The CMMI Model

SEI Trademarks and Service Marks

- SM CMM Integration SCAMPI are service marks of Carnegie Mellon University

- ® 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?

CMMI Experiences

- **SEI collects quantitative measures of CMMI performance improvement**

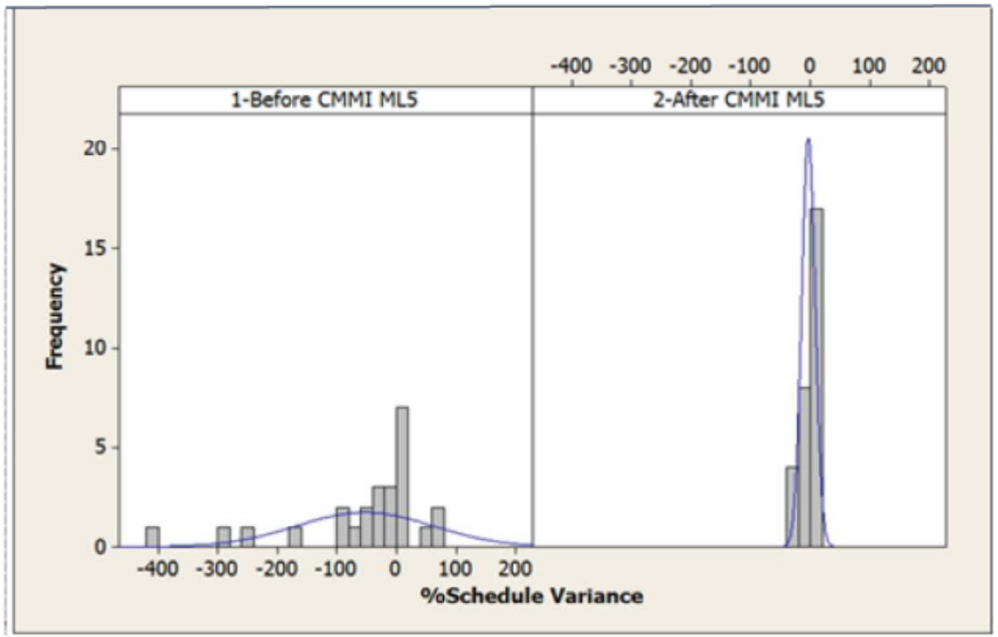
Performance Category	Median Improvement
Cost	34%
Schedule	50%
Productivity	61%
Quality	48%
Customer Satisfaction	14%
ROI	4.0 : 1
CMU/SEI-2006-TR-004. Data from 35 organizations.	

• Technical Report

http://www.sei.cmu.edu/pub/documents/06.reports/pdf/06tr004.pdf

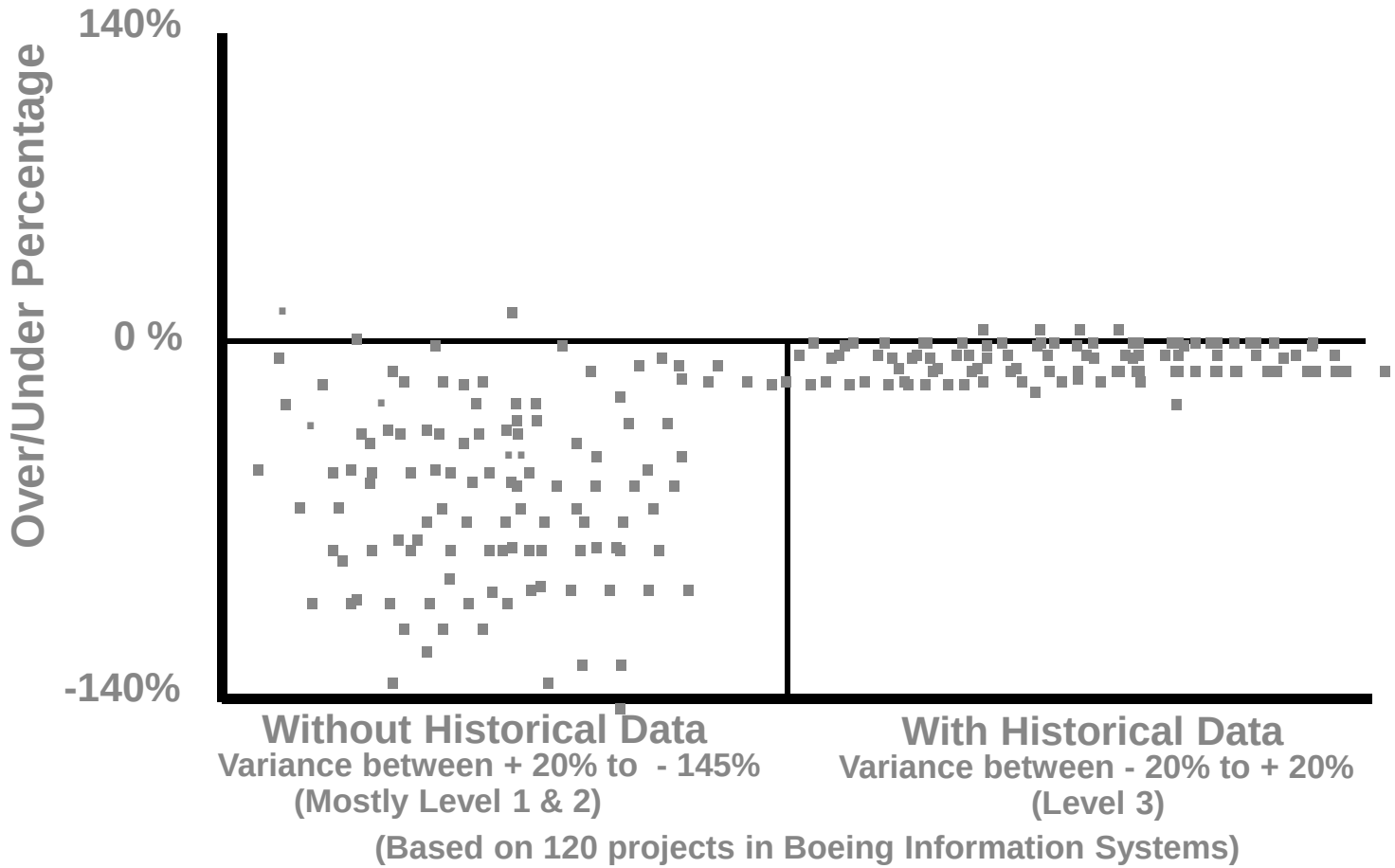
Example Benefit -2

The Software Maintenance Group at Warner Robins Air Logistics Center, a maturity level 5 organization, significantly reduced schedule variance.



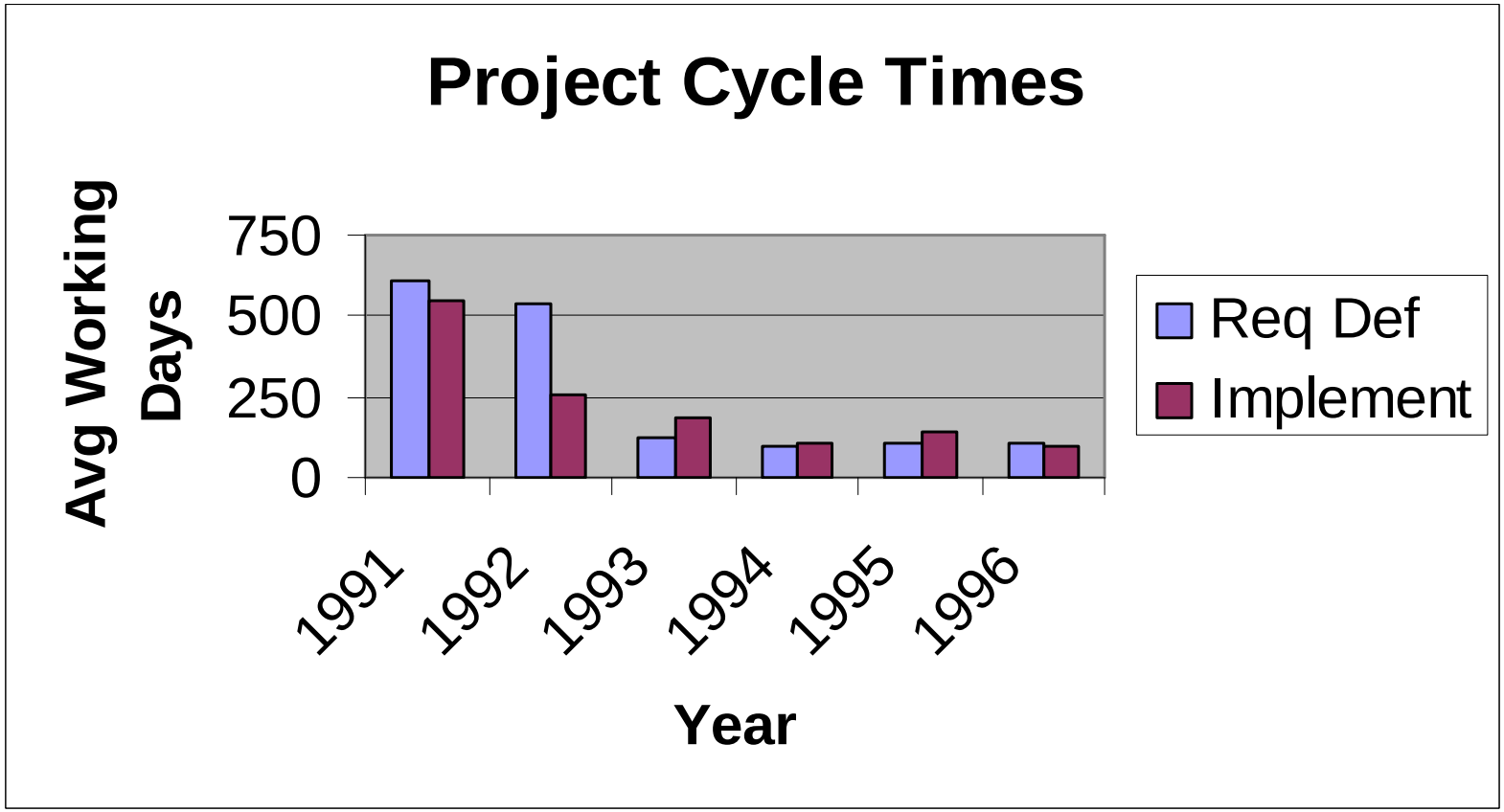
Improved Schedule and Budget Predictability

