

Capability Maturity Model[®] Integration (CMMISM) Fundamentals

What is the CMMI

- A Model
 - 22 process areas
 - Guides process improvement work in organizations that dev systems, s/w only, or h/w only product and services
 - In existence since 1987!
 - Bringing the field of software development/engineering under *statistical process control*
 - Today's defacto model upon which comparisons are drawn
 - has initiated a proliferation of family of models in other niche markets

CMMI Product Suite

- Reference Models
 - CMMI-Dev
 - CMMI-Dev + IPPD “addition”
 - CMMI-ACQ (acquisition, to come)
 - CMMI-SVC (services, to come)
- Training Products
- Assessment methods
 - SCAMPI A, B, C

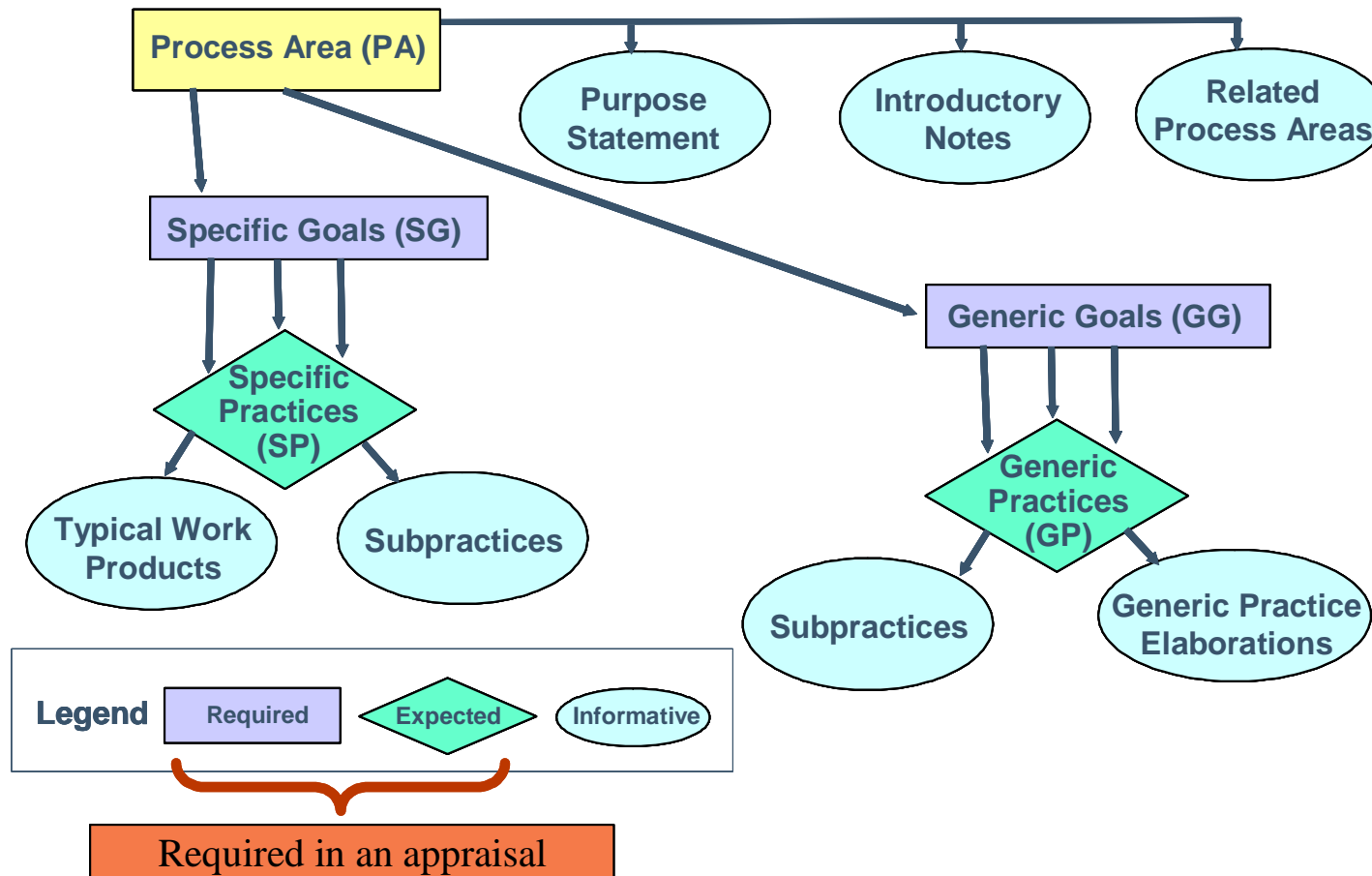
Maturity Levels

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>	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		

Maturity Levels

- Degree to which predefined sets of process areas are implemented
 - A maturity level is reached when all goals in the set have been achieved
- There are five levels (1-5)
- Each level represents a layer of process improvement
 - Maturity Level 3 builds upon basic project management processes addressed in Maturity Level 2

CMMI Components



Rating of CMMI Goals

- A goal is rated Satisfied if
 - There are no findings that document the weaknesses associated with a goal

or

- (a) All associated practices are characterized at the organizational unit level as either Largely Implemented or Fully Implemented

and

- (b) The aggregate of weaknesses associated with the goal does not have a significant negative impact on goal achievement
- Otherwise the goal is rated Unsatisfied

ML2 & ML3 Goals & Practices

<i>Requirements Management</i>	<i>Project Planning</i>	<i>Project Monitoring & Control</i>	<i>Supplier Agreement Management</i>
*SG1: Manage Requirements	*SG1: Establish Estimates	*SG1: Monitor Project Against Plan	*SG1: Establish Supplier Agreements
SP1.1: Obtain an Understanding of Requirements	SP1.1: Estimate the Scope of the Project	SP1.1: Monitor Project Planning Parameters	SP1.1: Determine Acquisition Type
