

*An Introduction to CMMI*

## *The CMMI Model*



## *SEI Trademarks and Service Marks*

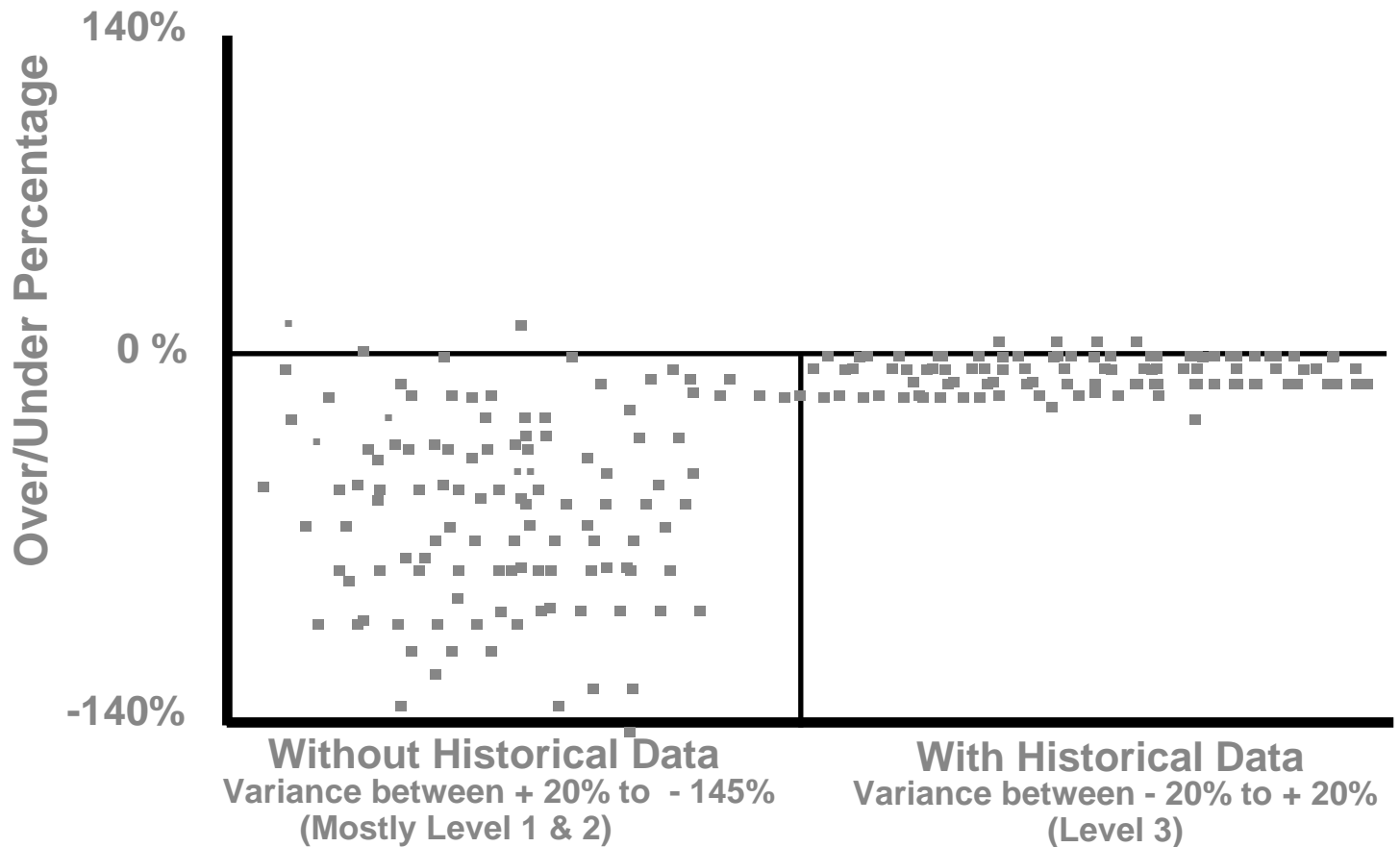
- <sup>SM</sup> CMM Integration SCAMPI are service marks of Carnegie Mellon University
- <sup>®</sup> Capability Maturity Model, Capability Maturity Modeling, CMM, and CMMI are registered in the U.S. Patent & Trademark Office

# *Agenda*

- Why CMMI?
- What is CMMI?
- Where does it come from and fit into?
- How does it look like?
- What can you achieve?

# *Improved Schedule and Budget Predictability*

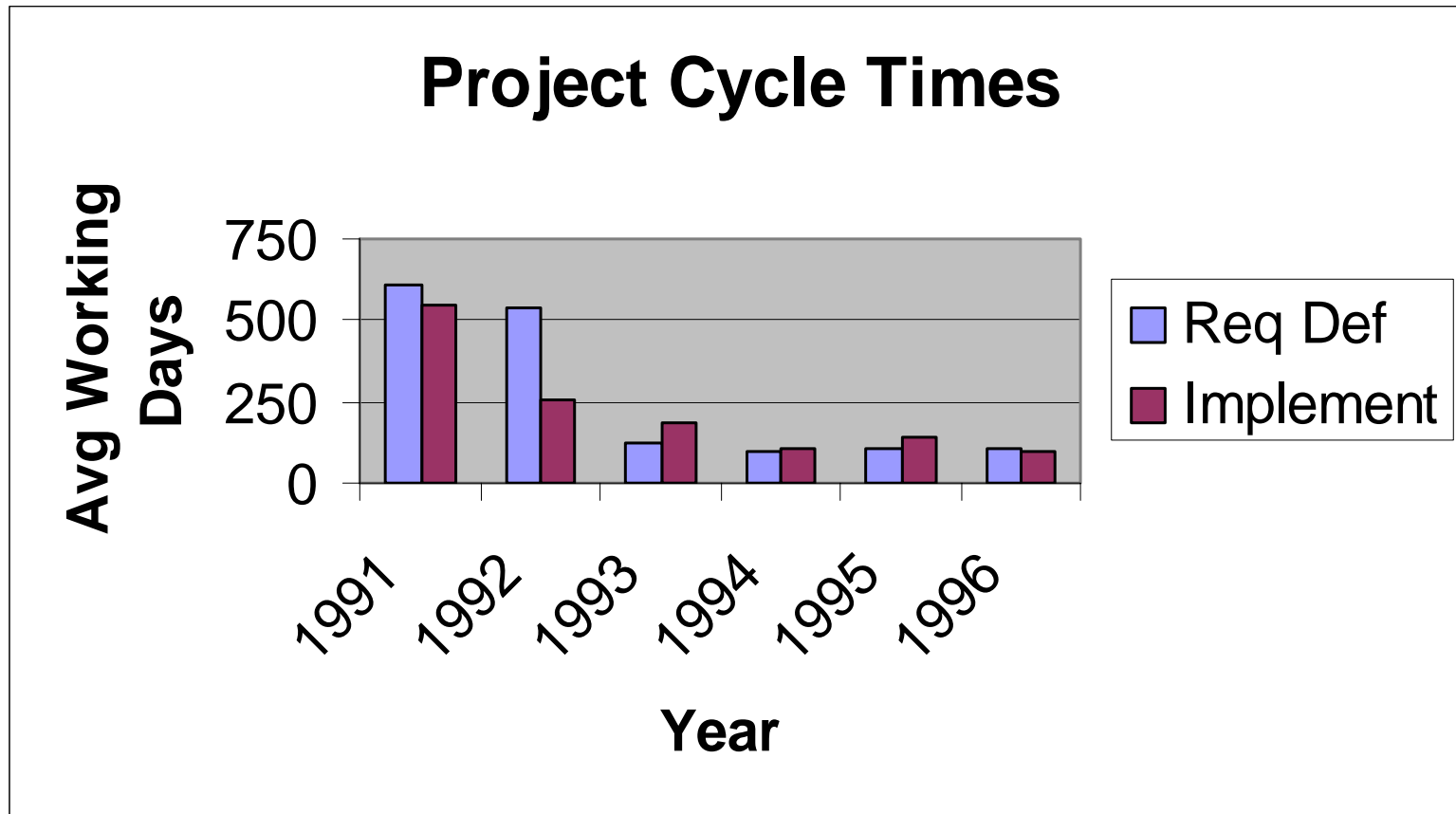
## *Results: Boeing Effort Estimation*



(Based on 120 projects in Boeing Information Systems)

Reference: John D. Vu. "Software Process Improvement Journey: From Level 1 to Level 5."  
7th SEPG Conference, San Jose, March 1997.