Results: Boeing Effort Estimation



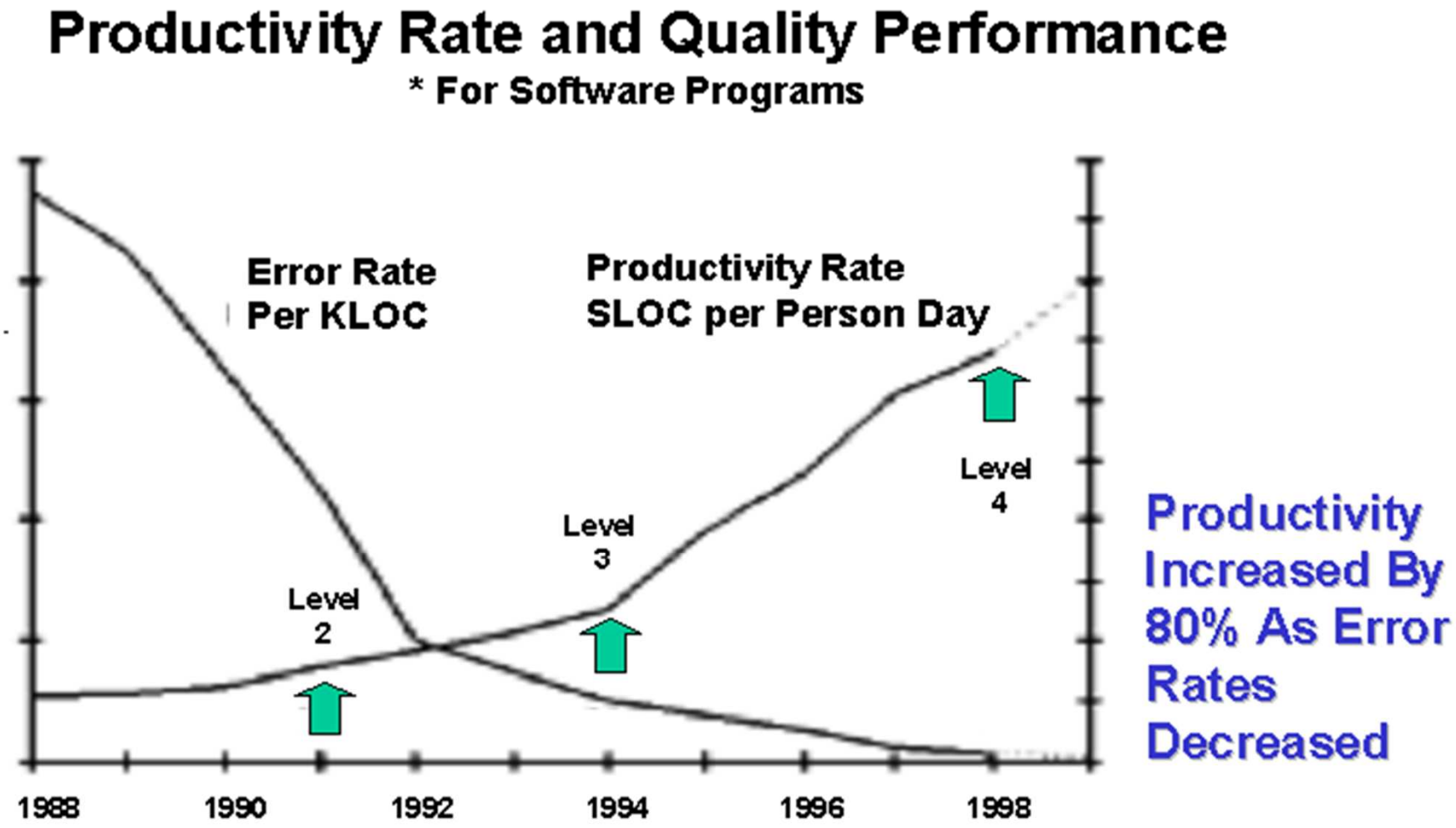
Reference: John D. Vu. "Software Process Improvement Journey:From Level 1 to Level 5." 7th SEPG Conference, San Jose, March 1997.

Improved Cycle Time



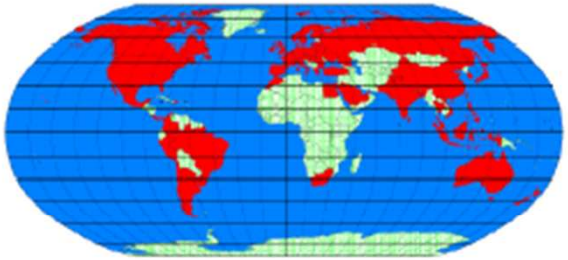
Source: Software Engineering Div., Hill AFB, Published in Crosstalk May 1999

Increased Productivity and Quality



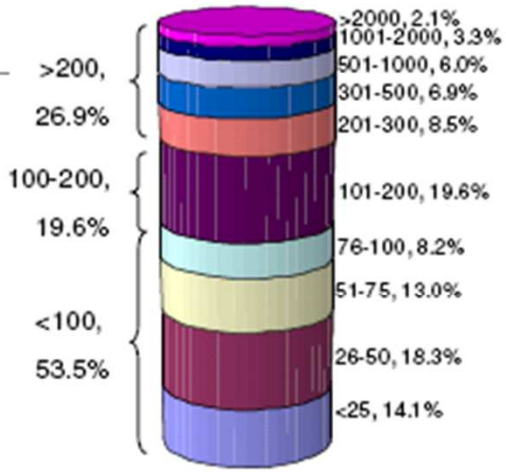
CMMI Adoption

CMMI appraisals are conducted worldwide…



	USA		Non-USA	
	Qty	%	Qty	%
Commercial In-House	318	32.5%	2207	90.9%
Contractor for Military/Government	555	56.7%	163	6.7%
Military/Government Agency	106	10.8%	57	2.3%
	979	100.0%	2427	100.0%

…in small and large organizations and projects



(3407 organizations reporting)

…in a wide range of business domains

Services (69.2%)

- Engineering and Management Services
- Public Administration
- Transportation and Utilities
- Finance, Insurance, Real Estate
- Health Services
- Retail/Wholesale Trade

Manufacturing (17.6%)

- Electronic and Electric Equipment
- Industrial Machinery
- Instruments and Related Products
- Transportation Equipment
- Other Mfg Industries

Based on primary Standard Industrial Classification (SIC) codes reported in CMMI-based appraisals.

…at all levels of process maturity

	Commercial In-House	Contractor for Military/ Government	Military/ Government Agency
No Rating Given	6.3%	9.6%	23.3%
Initial (ML1)	0.9%	1.7%	1.9%
Managed (ML2)	29.1%	31.9%	44.9%
Defined (ML3)	50.4%	45.1%	25.8%
Quantitatively Managed (ML4)	3.4%	1.5%	0.6%
Optimizing (ML5)	9.9%	11.1%	3.7%
	(2525 orgs)	(718 orgs)	(163 orgs)

Source: SEI Process Maturity Profile, March 2009.
http://www.sei.cmu.edu/appraisal-program/profile/

http://www.sei.cmu.edu/library/assets/CMMIimpact-JAC-EG.pdf

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?

Models

- “All models are wrong, but some are useful.”
  George Box

- Simplified approximations of reality that provide insight.

What is a CMM?

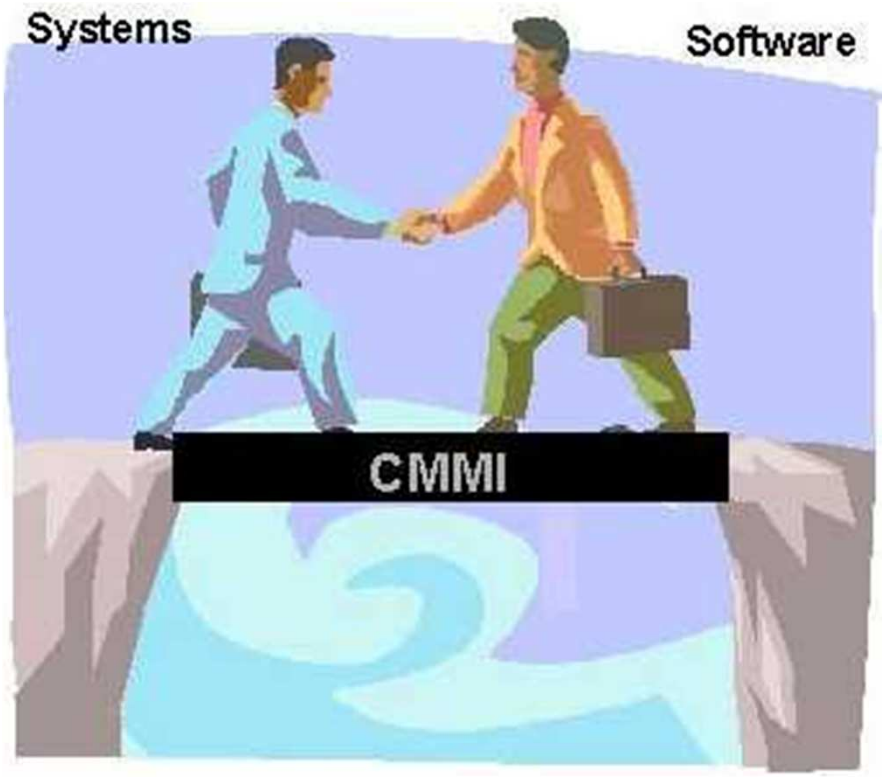
- Capability Maturity Model:
  A reference model of mature practices in a specified discipline, used to assess a group's capability to perform that discipline

- CMMs differ by
  - Discipline (software, systems, acquisition, etc.)
  - Structure (staged versus continuous)
  - How Maturity is Defined (process improvement path)
  - How Capability is Defined (institutionalization)

- NOT:
- It is not a ready-made scheme or template for describing processes
- It contains no methods for the processes

Bridging the Divide: CMM-I (Integrated)

- Integrates systems and software disciplines into one process improvement framework.
- Foreseen for Hardware / Software / System Development



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…….

