that is controlled using statistical and other quantitative techniques. The quality and process performance are understood in statistical terms and are managed throughout the life of the process.

# CMMI for DEV 1.3 Process Areas – Main Goal



# CMMI for DEV 1.3 Process Areas

## Process Management PA

---

OPD	Organizational Process Definition
OPF	Organizational Process Focus
OPM	Organizational Process Management
OPP	Organizational Process Performance
OT	Organizational Training

## Project Management PA

---

PP	Project Planning
PMC	Project Monitoring and Control
REQM	Requirements Management
RSKM	Risk Management
IPM	Integrated Project Management
SAM	Supplier Agreement Management
QPM	Quantitative Project Management

## Engineering PA

---

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

## Supporting PA

---

CM	Configuration Management
DAR	Decision Analysis and Resolution
MA	Measurement and analysis
PPQA	Process and Product Quality Assurance
CAR	Causal Analysis and Resolution



# CMMI for DEV 1.3 Process Areas

## Process Management PA

---

OPD	Organizational Process Definition
OPF	Organizational Process Focus
OPM	Organizational Process Management
OPP	Organizational Process Performance
OT	Organizational Training

## Project Management PA

---

PP	Project Planning
PMC	Project Monitoring and Control
REQM	Requirements Management
RSKM	Risk Management
IPM	Integrated Project Management
SAM	Supplier Agreement Management
QPM	Quantitative Project Management

**You can apply these process areas to lower year student's project as part of coaching**

## Engineering PA

---

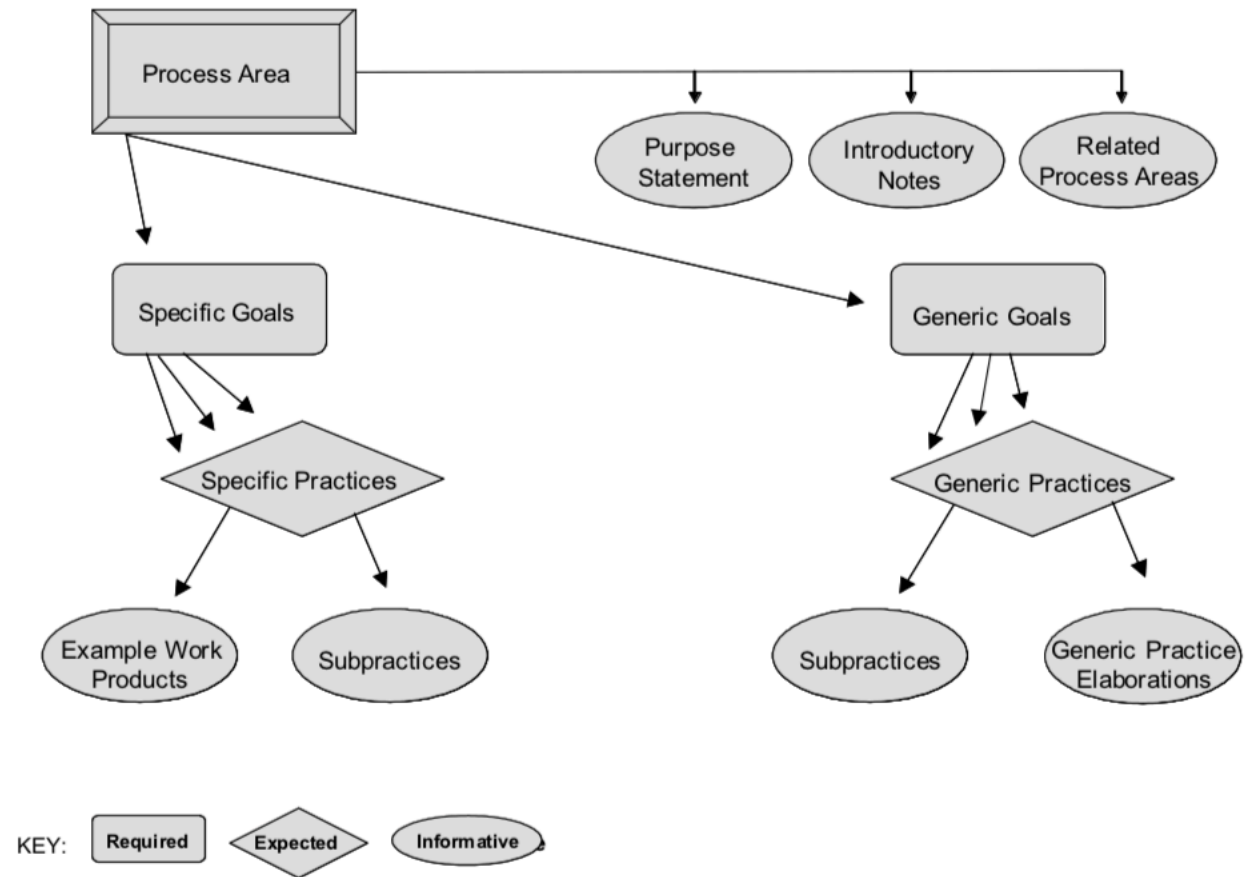
TS	Technical Solution
PI	Product Integration
RD	Requirements Development
VAL	Validation
VER	Verification