# Improved Cycle Time

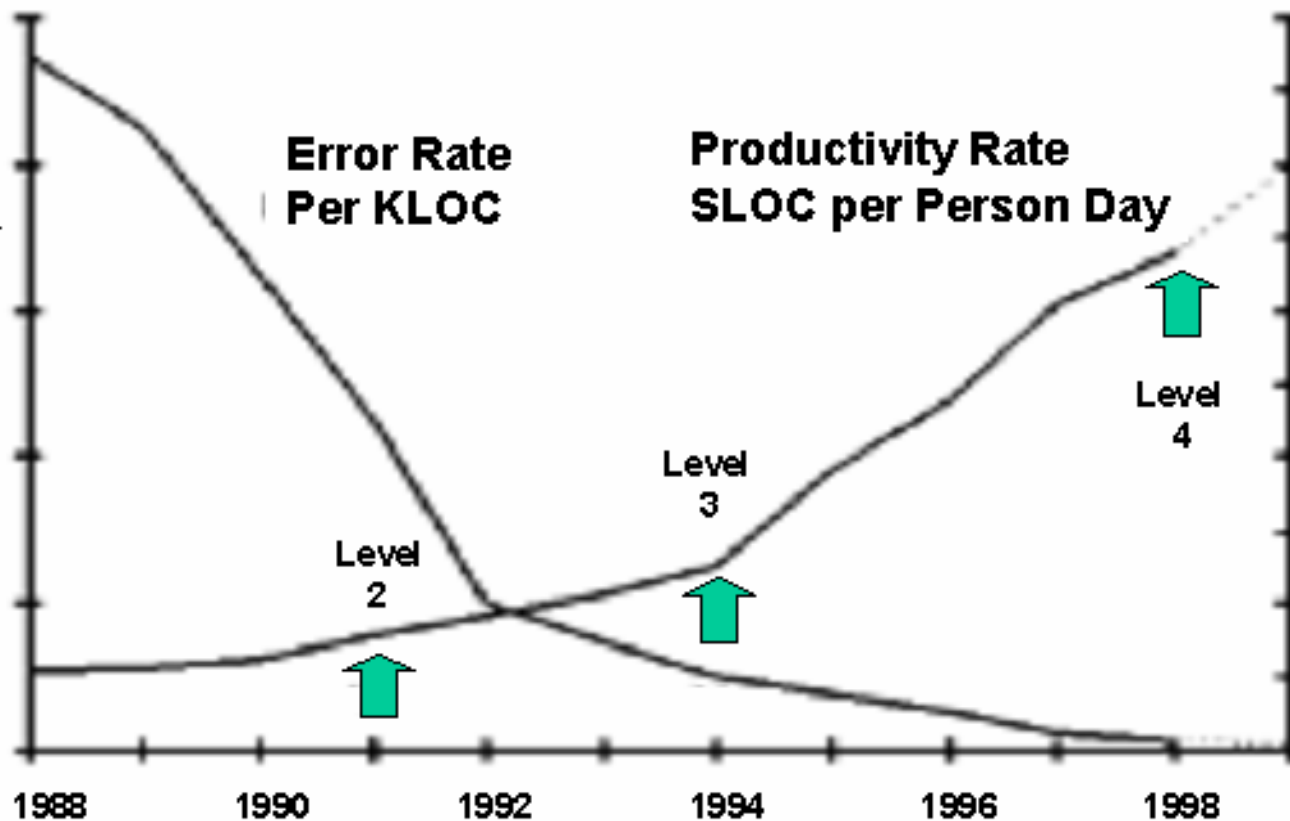


Source: Software Engineering Div., Hill AFB, Published in Crosstalk May 1999

# Increased Productivity and Quality

## Productivity Rate and Quality Performance

\* For Software Programs



**Productivity  
Increased By  
80% As Error  
Rates  
Decreased**

## *Why Base Your Organization's Process Improvement Success on the CMMI?*

- First and foremost the **emphasis is on developing processes** and changing cultures to show a measurable benefit for the organization's business objectives and vision
- Provides a **framework** from which to organize and **prioritize** engineering, people, and business activities
- Supports the **coordination of multi-disciplined activities** that may be required to successfully **build a product** or application
- Adds “**Engineering Systems Thinking**” back into building systems

# *Agenda*

- Why CMMI?
- What is CMMI?
- Where does it come from and fit into?
- How does it look like?
- What can you achieve?

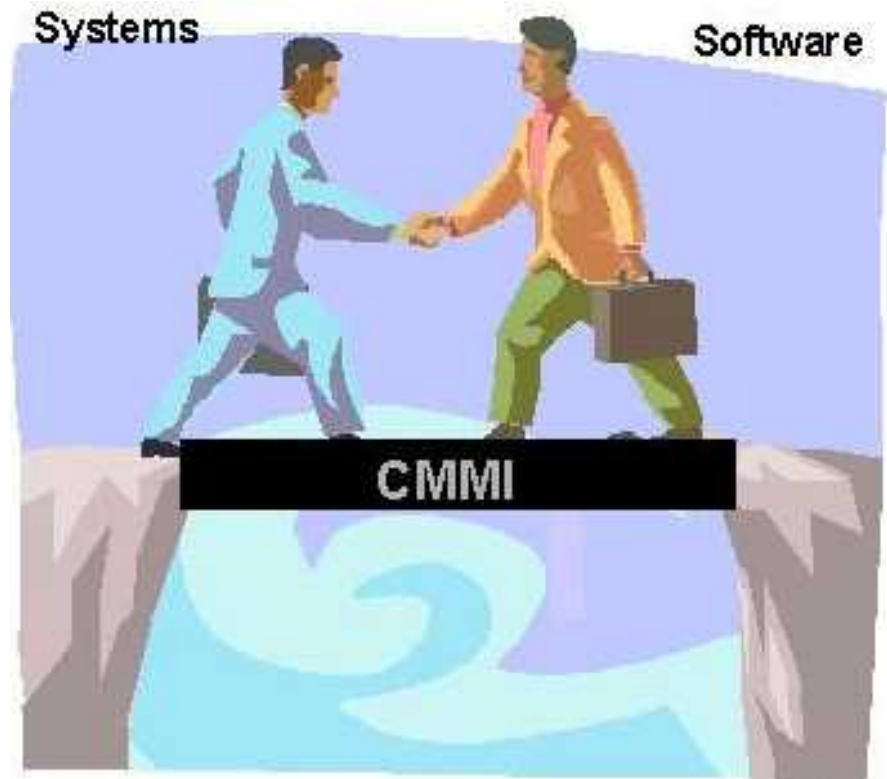


# *CMMI Model*

- Integrates systems and software disciplines into one process improvement framework.
- Provides a framework for introducing new disciplines as needs arise.
- CMMI-SE/SW/IPPD/SS, V1.1
  - ✦ Systems Engineering
  - ✦ Software Engineering
  - ✦ Integrated Product and Process Development
  - ✦ Supplier Sourcing
  
- Describes the WHAT?                      Not the HOW?

## *Bridging the Divide*

- Systems engineering and software engineering processes are integrated.
- Integrates systems and software disciplines into one process improvement framework.
- Provides a framework for introducing new disciplines as needs arise.