The CMMI Framework

The CMMI Framework is the structure that organizes the components used in generating models, training materials, and appraisal methods.

The CMMI Product Suite is the full collection of models, training materials, and appraisal methods generated from the CMMI Framework.

The components in the CMMI Framework are organized into groupings, called constellations, which facilitate construction of approved models.

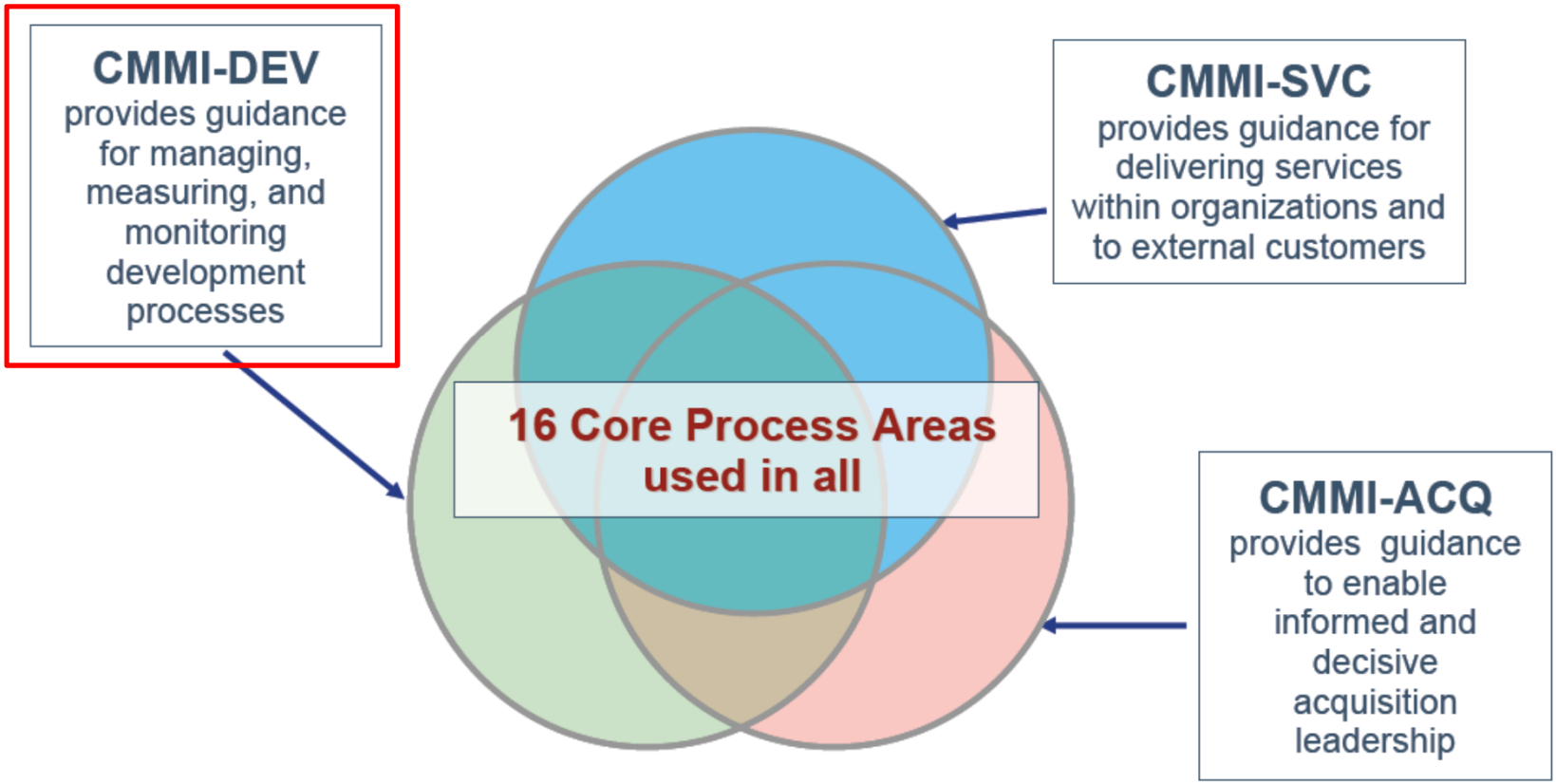
- During v1.2 development, CMMI-SE/SW/IPPD/SS was moved to the CMMI for Development (CMMI-DEV) constellation.
- Two new constellations have been commissioned by CMMI Steering Group:
  - CMMI for Services (CMMI-SVC)
  - CMMI for Acquisition (CMMI-ACQ)

Benefits from Using CMMI

- Organization's activities are explicitly linked to its business objectives.
- Visibility into the organization's activities is increased to help to ensure that the product or service meets the customer's expectations.
- The teams learn from new areas of best practice (e.g., measurement, risk)

- CMMI is being adopted worldwide, including North America, Europe, Asia, Australia, South America, and Africa.

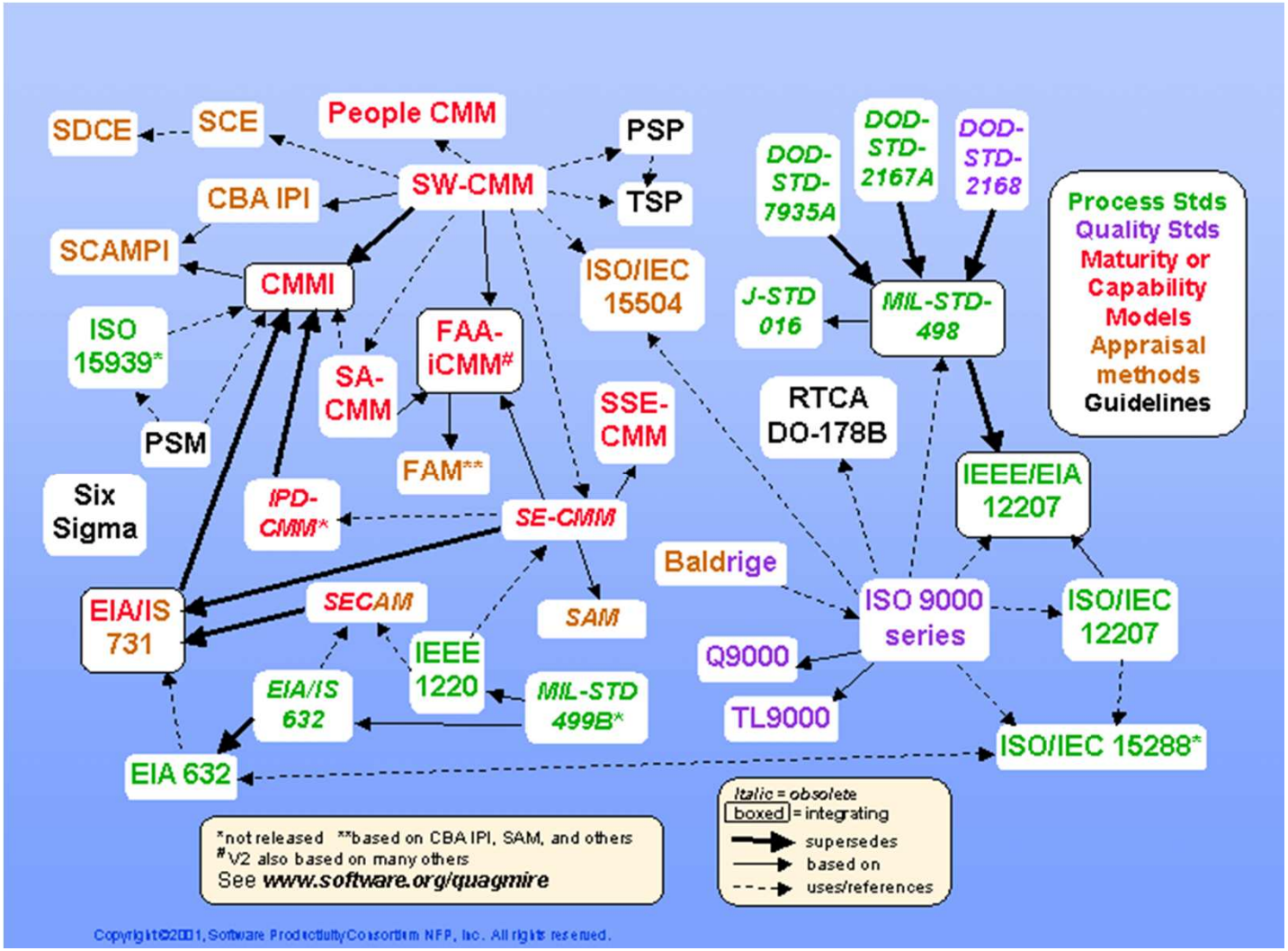
Three Complementary Constellations



Organization-Wide Improvements through the Use of CMMI for Development

- Better customer satisfaction
- Increased quality
- More accurate schedules
- Lower development costs
- Substantial return on investment
- Improved employee morale and reduced turnover