## Supporting PA

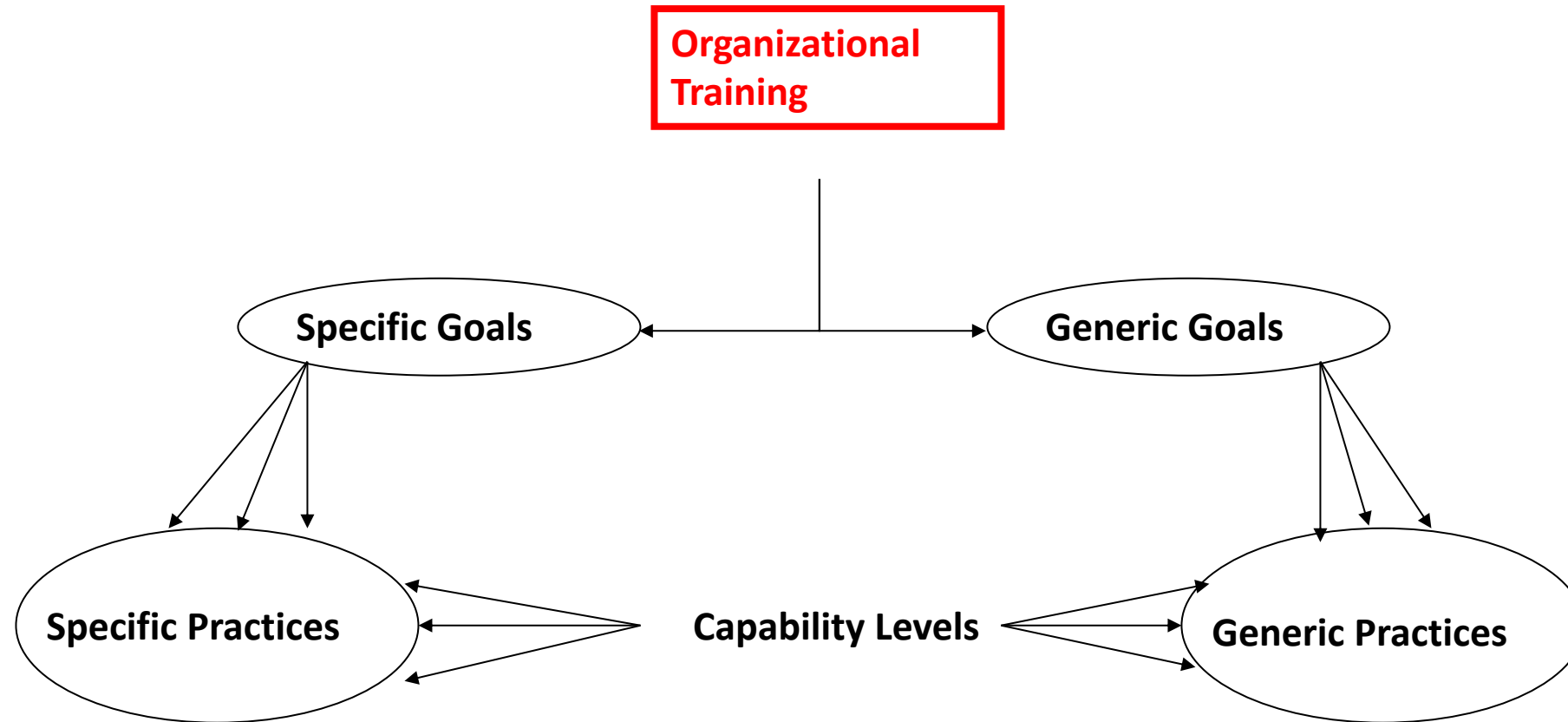
---

CM	Configuration Management
DAR	Decision Analysis and Resolution
MA	Measurement and analysis
PPQA	Process and Product Quality Assurance
CAR	Causal Analysis and Resolution