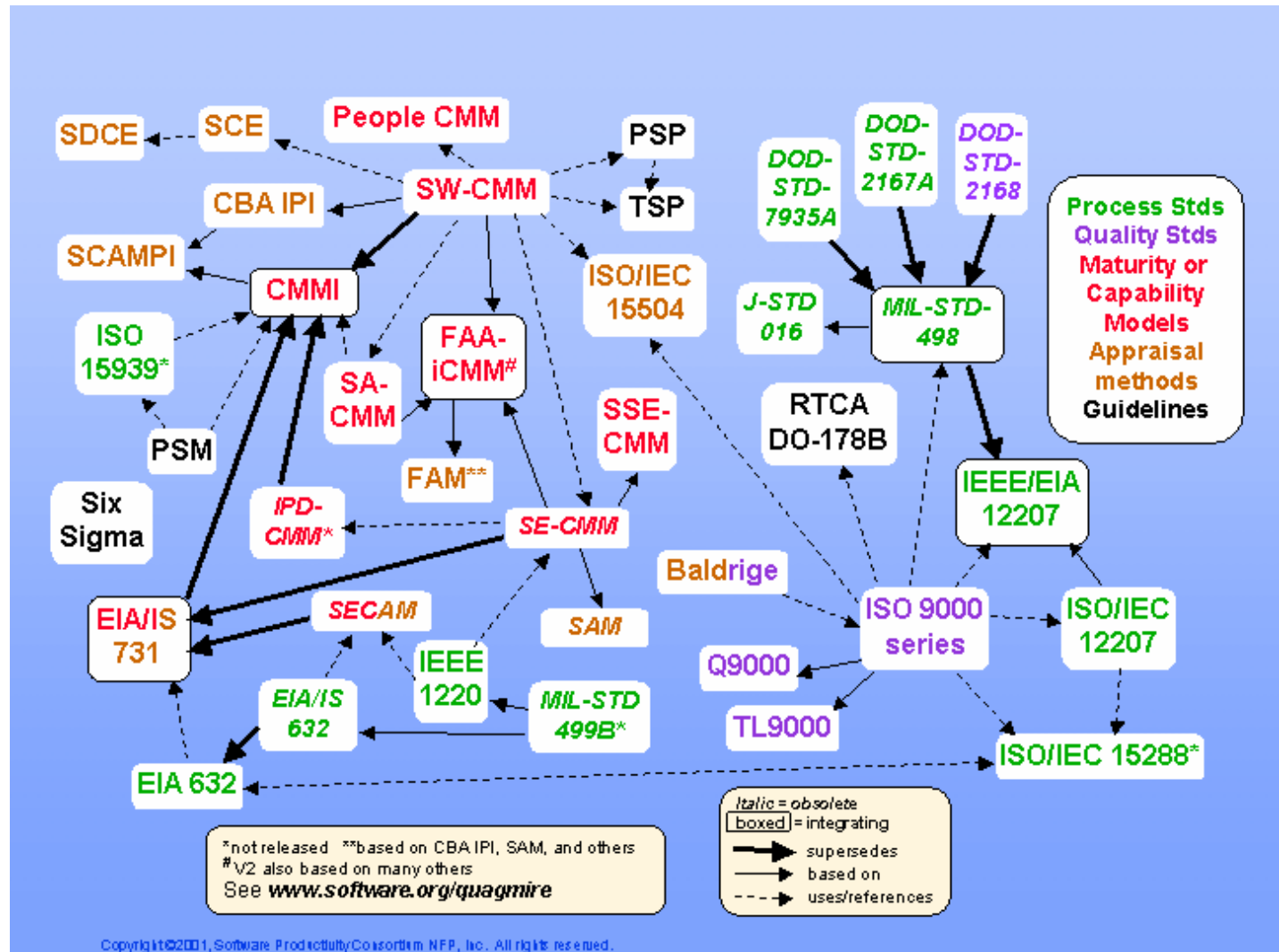
# *Agenda*

- Why CMMI?
- What is CMMI?
- Where does it come from and fit into?
- How does it look like?
- What can you achieve?

# *The CMM Explosion*

- The first CMM (CMM v1.0) was developed for software and released in August 1991
- Based on this success and the demand from other interests CMMs were developed for other disciplines and functions
  - ✦ Systems Engineering
  - ✦ People
  - ✦ Integrated Product Development
  - ✦ Software Acquisition
  - ✦ Software Quality Assurance
  - ✦ Measurement
  - ✦ Others.....