World of Standards



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

The Support of CMMI to ISO 9001:2008

- Organizations at the CMMI Maturity Level 3 will be ready for ISO 9001:2000 registration with minor adjustments
- Organizations registered as ISO 9001:2008 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

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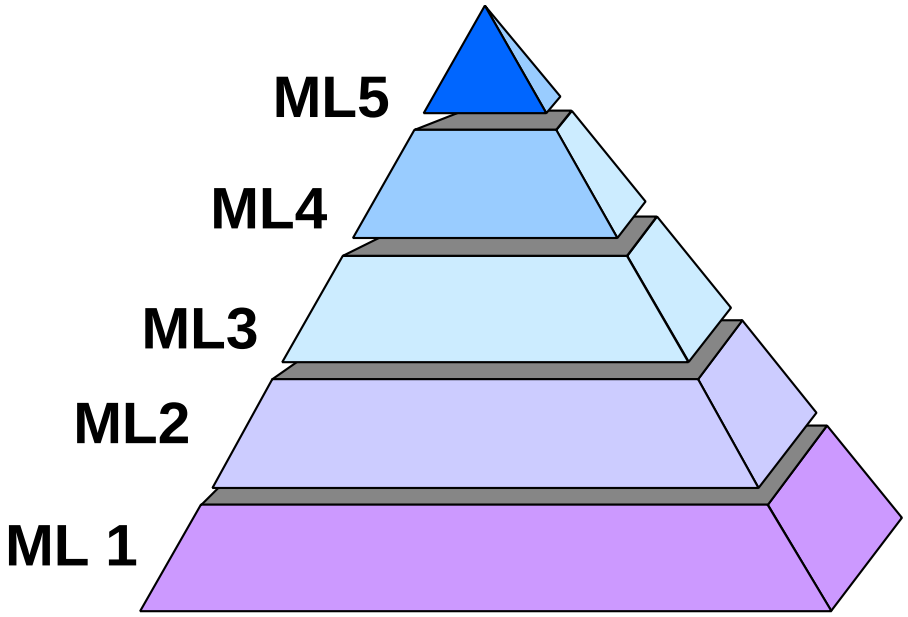
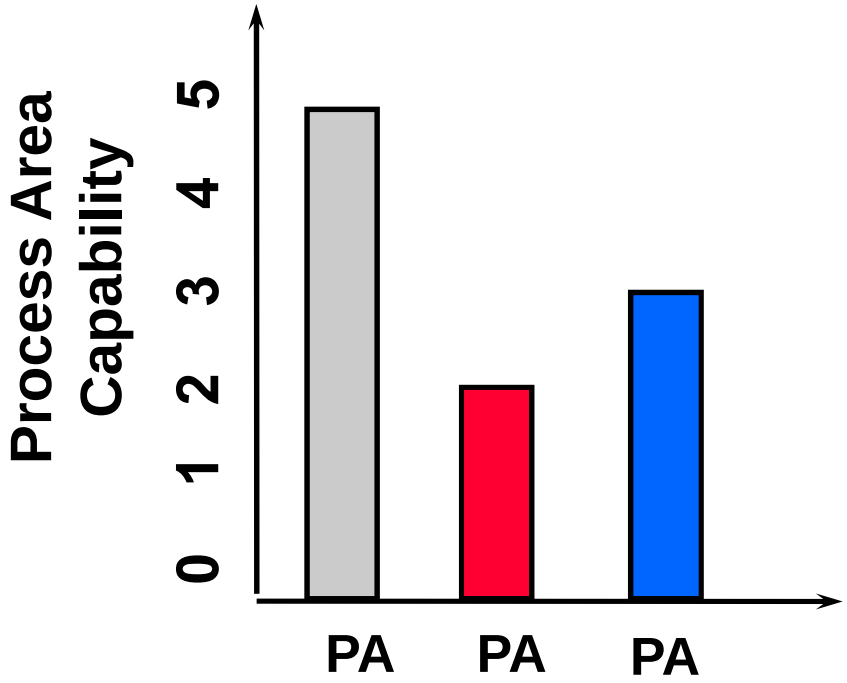
Comparing Model Representations

Staged



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

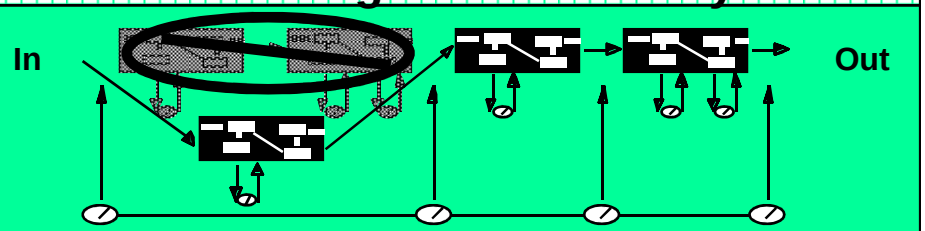
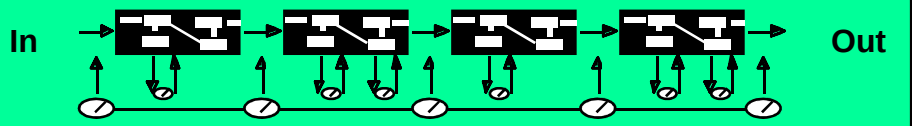
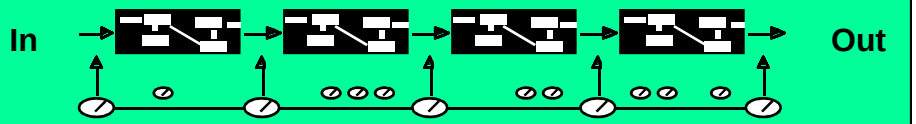
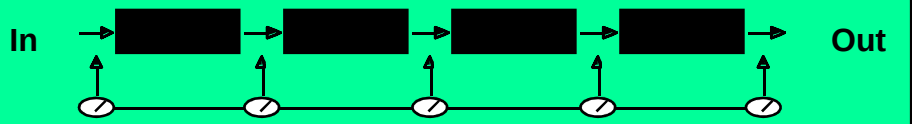
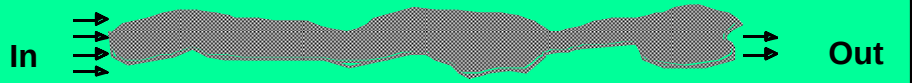
Continuous



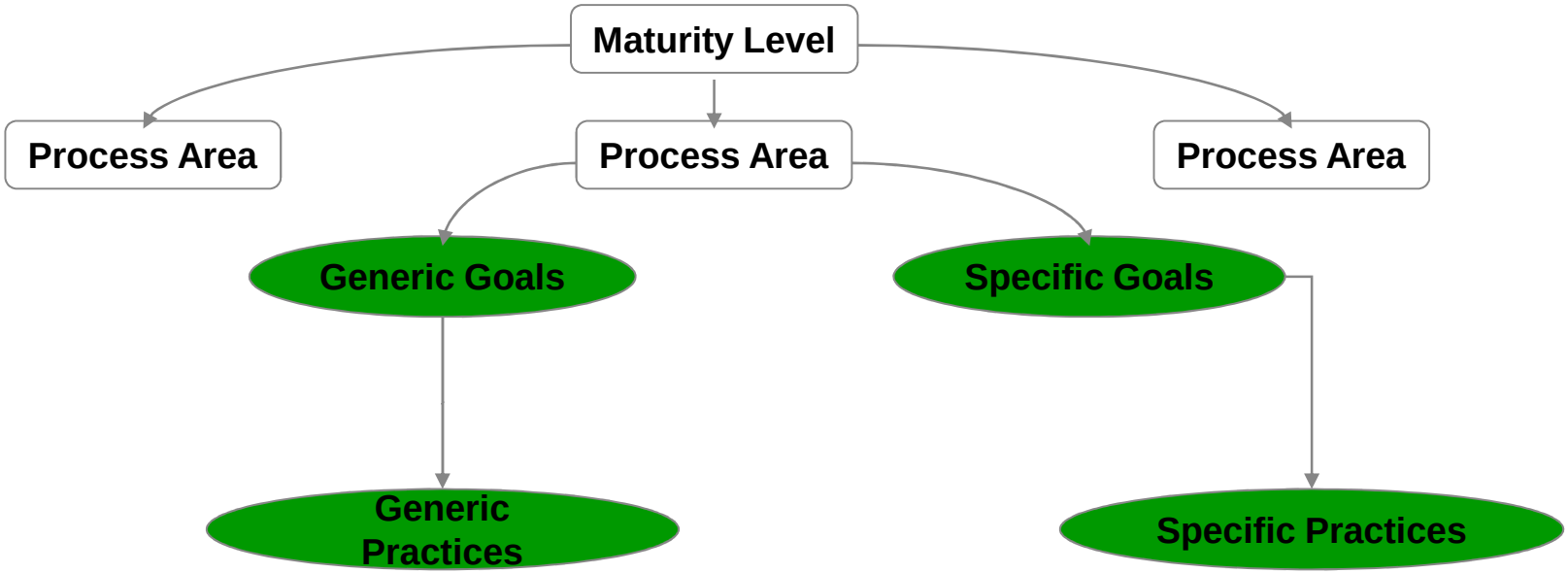
. . .for a single process area or a set of process areas (PA)