# Continuous CMMI Structure



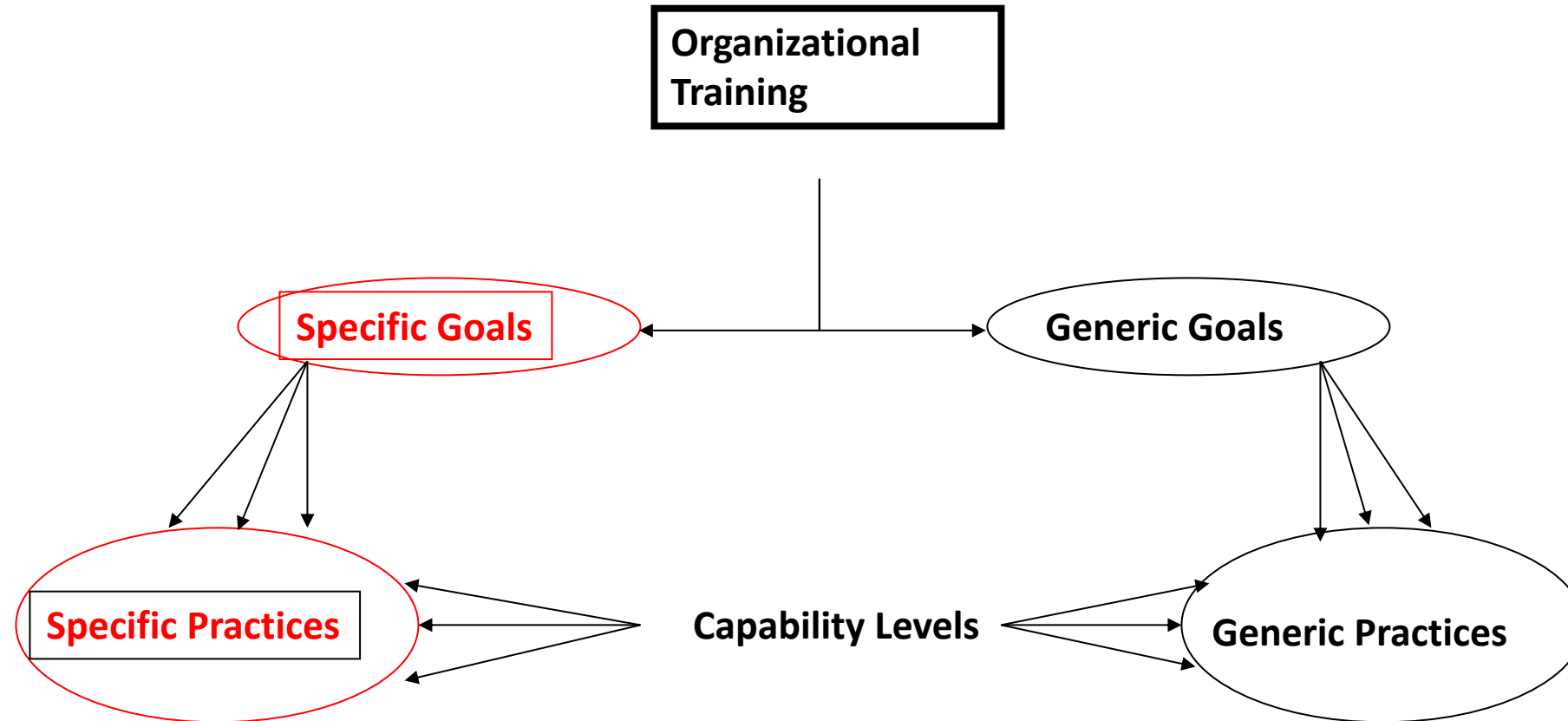
# Continuous CMMI Structure



# Continuous CMMI – Organizational Training

- The purpose of Organizational Training (OT) is to develop skills and knowledge of people so they can perform their roles effectively and efficiently.
- An organizational training program involves the following activities:
  - Identifying the training needed by the organization
  - Obtaining and providing training to address those needs
  - Establishing and maintaining training records
  - Assessing training effectiveness

# Continuous CMMI – Organizational Training



# Continuous CMMI – Organizational Training

SG	SP	Description
SG1		Establish and organizational training capability
	SP1.1	Establish strategic training needs
	SP1.2	Determine which training needs are the responsibility of the organization
	SP1.3	Establish an organizational training tactical plan
	SP1.4	Establish training capability
SG2		Provide training
	SP2.1	Deliver training
	SP2.2	Establish training records
	SP2.3	Asses training effectiveness

# SG 1 -> SP 1.1 Establish Strategic Training Needs

- Strategic training needs to address long-term objectives to build a capability by filling significant knowledge gaps, introducing new technologies, or implementing major changes in behaviour.
- Strategic planning typically looks two to five years into the future
- Example Work Product:
  - Training needs
  - Assessment analysis
- Sub Practices:
  - Analyse the organization's strategic business objectives and process improvement plan to identify potential training needs