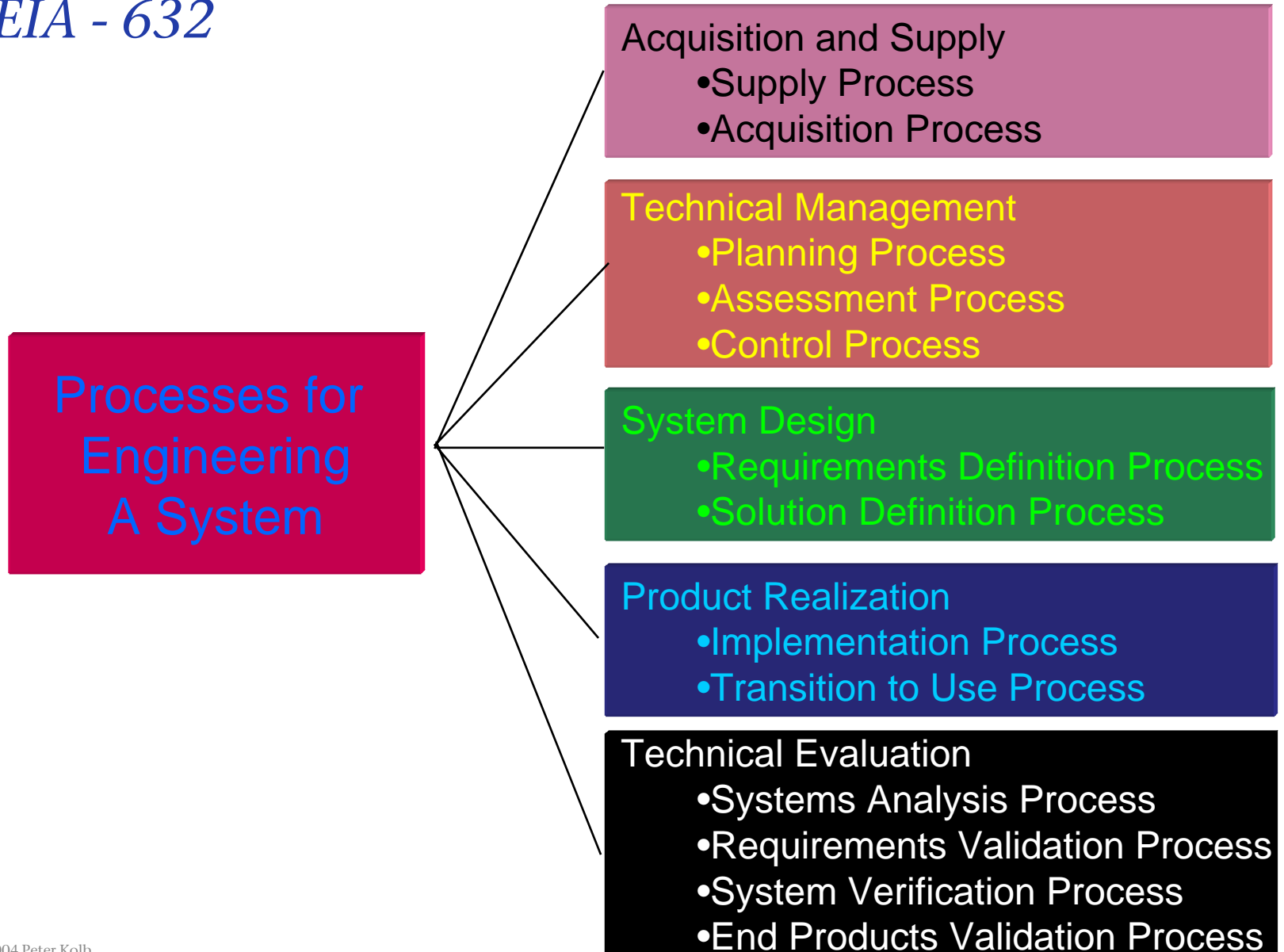
# World of Standards



<http://www.software.org/quagmire/>

# *Fundamental Processes for Engineering a System*

*EIA - 632*



# *ISO 9001:2000 vs CMMI*

# *ISO 9001:2000*

## *vs CMMI*

### ● ISO 9001:2000

#### ✦ No explicit requirements for

##### ● Institutionalization

##### ● Creating and maintaining organizational process assets

###### ✦ Organizational Measurement Repository

###### ✦ Database of good and best practices

##### ● Misses details for the following process areas

###### ✦ Organizational Training (Lvl 3)

###### ✦ Risk Management (Lvl 3)

###### ✦ Decision Analysis and Resolution (Lvl 3)

###### ✦ Organization Process Performance (Lvl 4)

###### ✦ Quantitative Project Management (Lvl 4)

###### ✦ Organization Innovation and Deployment (Lvl 5)

###### ✦ Causal Analysis (Lvl 5)



## *The Support of CMMI to ISO 9001:2000*

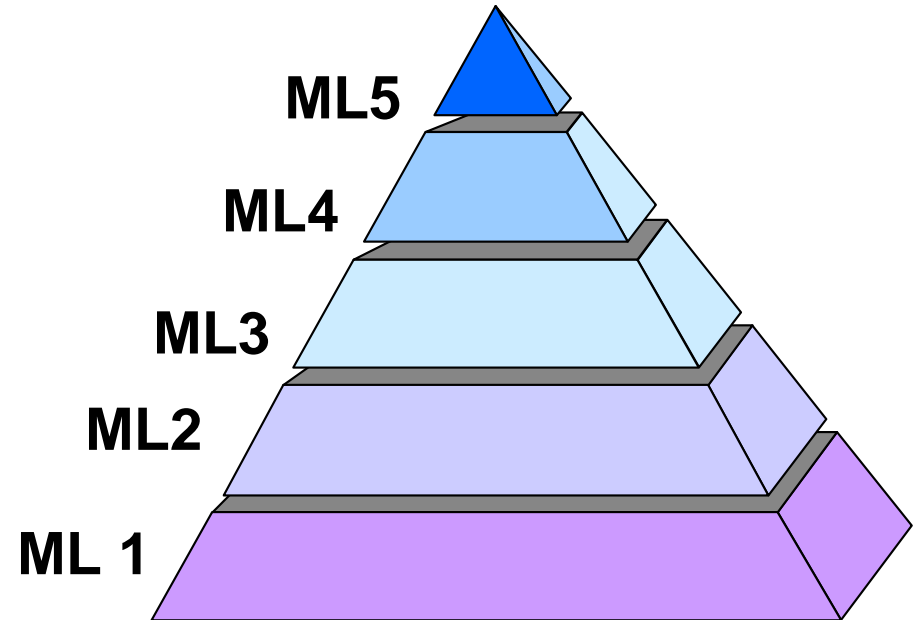
- Organizations at the CMMI Maturity Level 3 will be ready for ISO 9001:2000 registration with minor adjustments
- Organizations registered as ISO 9001:2000 compliant will require additional effort to reach the CMMI Level 2 or 3
  - ✦ The CMMI path leverages the investment an organization may have in ISO 9001
  - ✦ Provides additional benefits especially in institutionalizing the engineering discipline
  - ✦ Takes an organization to the quantitative management level of process improvements

# *Agenda*

- Why CMMI?
- What is CMMI?
- Where does it come from and fit into?
- How does it look like?
- What can you achieve?

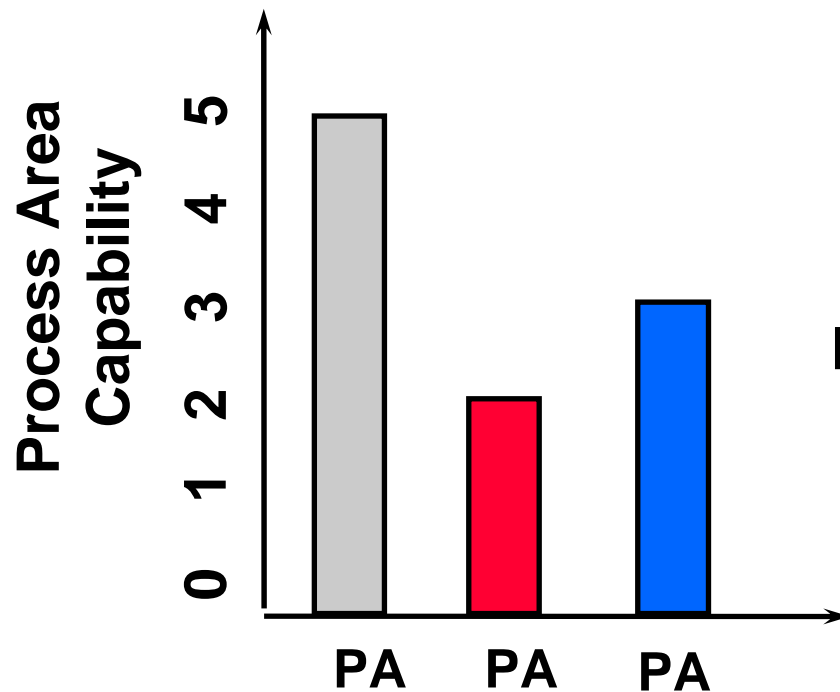
# Comparing Model Representations

**Staged**



...for an established set of process areas across an organization

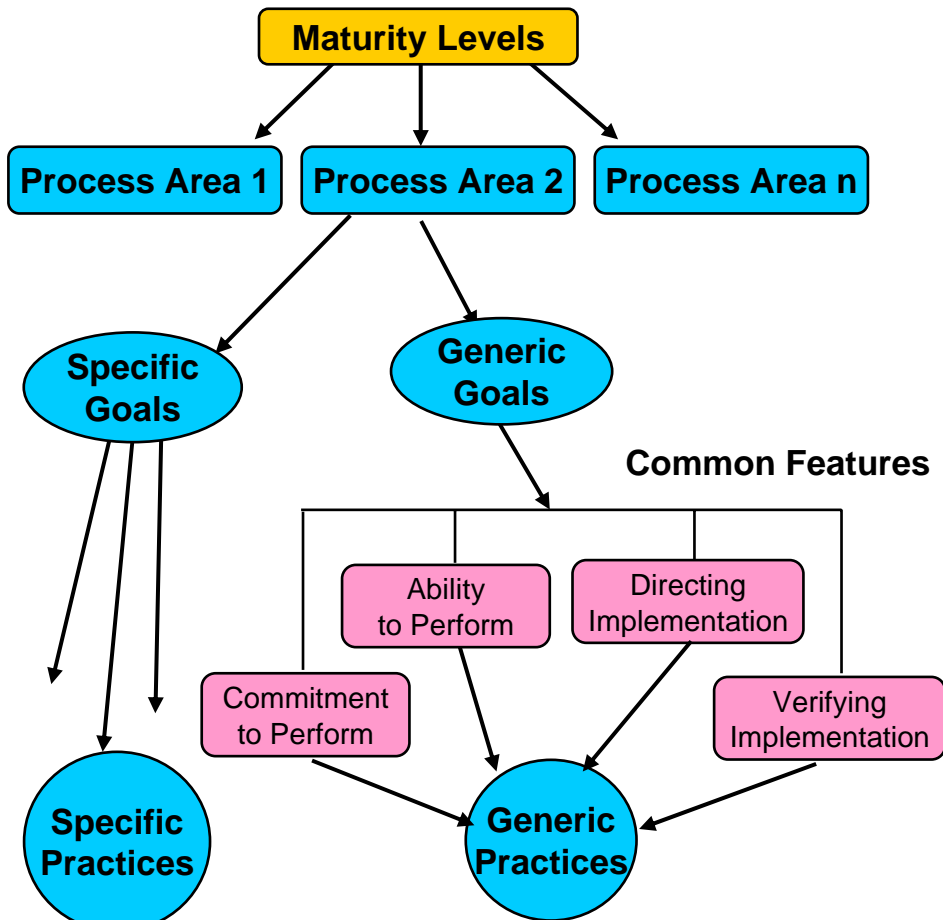
**Continuous**



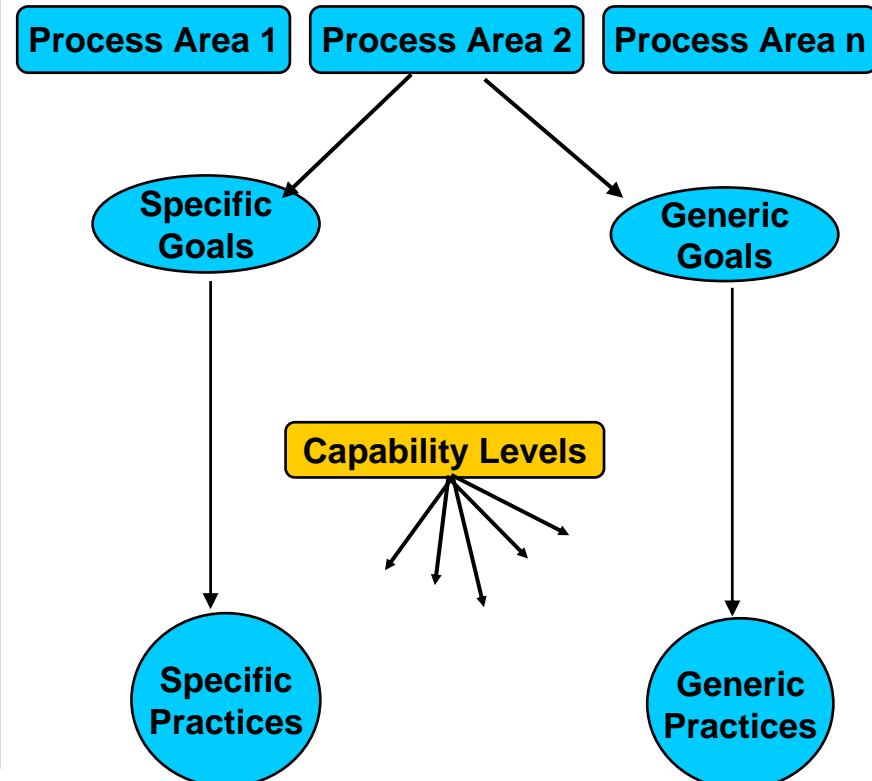
...for a single process area or a set of process areas