CMMI: Staged Representation

Management Visibility by Maturity Level

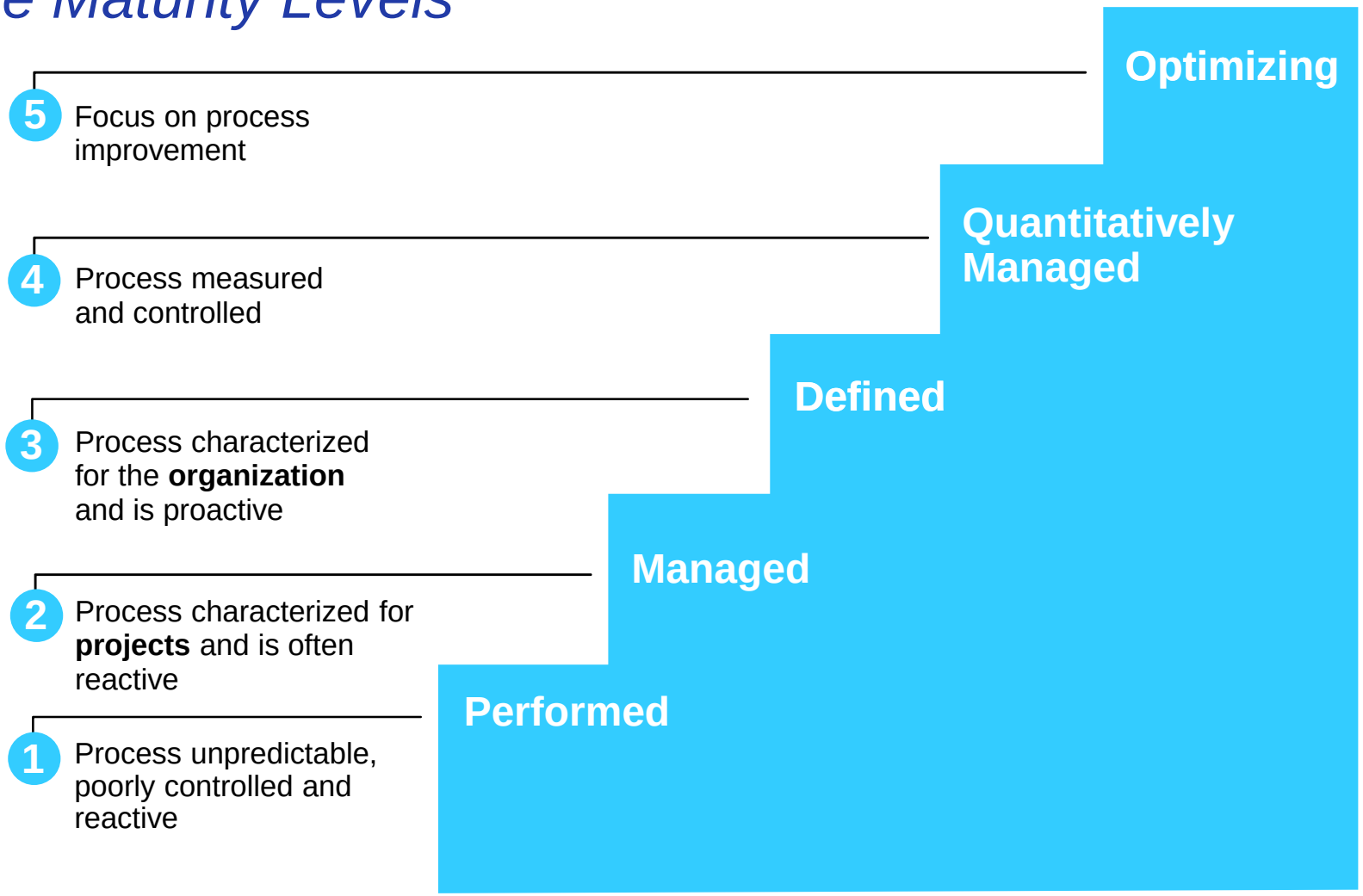
Level	Process Characteristics	Management Visibility
5 Optimizing	Focus is on continuous quantitative improvement	
4 Quantitatively Managed	Process is measured and controlled	
3 Defined	Process is characterized for the organization and is proactive	
2 Managed	Process is characterized for projects and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

Structure of the CMMI Staged Representation



Generic Practices cover the following features:
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

The Maturity Levels



Process Areas by Maturity Level

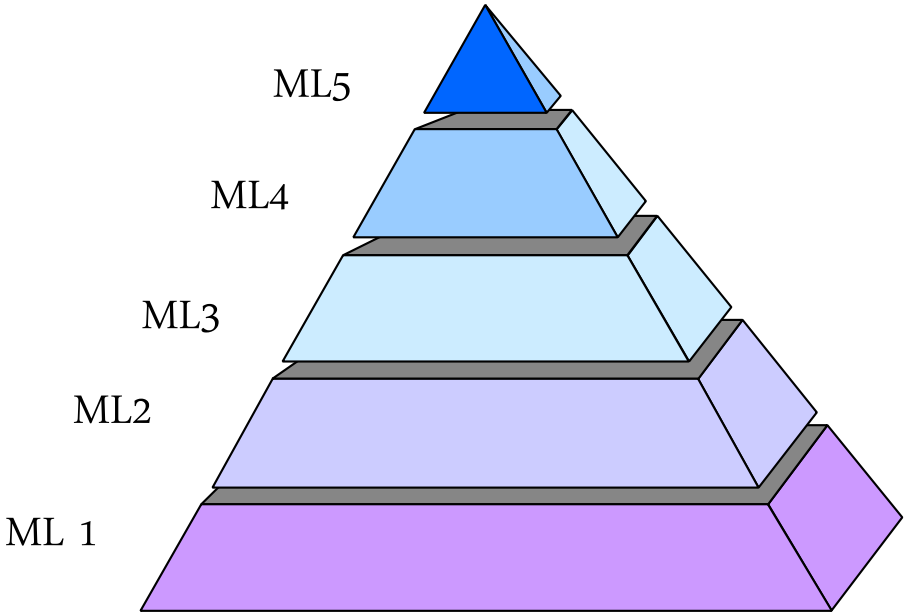
Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	*Quantitative management*	Organizational Process Performance Quantitative Project Management
3 Defined	*Process standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Organizational Environment for Integration
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