SP1.2: Obtain Commitment to Requirements	SP1.2: Establish Estimates of Work Product and Task Attributes	SP1.2: Monitor Commitments	SP1.2: Select Suppliers
SP1.3: Manage Requirements Changes	SP1.3: Define Project Lifecycle	SP1.3: Monitor Project Risks	SP1.3: Establish Supplier Agreements
SP1.4: Maintain Bidirectional Traceability of Requirements	SP1.4: Determine Estimates of Effort and Cost	SP1.4: Monitor Data Management	*SG2: Satisfy Supplier Agreements
SP1.5: Identify Inconsistencies Between Project Work and Requirements	*SG2: Develop a Project Plan	SP1.5: Monitor Stakeholder Involvement	SP2.1: Execute the Supplier Agreement
	SP2.1: Establish the Budget and Schedule	SP1.6: Conduct Progress Reviews	SP2.2: Monitor Selected Supplier Processes
	SP2.2: Identify Project Risks	SP1.7: Conduct Milestone Reviews	SP2.3: Evaluate Selected Supplier Work Products
	SP2.3: Plan for Data Management	*SG2: Manage Corrective Action to Closure	SP2.4: Accept the Acquired Product
	SP2.4: Plan for Project Resources	SP2.1: Analyze Issues	SP2.5: Transition Products
	SP2.5: Plan for Needed Knowledge and Skills	SP2.2: Take Corrective Action	
	SP2.6: Plan Stakeholder Involvement	SP2.3: Manage Corrective Action	
	SP2.7: Establish the Project Plan		
	*SG3: Obtain Commitment to Plan		
<i>Generic Goals (Capability Level 1 & 2)</i>	SP3.1: Review Plans that affect the Project		<i>Generic Goals (Capability Level 2 & 3)</i>
*GG1: Achieve Specific Goals	SP3.2: Reconcile Work and Resource Levels		GP2.6: Manage Configurations
GP1.1: Perform Specific Practices	SP3.3: Obtain Plan Commitment		GP2.7: Identify and Involve Relevant Stakeholders
*GG2: Institutionalize a Managed Process			GP2.8: Monitor and Control the Process
GP2.1: Establish an Organizational Policy			GP 2.9: Objectively Evaluate Adherence
GP2.2: Plan the Process			GP2.10: Review Status with Higher Level Management
GP2.3: Provide Resources			*GG3: Institutionalize a Managed Process
GP2.4: Assign Responsibility			GP3.1: Establish a Defined Process
GP2.5: Train People			GP3.2: Collect Improvement Information