# CMMI Model Structure

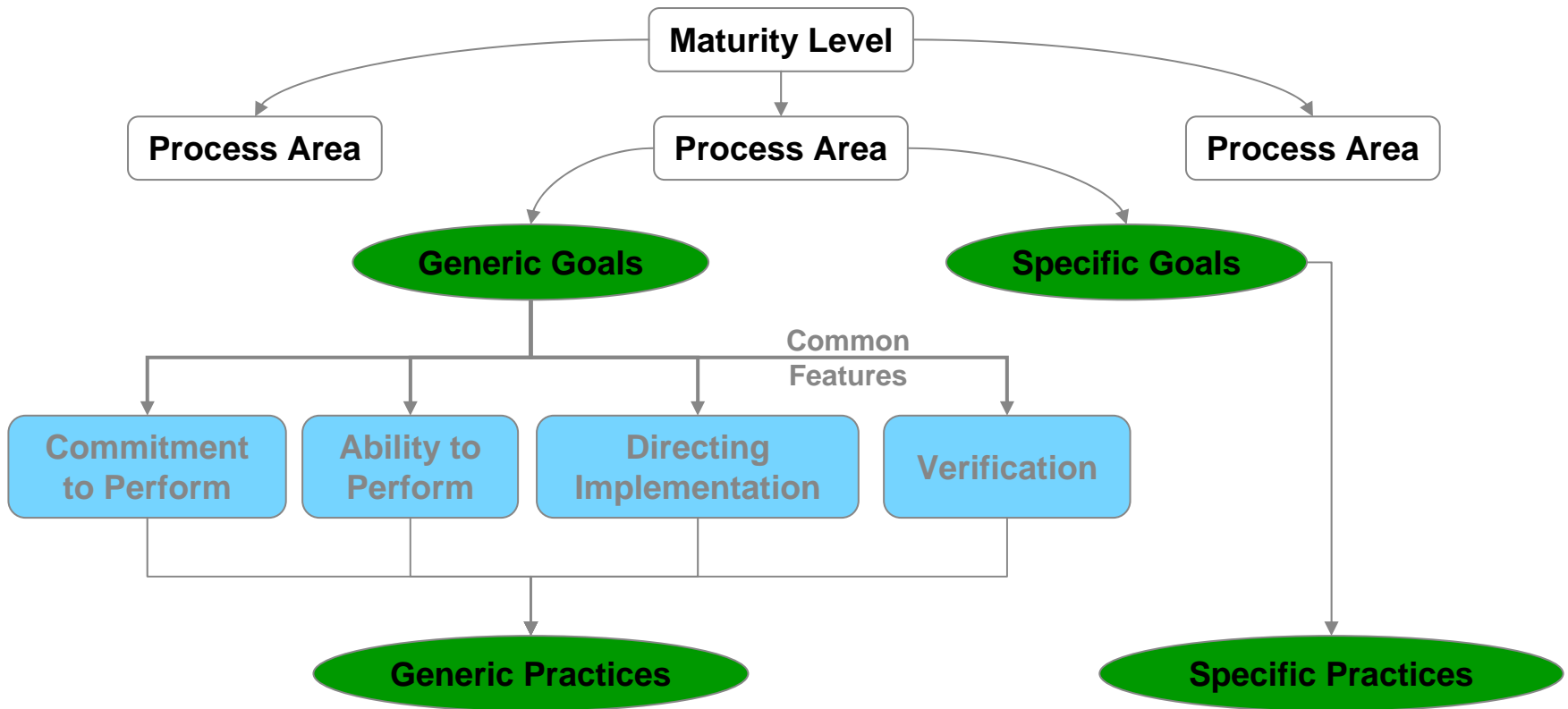
## Staged



## Continuous



# Structure of the CMMI Staged Representation



**Commitment to Perform:** creates policies and secures sponsorship for process improvement efforts

**Ability to Perform:** ensures that the project and/or organization has the resources it needs to pursue process improvement

**Directing Implementation:** collects, measures, and analyzes data related to processes

**Verification:** verifies that the projects and/or organization's activities conform to requirements, processes, and procedures

# *Model Terminology*

## ● Establish and Maintain

- ✦ This phrase connotes a meaning beyond the component terms; it includes documentation and usage.

## ● Work product

- ✦ The term “work product” is used throughout the CMMI Product Suite to mean any artifact produced by a process. These artifacts can include files, documents, parts of the product, services, processes, specifications, and invoices.

## ● Planned Process

- ✦ A process that is **documented both by a description and a plan**. The description and plan should be coordinated, and the plan should include standards, requirements, objectives, resources, assignments, etc.

## *Model Terminology -2*

### ● Performed Process

- ✎ A process that accomplishes the needed work to **produce identified output** work products using identified input work products. The specific **goals of the process area** are satisfied.

### ● Managed Process

- ✎ A “managed process” is a **performed process** that is planned and executed in accordance with **policy**; employs skilled people having adequate resources to produce controlled outputs; involves relevant stakeholders; is monitored, controlled, and reviewed; and is **evaluated for adherence** to its process description.

### ● 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; has a **maintained process description**; and contributes work products, measures, and other **process-improvement information** to the organizational process assets