CMMI Model, Continuous Representation and Generic Goals and Practices

Peter Kolb

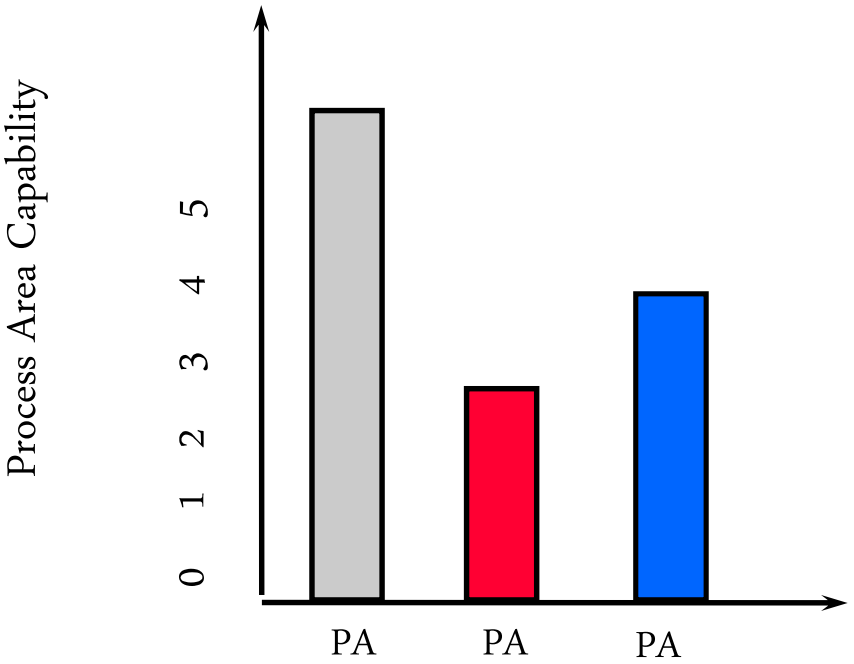
Comparing Model Representations

Staged



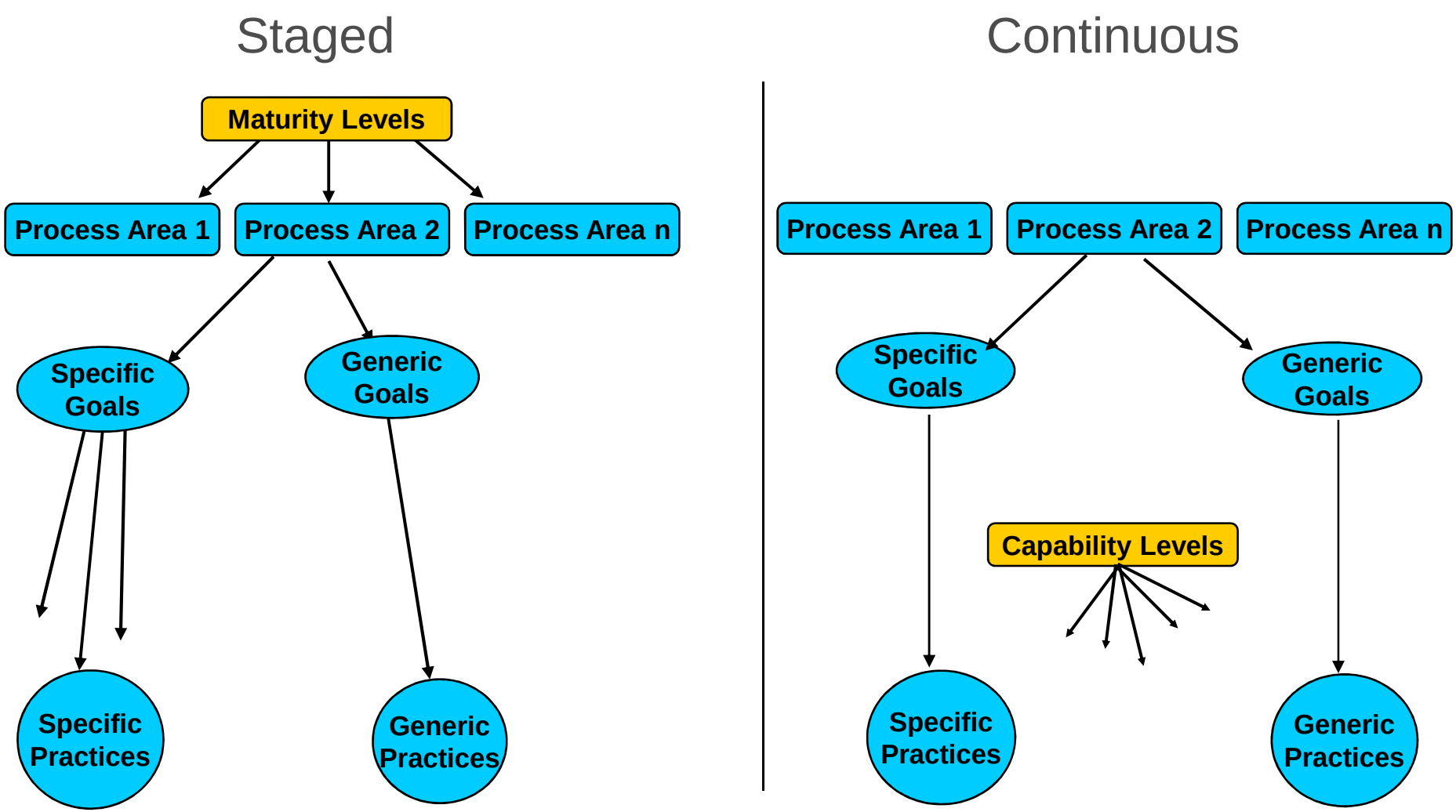
. . .for an established
set of process areas across an
organization

Continuous

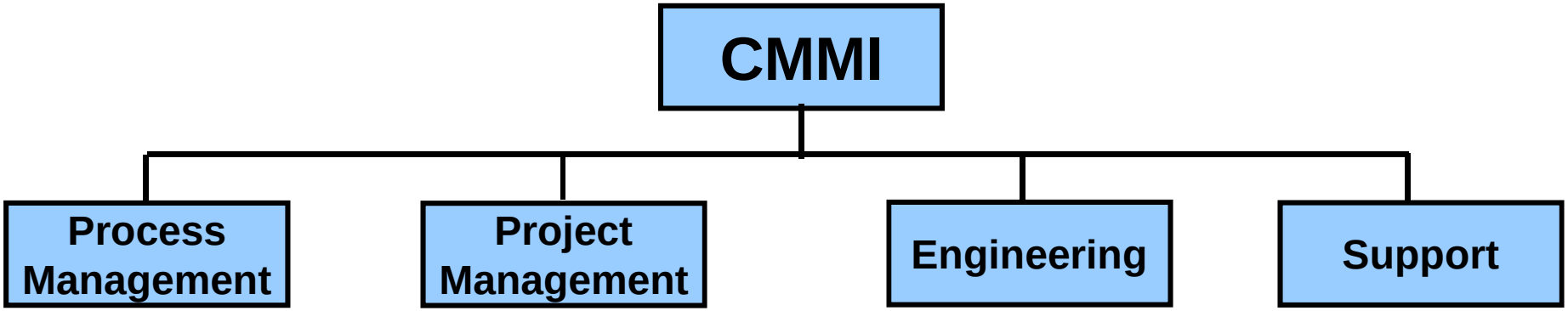


. . .for a single process area
or a set of process areas

CMMI Model Structure



CMMI-SE/SW/IPPD/SS Continuous



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- L3
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training

- L4
- Organizational Process Performance

L5
- Organizational Innovation and Deployment

- L2
- Project Planning
- Project Monitoring and Control
- Supplier Agreement Mgmt.

•L3
- Integrated Project Mgmt.
- Risk Management
- Integrated Supplier Mgmt.
- Integrated Teaming
- Integrated Project Mgmt. for IPPD

L4
•Quantitative Project Mgmt.

- L2
•Requirements Management

•L3
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

•L2
•Configuration Mgmt.
- Process and Product Quality Assurance
- Measurement & Analysis

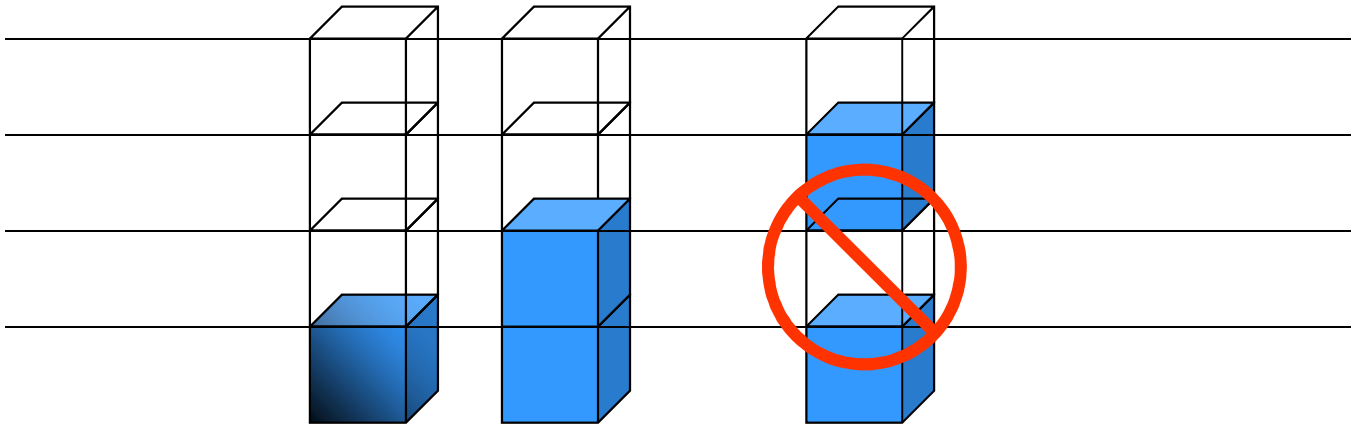
•L3
•Decision Analysis and Resolution
•Organizational Environment For Integration

L5
•Causal Analysis and Resolution

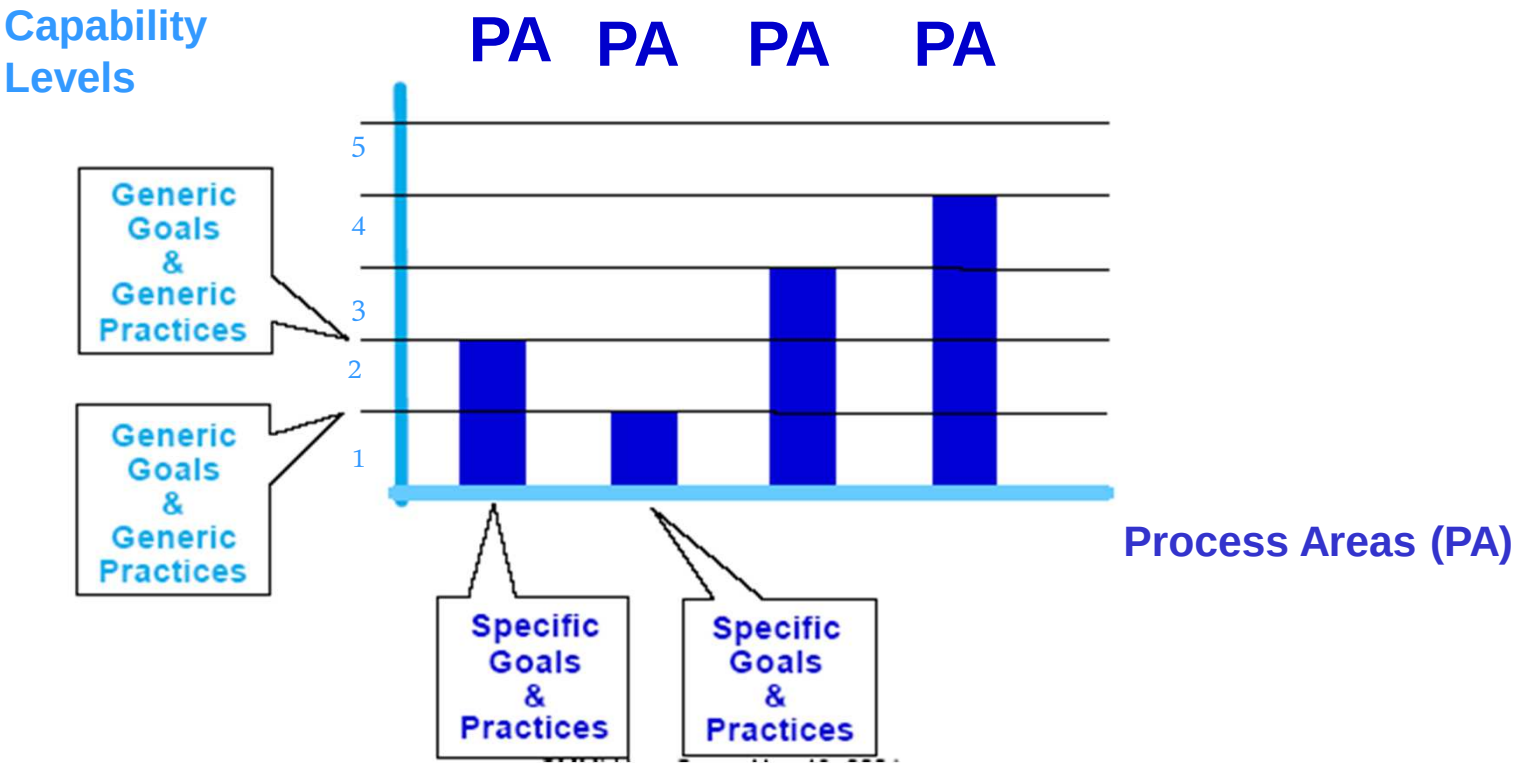
The Capability Levels

Capability Levels are Cumulative

- Because capability levels build upon one another, there can be no gaps.