  - Document the strategic training needs of the organization
  - Document the training needed to maintain the safe, secure, and continued operation of the business.
  - Revise the organization's strategic needs and required training as necessary.

# Continuous CMMI – Organizational Training

SG	SP	Description
SG1		Establish and organizational training capability
	SP1.1	Establish strategic training needs
	SP1.2	Determine which training needs are the responsibility of the organization
	SP1.3	Establish an organizational training tactical plan
	SP1.4	Establish training capability
SG2		Provide training
	SP2.1	Deliver training
	SP2.2	Establish training records
	SP2.3	Asses training effectiveness



# SG 2 -> SP 2.1 Deliver Training

- Deliver training following the organizational training plan
- Example Work Product:
  - Delivered training course
- Sub Practices:
  - Select those who will receive the training necessary to perform their roles effectively
  - Schedule the training, including any resources, as necessary (e.g., facilities, instructors).
  - Deliver the training
  - Track the delivery of training against the plan.

# CMMI for DEV 1.3 Process Areas

## Process Management PA

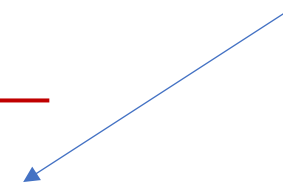
---

OPD	Organizational Process Definition
OPF	Organizational Process Focus
OPM	Organizational Process Management
OPP	Organizational Process Performance
OT	Organizational Training

## Project Management PA

---

PP	Project Planning
PMC	Project Monitoring and Control
REQM	Requirements Management
RSKM	Risk Management
IPM	Integrated Project Management
SAM	Supplier Agreement Management
QPM	Quantitative Project Management