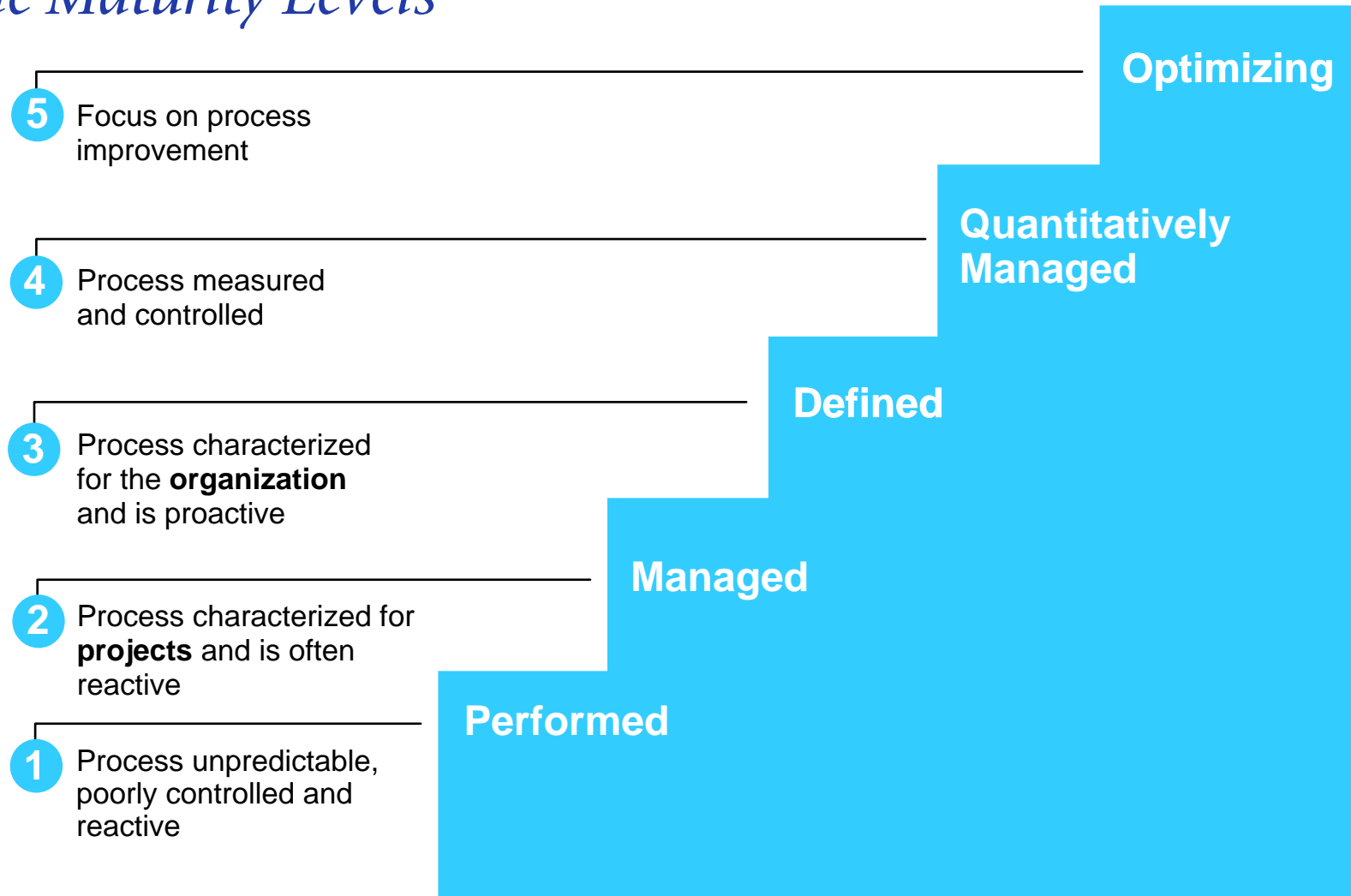
# Generic Practices

Level	Generic Goals	Generic Practices
2	<ul style="list-style-type: none"><li>● <b>Institutionalize a Managed Process</b></li></ul>	<ul style="list-style-type: none"><li>● GP 2.1 Establish an Organizational Policy</li><li>● GP 2.2 Plan the Process</li><li>● GP 2.3 Provide Resources</li><li>● GP 2.4 Assign Responsibility</li><li>● GP 2.5 Train People</li><li>● GP 2.6 Manage Configurations</li><li>● GP 2.7 Identify and Involve Relevant Stakeholders</li><li>● GP 2.8 Monitor and Control the Process</li><li>● GP 2.9 Objectively Evaluate Adherence</li><li>● GP 2.10 Review Status with Higher Level Mgmt</li></ul>
3	<ul style="list-style-type: none"><li>● <b>Institutionalize a Defined Process</b></li></ul>	<ul style="list-style-type: none"><li>● GP 3.1 Establish a Defined Process</li><li>● GP 3.2 Collect Improvement Information</li></ul>



# *Staged Representation*

# The Maturity Levels

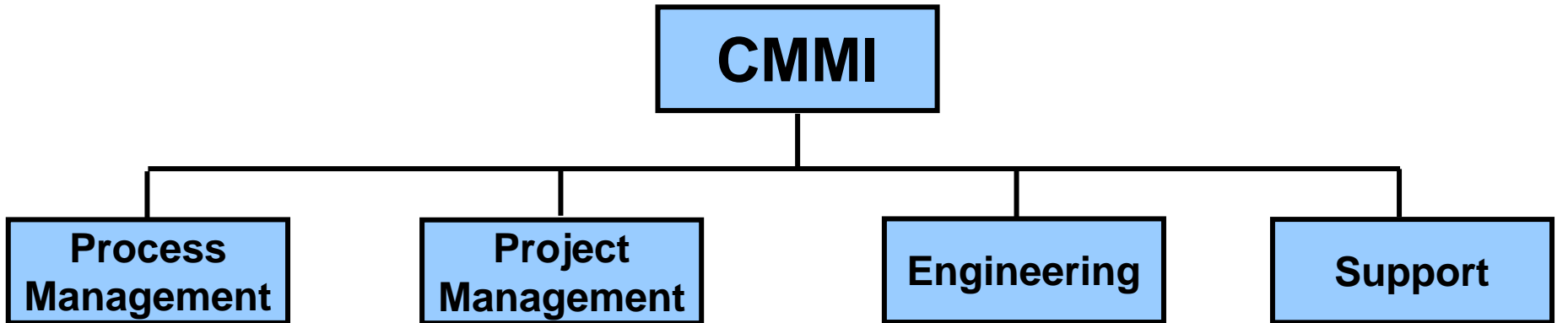


## Process Areas by Maturity Level

Level	Focus	Process Areas
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>  (SS)  (IPPD) (IPPD)	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Integrated Supplier Management Risk Management Decision Analysis and Resolution Organizational Environment for Integration Integrated Teaming
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 Performed		

# *Continuous Representation*

# *CMMI-SE/SW/IPPD/SS Continuous*



- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Mgmt.
- Integrated Project Mgmt.
- Risk Management
- Quantitative Project Mgmt.
- Integrated Supplier Mgmt.
- Integrated Teaming
- Integrated Project Mgmt. for IPPD

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

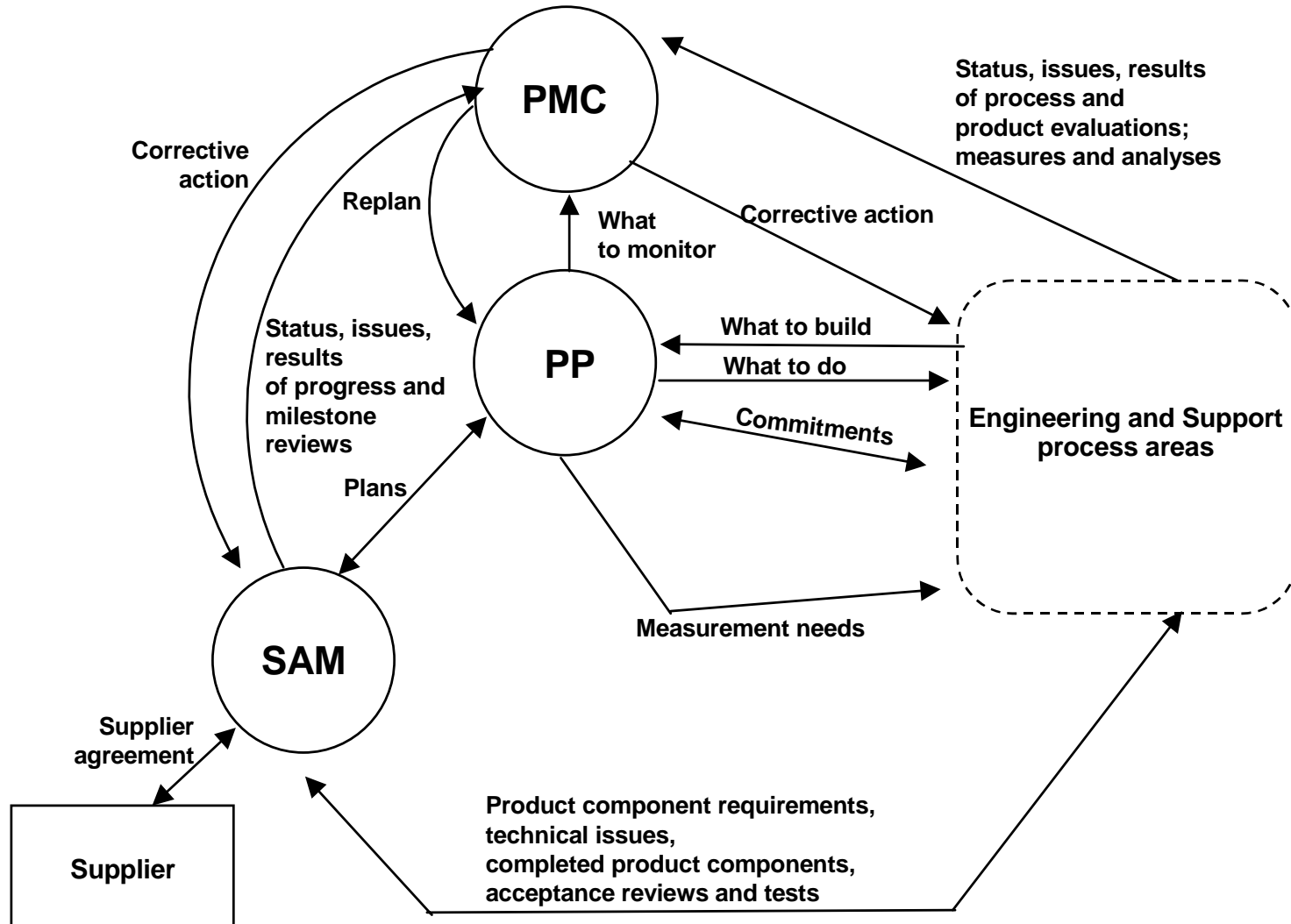
- Configuration Mgmt.
- Process and Product Quality Assurance
- Measurement & Analysis
- Decision Analysis and Resolution
- Causal Analysis and Resolution
- Organizational Environment For Integration