Specific and Generic Goals and Practices



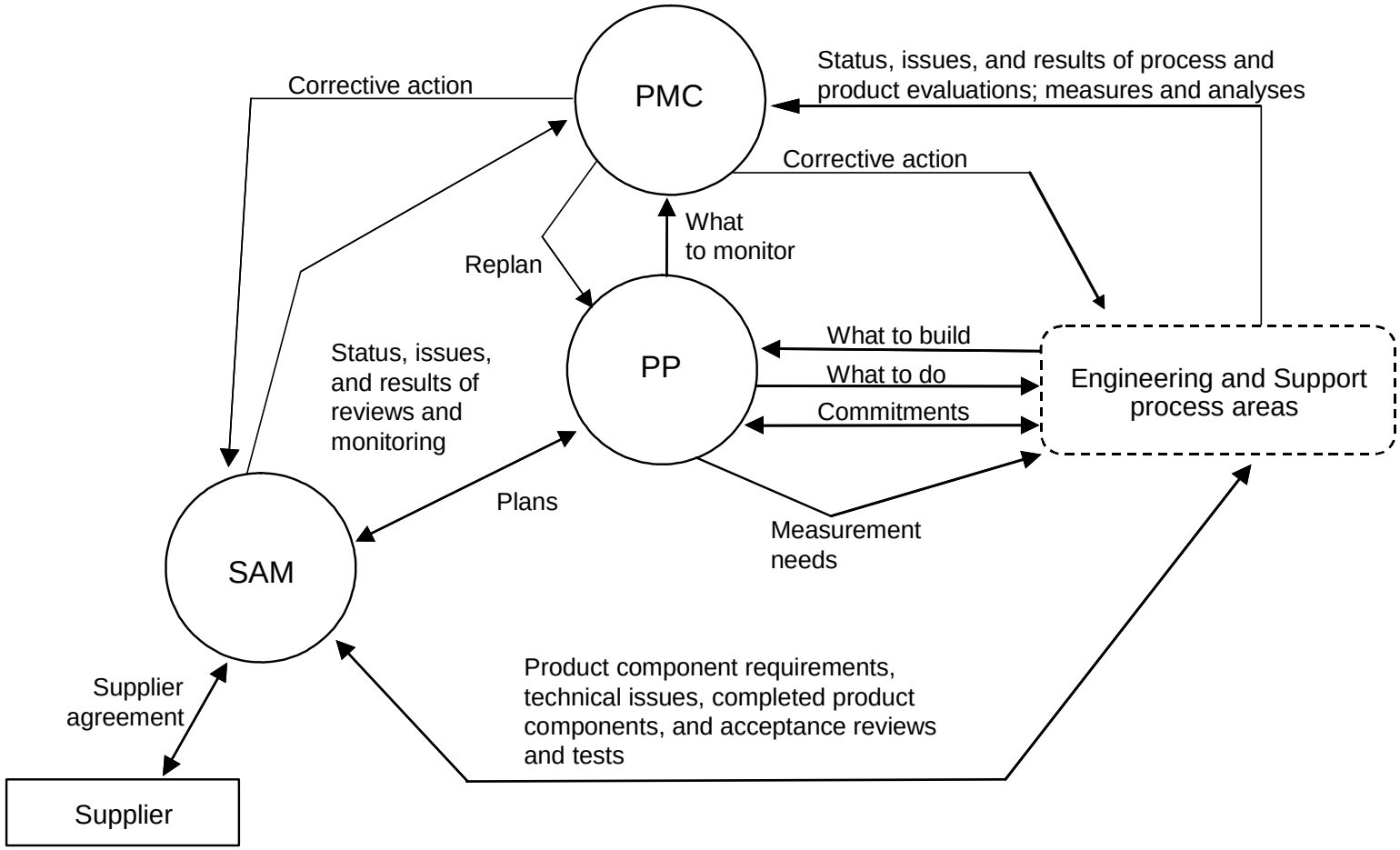
Generic Goals and Practices

Capability Level	Generic Goals	Generic Practices	
1	**Achieve Specific Goals**	GP 1.1	Perform Base Practices
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 Mgmt
3	**Institutionalize a Defined Process**	GP 3.1	Establish a Defined Process
		GP 3.2	Collect Improvement Information
4	**Institutionalize a Quantitatively Managed Process**	GP 4.1	Establish Quantitative Objectives for the Process
		GP 4.2	Stabilize Sub-process Performance
5	**Institutionalize an Optimizing Process**	GP 5.1	Ensure Continuous Process Improvement
		GP 5.2	Correct Root Causes of Problems

Process Areas, Maturity Levels, Capability Levels

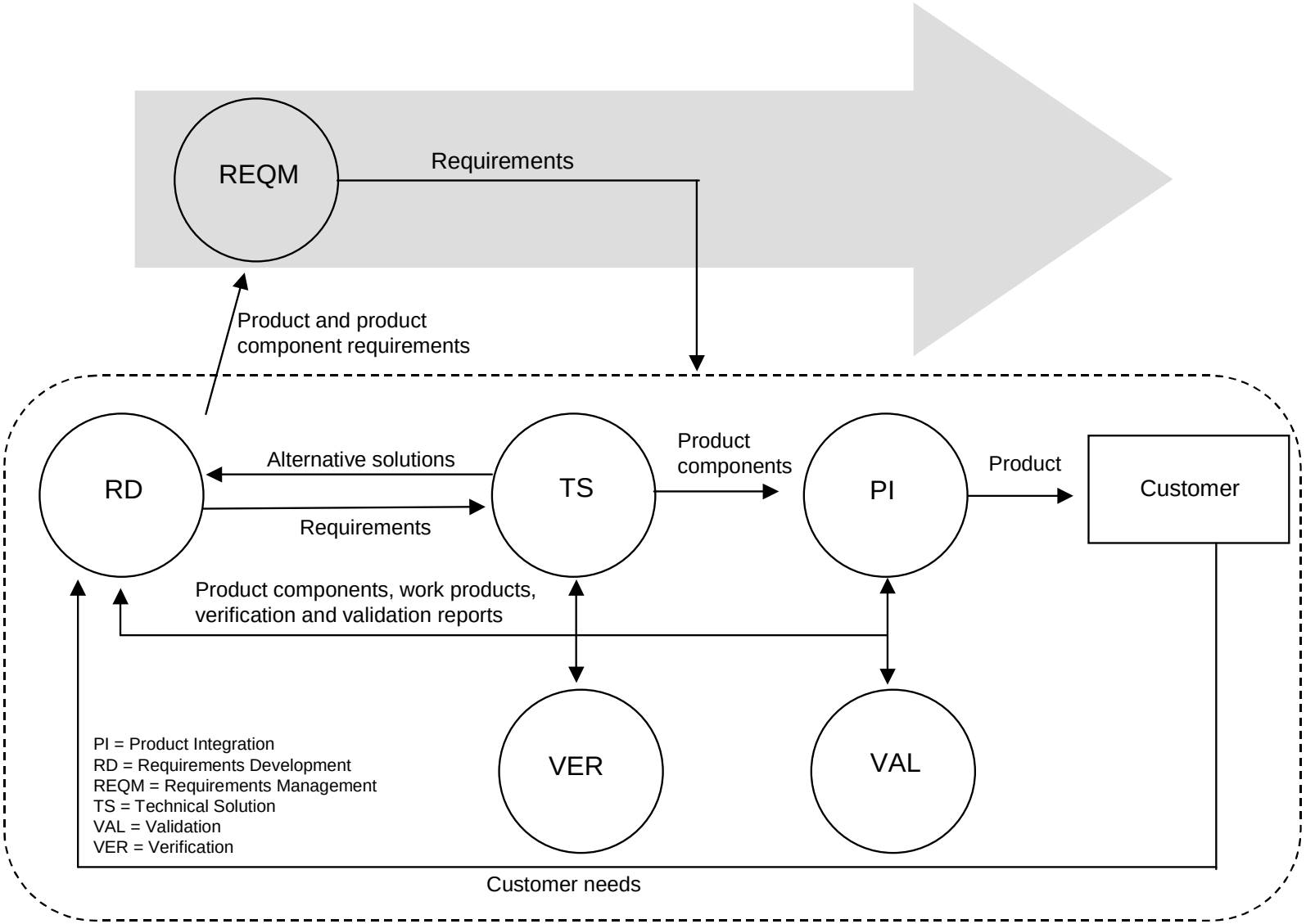
Name	*Abbr*	*ML*	*CL1*	*CL2*	*CL3*	*CL4*	*CL5*
Requirements Management	REQM	2		**Target Profile 2**			
Project Planning	PP	2					
Project Monitoring and Control	PMC	2					
Supplier Agreement Management	SAM	2					
Measurement and Analysis	MA	2					
Process and Product Quality Assurance	PPQA	2					
Configuration Management	CM	2					
Requirements Development	RD	3			**Target Profile 3**		
Technical Solution	TS	3					
Product Integration	PI	3					
Verification	VER	3					
Validation	VAL	3					
Organizational Process Focus	OPF	3					
Organizational Process Definition +IPPD	OPD +IPPD	3					
Organizational Training	OT	3					
Integrated Project Management +IPPD	IPM +IPPD	3					
Risk Management	RSKM	3					
Decision Analysis and Resolution	DAR	3					