**You can apply these process areas to lower year student's project as part of coaching**

## Engineering PA

---

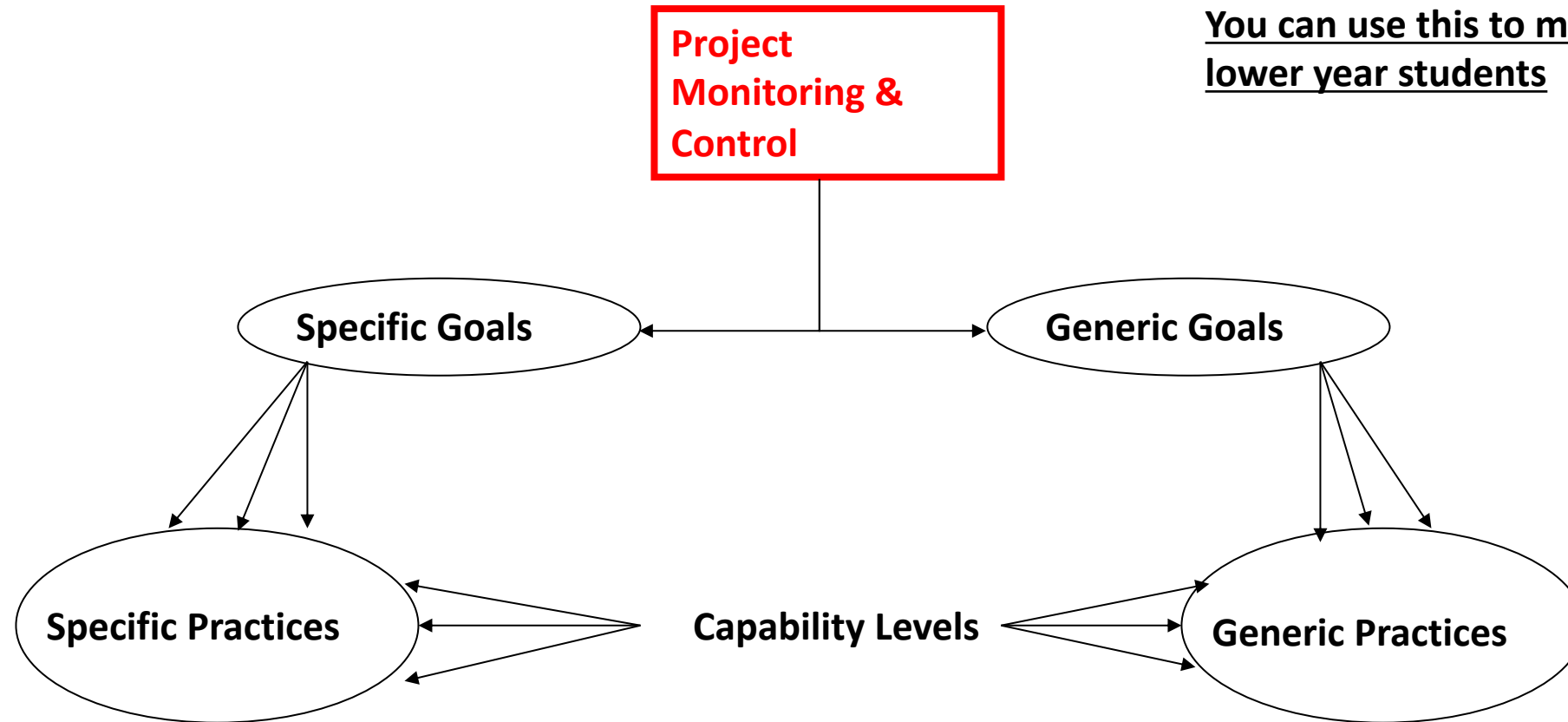
TS	Technical Solution
PI	Product Integration
RD	Requirements Development
VAL	Validation
VER	Verification

## Supporting PA

---

CM	Configuration Management
DAR	Decision Analysis and Resolution
MA	Measurement and analysis
PPQA	Process and Product Quality Assurance
CAR	Causal Analysis and Resolution