# Basic Project Management

PP: Project Planning

PMC: Project Monitoring & Control

SAM: Supplier Agreement Mgmt



# Engineering

RD: Requirements Development

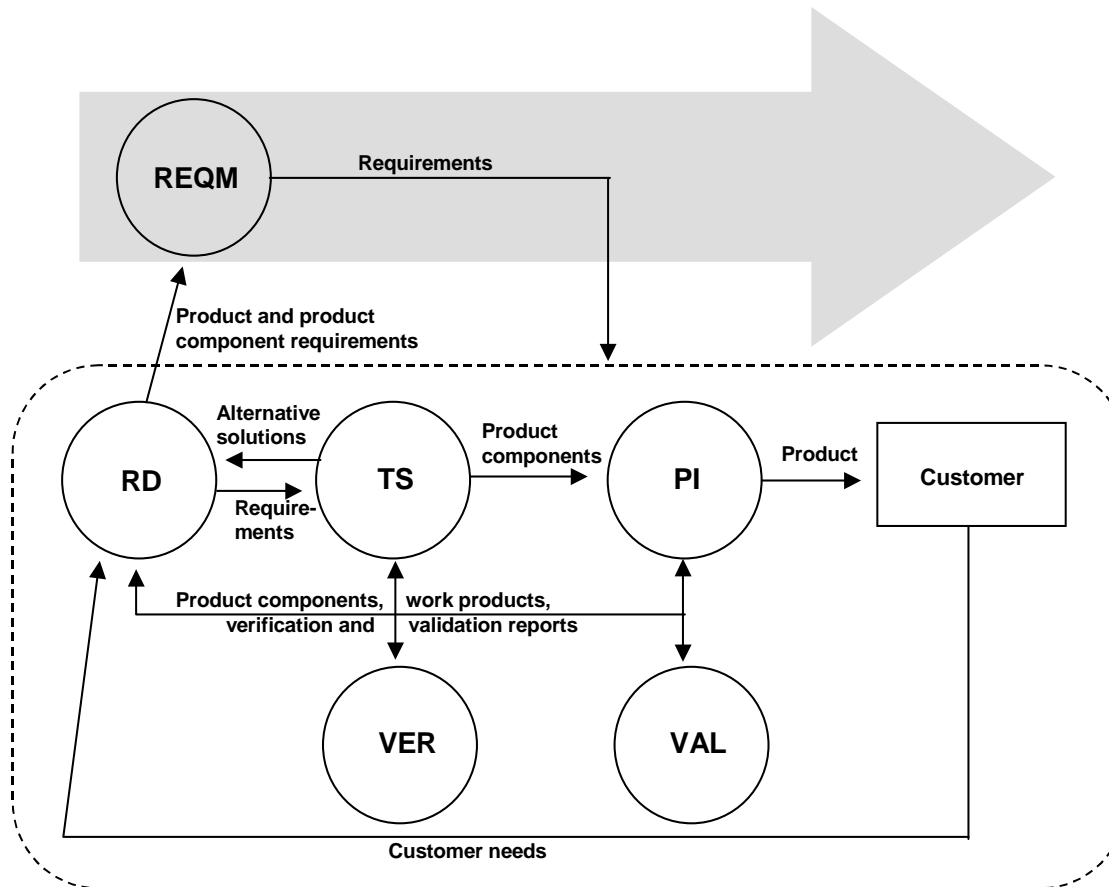
TS: Technical Solution

REQM: Requirements Mgmt

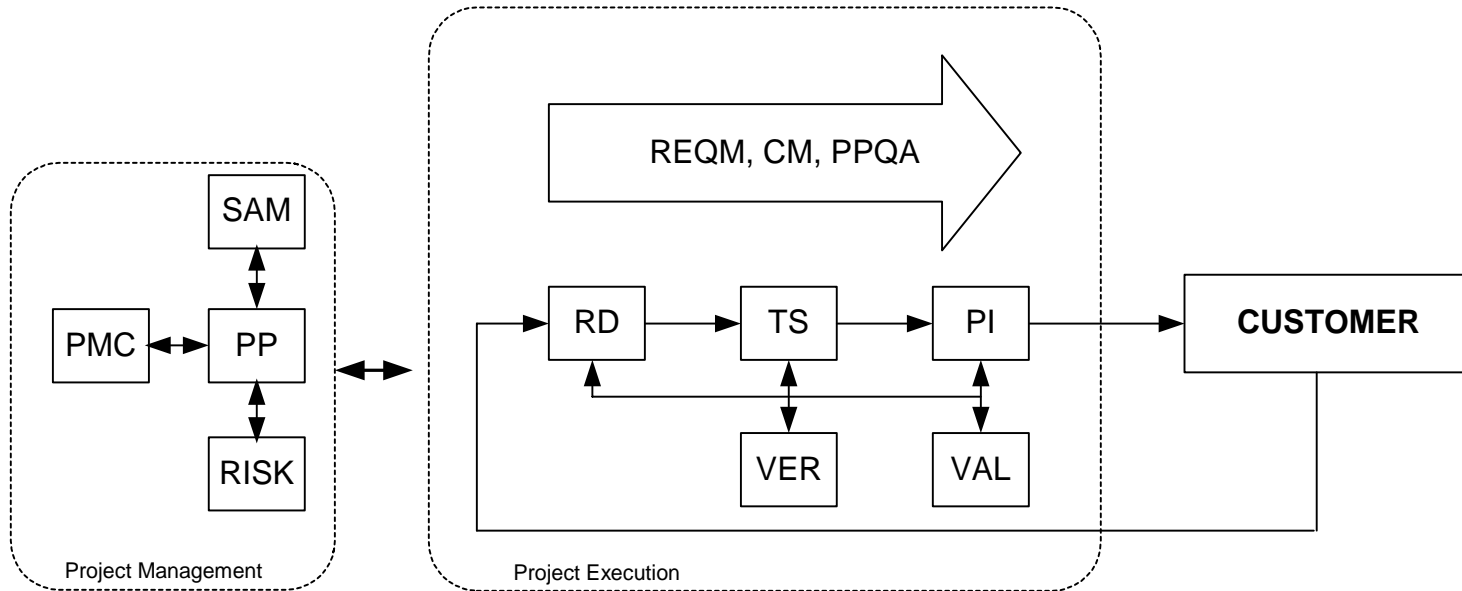
VER: Verification

PI: Product Integration

VAL: Validation



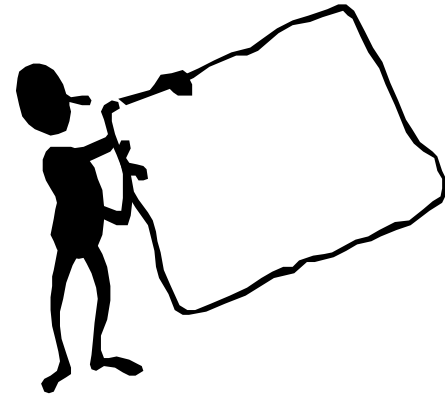
# *CMMI Process Areas for R&D Projects*





# *Appraisal Requirements for CMMI (ARC)* *v1.1*

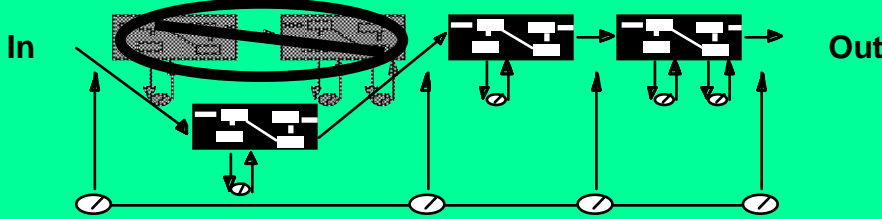
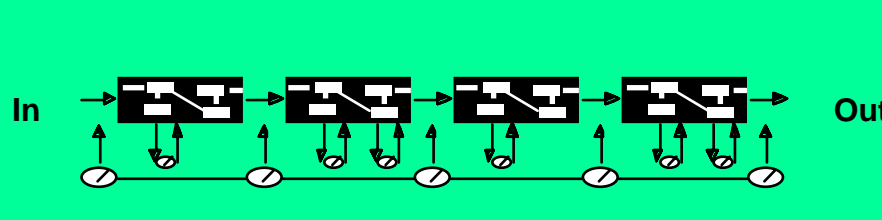
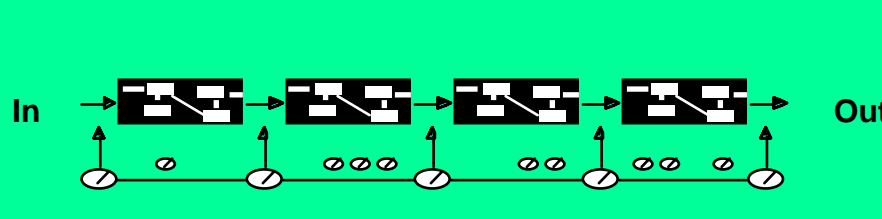
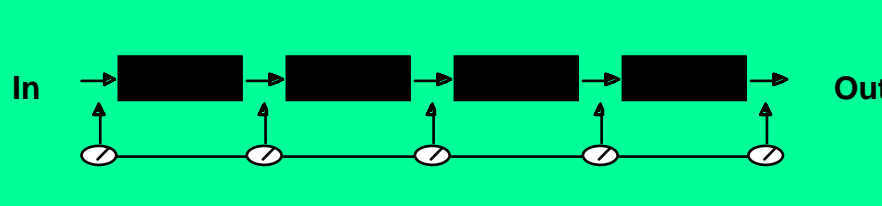
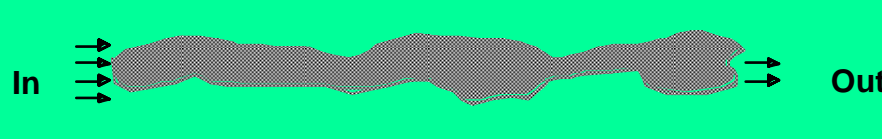
- A guide to appraisal method developers
- Specifies the requirements for classes of appraisal methods
  - ✦ Class A: Full, comprehensive appraisal methods
  - ✦ Class B: Initial, incremental, self-appraisals
  - ✦ Class C: Quick-look
- Method developers can declare which class their method fits
- Implications of the desired class of appraisal



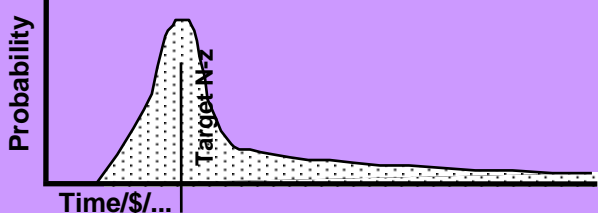
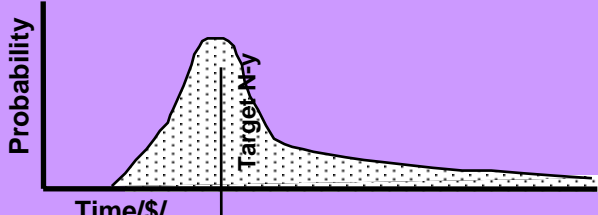
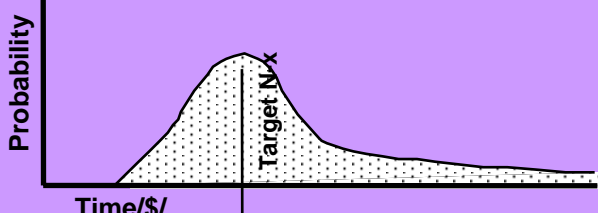
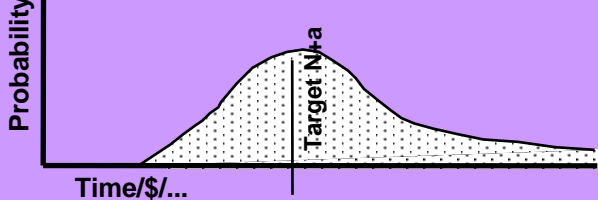
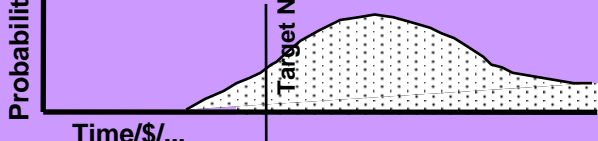
# *Agenda*

- Why CMMI?
- What is CMMI?
- Where does it come from and fit into?
- How does it look like?
- What can you achieve?

# Management Visibility by Maturity Level

Level	Process Characteristics	Management Visibility
<p><b>5</b> Optimizing</p>	<p>Focus is on continuous quantitative improvement</p>	
<p><b>4</b> Quantitatively Managed</p>	<p>Process is measured and controlled</p>	
<p><b>3</b> Defined</p>	<p>Process is characterized for the organization and is proactive</p>	
<p><b>2</b> Managed</p>	<p>Process is characterized for projects and is often reactive</p>	
<p><b>1</b> Initial</p>	<p>Process is unpredictable, poorly controlled, and reactive</p>	

# Process Capability Prediction

Level	Process Characteristics	Predicted Performance
<p>5</p> <p><b>Optimizing</b></p>	<p>Focus is on continuous quantitative improvement</p>	
<p>4</p> <p><b>Quantitatively Managed</b></p>	<p>Process is measured and controlled</p>	
<p>3</p> <p><b>Defined</b></p>	<p>Process is characterized for the organization and is proactive</p>	
<p>2</p> <p><b>Managed</b></p>	<p>Process is characterized for projects and is often reactive</p>	