Project Management

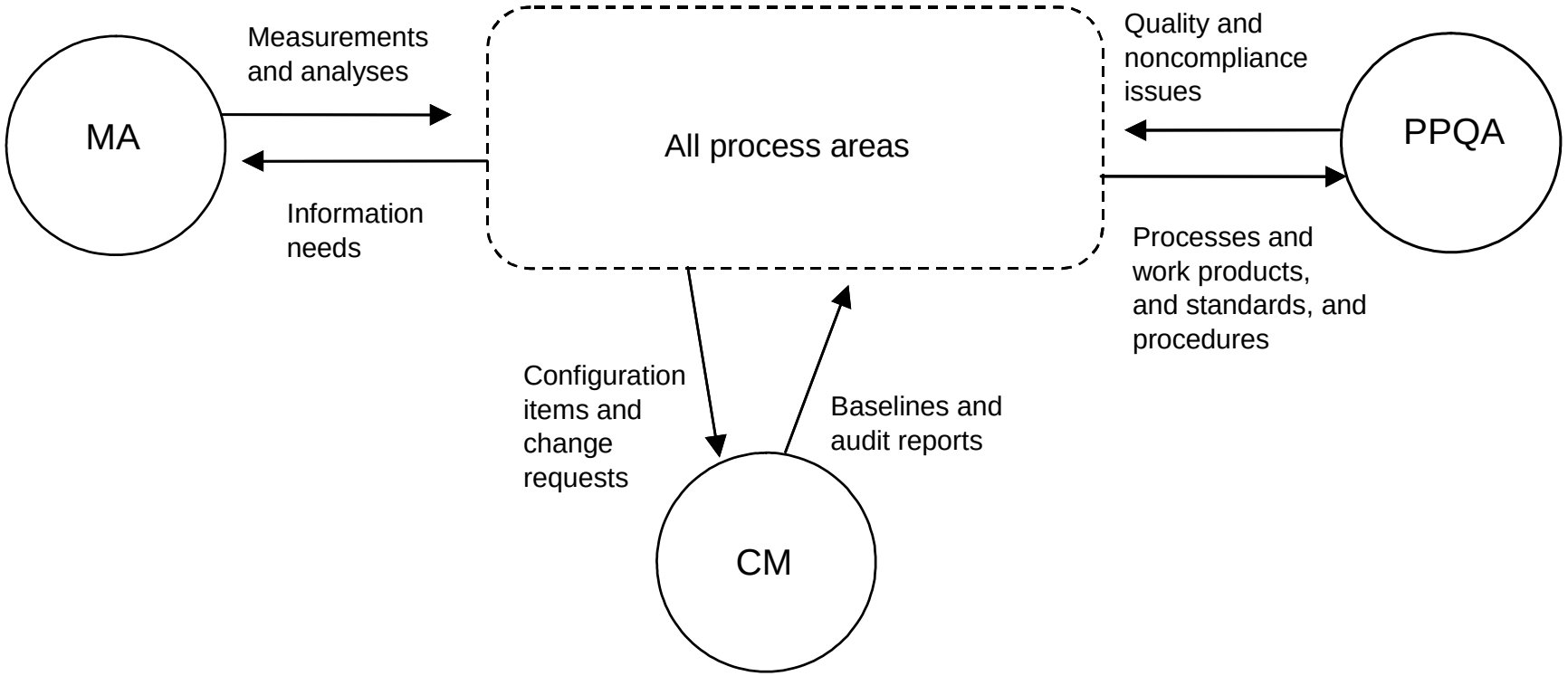


PMC = Project Monitoring and Control
PP = Project Planning
SAM = Supplier Agreement Management

Engineering Process Areas

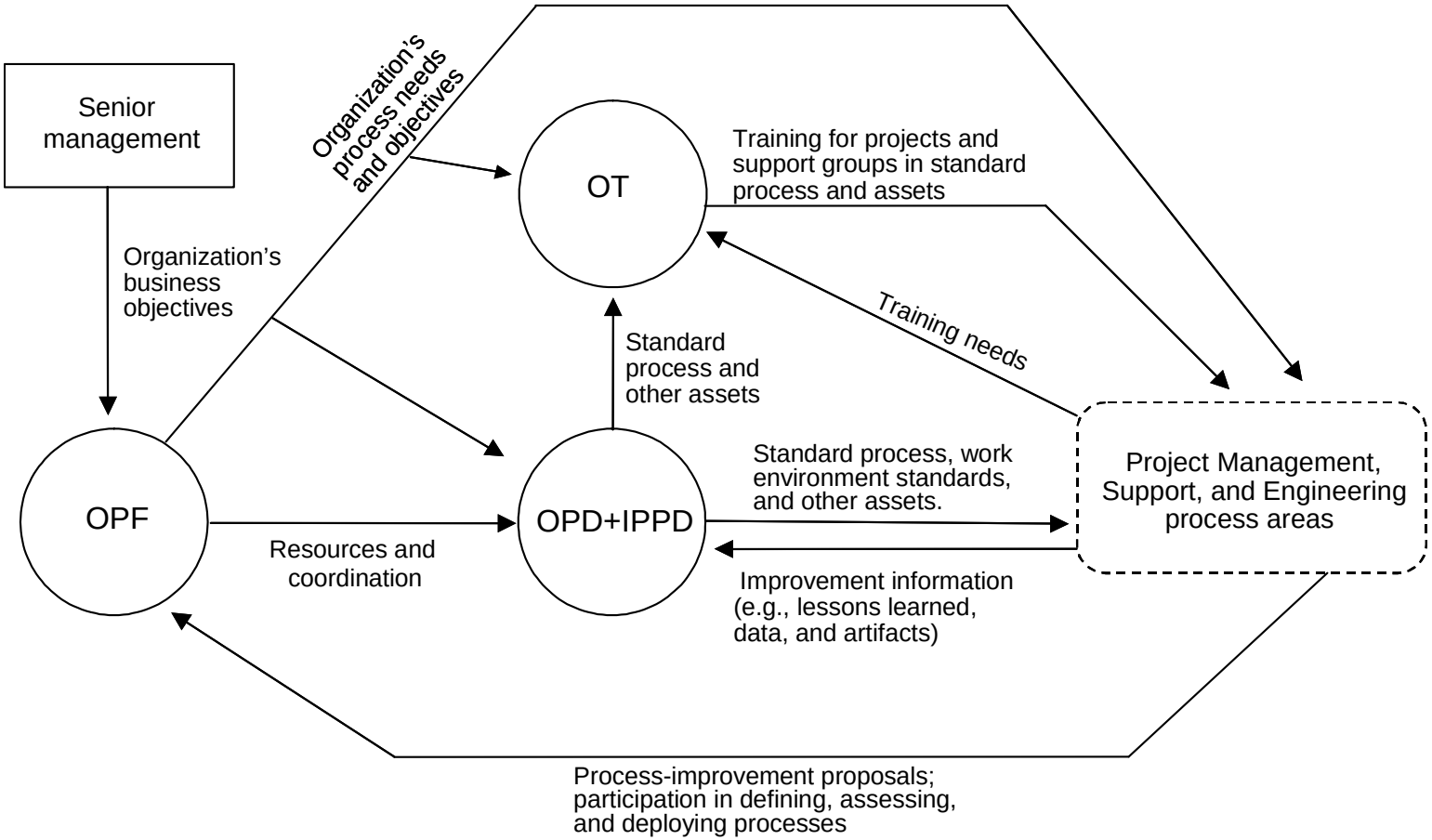


Support Process Areas



MA = Measurement and Analysis
CM = Configuration Management
PPQA = Process and Product Quality Assurance

Process Management



OPF = Organizational Process Focus
OT = Organizational Training
OPD+IPPD = Organizational Process Definition (with the IPPD addition)

Model Terminology -1

- Institutionalization

  involves implementing practices that

  - Ensure the process areas are effective, repeatable and long lasting
  - Provide needed infrastructure support
  - Ensure processes are defined, documented, understood
  - Enable organizational learning to improve the processes

Model Terminology -2

- 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 -3

- Performed Process (Capability Level 1)
  - 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 (Capability Level 2)
  - 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 (Capability Level 3)
  - 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 Summary

- The Generic Practices support institutionalization of critical practices for an organization to have a successful process improvement initiative
  - Processes will be **executed and managed consistently**
  - Processes will **survive staff changes**
  - Process **improvement** will be **related to business goals**
  - The organization will **not** find itself continuously "**reinventing** the wheel"
  - There will be the commitment to provide **resources** or infrastructure to support or improve the processes
  - There will be historical basis for cost **estimation**

For More Information About CMMI

- Go to CMMI Website
  - http://sei.cmu.edu/cmmi
  - http://seir.sei.cmu.edu/seir/
  - http://www.sei.cmu.edu/library/abstracts/reports/06tr008.cfm
  - http://dtic.mil/ndia (annual CMMI Conference)
  - http://www.faa.gov/aio
- Assistance for government organizations:
  - Software Technology Support Center
  - http://www.stsc.hill.af.mil