# Continuous CMMI Structure



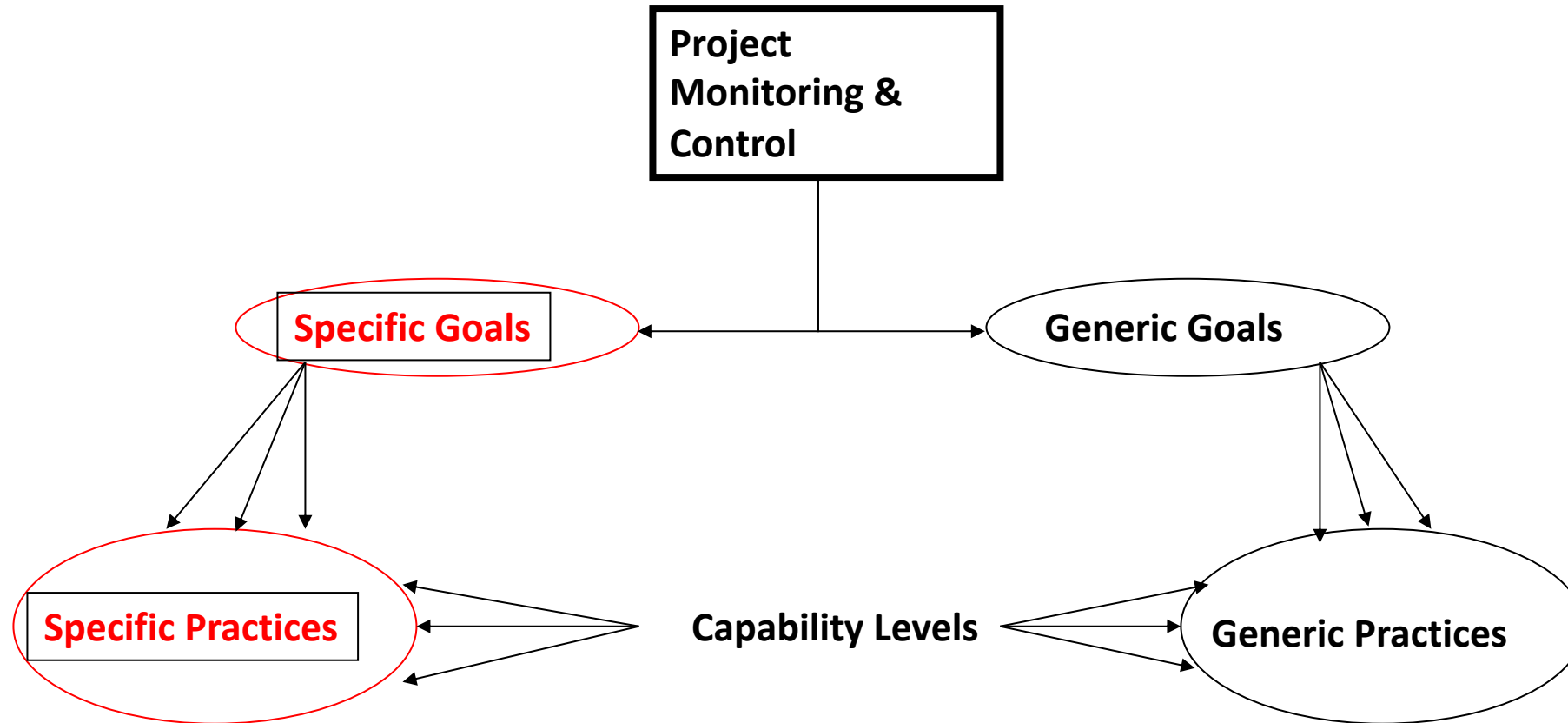
You can use this to monitor the projects of lower year students

You can use this to monitor the projects of lower year students

# Continuous CMMI

- The purpose of Project Monitoring and Control (PMC) 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
- A project plan:
  - For monitoring activities, communicating status, and taking corrective action.
  - Progress is primarily determined by comparing actual work product and task attributes, effort, cost, and schedule to the plan at prescribed milestones or control levels in the project schedule or WBS
  - When actual status deviates significantly from expected values, corrective actions are taken as appropriate.
    - These actions can require re-planning, which can include revising the original plan, establishing new agreements, or including additional mitigation activities in the current plan