<p>1</p> <p><b>Initial</b></p>	<p>Process is unpredictable, poorly controlled, and reactive</p>	

# People Implications of Process Maturity

Level	Process Characteristics	People Implications
<b>5</b> Optimizing	Focus is on continuous quantitative improvement	Focus on "fire prevention"; improvement anticipated and desired, and impacts assessed
<b>4</b> Quantitatively Managed	Process is measured and controlled	Sense of teamwork and inter-dependencies
<b>3</b> Defined	Process is characterized for the organization and is proactive	Increased reliance on defined process; investment in people and process as corporate assets
<b>2</b> Managed	Process is characterized for projects and is often reactive	Overreliance on experience of good people – when they go, the process goes
<b>1</b> Initial	Process is unpredictable, poorly controlled, and reactive	Focus on "fire fighting"; effectiveness low – frustration high

# Risk Implications of Process Maturity

Level	Process Characteristics	Results				
<p><b>5</b> Optimizing</p>	<p>Focus is on continuous quantitative improvement</p>	<p><b>P</b> <b>r</b> <b>o</b> <b>d</b> <b>u</b> <b>c</b> <b>t</b> <b>i</b> <b>v</b> <b>i</b> <b>t</b> <b>y</b></p>	<p><b>Q</b> <b>u</b> <b>a</b> <b>l</b> <b>i</b> <b>t</b> <b>y</b></p>	<p><b>R</b> <b>i</b> <b>s</b> <b>k</b></p>	<p><b>C</b> <b>u</b> <b>s</b> <b>t</b> <b>o</b> <b>m</b> <b>e</b> <b>r</b></p>	<p><b>S</b> <b>a</b> <b>t</b> <b>i</b> <b>s</b> <b>f</b> <b>a</b> <b>c</b> <b>t</b> <b>i</b> <b>o</b> <b>n</b></p>
<p><b>4</b> Quantitatively Managed</p>	<p>Process is measured and controlled</p>					
<p><b>3</b> Defined</p>	<p>Process is characterized for the organization and is proactive</p>					
<p><b>2</b> Managed</p>	<p>Process is characterized for projects and is often reactive</p>					
<p><b>1</b> Initial</p>	<p>Process is unpredictable, poorly controlled, and reactive</p>					

# *For More Information About CMMI*

## ✦ Go to CMMI Website

- <http://sei.cmu.edu/cmmi>
- <http://seir.sei.cmu.edu/seir/>
- <http://jo.sei.cmu.edu/pub/english.cgi/0/323123>
- <http://dtic.mil/ndia> (first annual CMMI Conference)
- <http://www.faa.gov/aio>

## ✦ Assistance for government organizations:

- SW-CMM v1.1 to CMMI v1.1 Mappings
- Software Technology Support Center
- OO-ALC/TI-3
- 7278 4th Ave
- Hill AFB, UT 84056-5705
- <http://www.stsc.hill.af.mil>