# Continuous CMMI Structure



# Project Monitoring and Control

SG	SP	Description
SG1		Monitor the project against the plan
	SP1.1	Monitor project planning parameters
	SP1.2	Monitor commitments
	SP1.3	Monitor project risks
	SP1.4	Monitor data management
	SP1.5	Monitor stakeholders involvement
	SP1.6	Conduct progress reviews
	SP1.7	Conduct milestones reviews
SG2		Manage corrective actions to closure
	SP2.1	Analyze issues
	SP2.2	Take corrective action
	SP2.3	Manage corrective action

# SG 1 -> SP 1.6 Conduct Progress Reviews

- A project's progress is the project's status as viewed at a particular time when the project activities performed so far and their results and impacts are reviewed with relevant stakeholders to determine whether there are significant issues or performance shortfalls to be addressed
- Example Work Product:
  - Documented project review results
- Sub Practices:
  - Regularly communicate status on assigned activities and work products to relevant stakeholders
  - Review the results of collecting and analyzing measures for controlling the project
  - Identify and document significant issues and deviations from the plan
  - Document change requests and problems identified in work products and processes
  - Document the results of reviews
  - Track change requests and problem reports to closure

# SG 2 -> SP 2.1 Analyse Issues

- Collect and analyse issues and determine corrective actions to address them
- Example Work Product:
  - List of issues requiring corrective actions
- Sub Practices:
  - Gather issues for analysis
    - Issues discovered when performing technical reviews, verification, and validation
    - Significant deviations in project planning parameters from estimates in the project plan
    - Commitments (either internal or external) that have not been satisfied
    - Significant changes in risk status
    - Data access, collection, privacy, or security issues
    - Stakeholder representation or involvement issues
    - Product, tool, or environment transition assumptions (or other customer or supplier commitments) that have not been achieved
  - Analyse issues to determine the need for corrective actions



# CMMI for DEV 1.3 Process Areas

## Process Management PA

---

OPD	Organizational Process Definition
OPF	Organizational Process Focus
OPM	Organizational Process Management
OPP	Organizational Process Performance
OT	Organizational Training

## Project Management PA

---

PP	Project Planning
PMC	Project Monitoring and Control
REQM	Requirements Management
RSKM	Risk Management
IPM	Integrated Project Management
SAM	Supplier Agreement Management
QPM	Quantitative Project Management

## Engineering PA

---

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

## Supporting PA

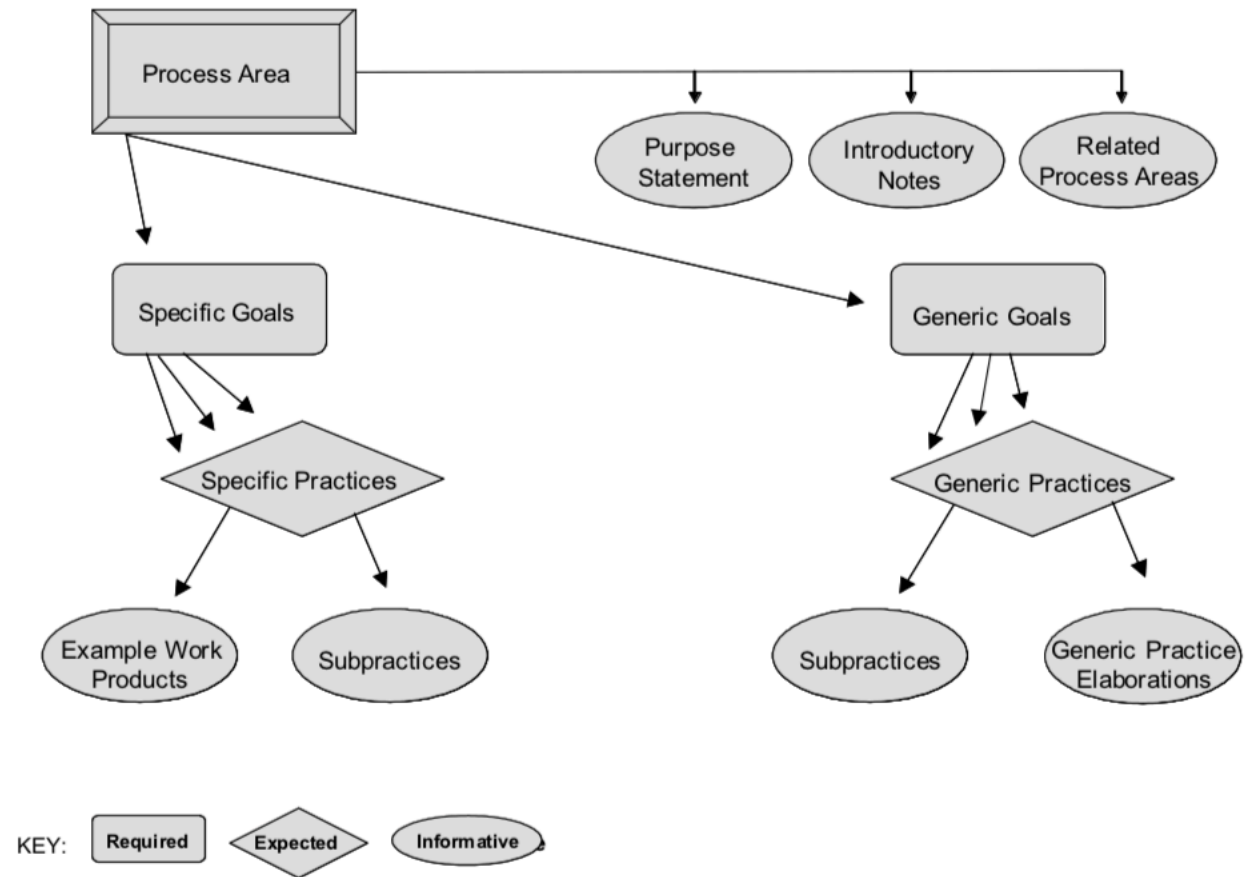
---

CM	Configuration Management
DAR	Decision Analysis and Resolution
MA	Measurement and analysis
PPQA	Process and Product Quality Assurance
CAR	Causal Analysis and Resolution

**Mentimeter -> which one is important!**

Go to [www.menti.com](http://www.menti.com) and use the code 34 67 87 7

# Continuous CMMI Structure



# CMMI for DEV 1.3 General Goals

---

<i>Generic Goal</i>	<i>Progression of Processes</i>
GG 1	Performed process
GG 2	Managed process
GG 3	Defined process

---

# CMMI for DEV 1.3 General Goals 2.0

## **GG2 Institutionalize a Managed Process**

---

- GP2.1 Establish organizational policy
- GP2.2 Plan the process
- GP2.3 Provide Resources
- GP2.4 Assign Responsibility
- GP2.5 Train People
- GP2.6 Control Work Products
- 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

There are more!

# General Goals 2.2->Plan the Process

- ***Establish and maintain the plan for performing the process.***
  - The purpose of this generic practice is to determine what is needed to perform the process and to achieve the established objectives, to prepare a plan for performing the process, to prepare a process description, and to get agreement on the plan from relevant stakeholders.

# General Practices 2.2->Plan the Process

The plan for performing the process typically includes the following:

- Process description
- Standards and requirements for the work products and services of the process
- Specific objectives for the execution of the process and its results (e.g., quality, time scale, cycle time, use of resources)
- Dependencies among the activities, work products, and services of the process
- Resources (e.g., funding, people, tools) needed to perform the process
- Assignment of responsibility and authority
- Training needed for performing and supporting the process
- Work products to be controlled and the level of control to be applied
- Measurement requirements to provide insight into the execution of the process, its work products, and its services
- Involvement of relevant stakeholders
- Activities for monitoring and controlling the process
- Objective evaluation activities of the process
- Management review activities for the process and the work products

# CMMI Benefits

- Reducing the opportunity for defects to occur
- Data will enable understanding of where a defect was inserted and where it was detected in the lifecycle
- Improving predictability of projects
- Focus on what is required to get projects back on track earlier in the lifecycle
- Improve profitability
- Culture for maintaining Quality in projects starts in the mind of the junior programmers to the senior programmers and project managers
- Cost saving in terms of lesser effort due to less defects and less rework
- On-Time Deliveries
- Increased Customer Satisfaction