ML2 & ML3 Goals & Practices (cont'd)

<i>Measurement & Analysis</i>
*SG1: Align Measurement and Analysis Activities
SP1.1: Establish Measurement Objectives
SP1.2: Specify Measures
SP1.3: Specify Data Collection and Storage Procedures
SP1.4: Specify Analysis Procedures
*SG2: Provide Measurement Results
SP2.1: Collect Measurement Data
SP2.2: Analyze Measurement Data
SP2.3: Store Data Results
SP2.4: Communicate Results

<i>Process & Product Quality Assurance</i>
*SG1: Objectively Evaluate Processes and Work Products
SP1.1: Objectively Evaluate Processes
SP1.2: Objectively Evaluate Work Products and Services
*SG2: Provide Objective Insight
SP2.1: Communicate & Ensure Resolution of Noncompliance Issues
SP2.2: Establish Records

<i>Configuration Management</i>
*SG1: Establish Baselines
SP1.1: Identify Configuration Items
SP1.2: Establish Configuration Management System
SP1.3: Create or Release Baselines
*SG2: Track and Control Changes
SP2.1: Track Change Requests
SP2.2: Control Configuration Items
*SG3: Establish Integrity
SP3.1: Establish Configuration Management Records
SP3.2: Perform Configuration Audits

<i>Generic Goals (Capability Level 1 & 2)</i>
*GG1: Achieve Specific Goals
GP1.1: Perform Specific Practices
*GG2: Institutionalize a Managed Process
GP2.1: Establish an Organizational Policy
GP2.2: Plan the Process
GP2.3: Provide Resources
GP2.4: Assign Responsibility
GP2.5: Train People

<i>Generic Goals (Capability Level 2 & 3)</i>
GP2.6: Manage Configurations
GP2.7: Identify and Involve Relevant Stakeholders
GP2.8: Monitor and Control the Process
GP 2.9: Objectively Evaluate Adherence
GP2.10: Review Status with Higher Level Management
*GG3: Institutionalize a Managed Process
GP3.1: Establish a Defined Process
GP3.2: Collect Improvement Information

ML2 & ML3 Goals & Practices (cont'd)

Requirements Development	Technical Solution	Product Integration	Verification
*SG 1: Develop Customer Requirements	*SG1: Select Product Component Solutions	*SG1: Prepare for Product Integration	*SG1: Prepare for Verification
SP1.1: Elicit Needs	SP1.1: Develop Alternative Solutions and Selection Criteria	SP1.1: Determine Integration Sequence	SP1.1: Select Work Products for Verification
SP1.2: Develop the Customer Requirements	SP1.2: Select Product Component Solutions	SP1.2: Establish the Product Integration Environment	SP1.2: Establish the Verification Environment
*SG2: Develop a Project Plan	*SG2: Develop the Design	SP1.3: Establish Product Integration Procedures and Criteria	SP1.3: Establish Verification Procedures and Criteria
SP2.1: Establish Product and Product Component Requirements	SP2.1: Design the Product or Product Component	*SG2: Ensure Interface Compatibility	*SG2: Perform Peer Reviews
SP2.2: Allocate Product Component Requirements	SP2.2: Establish a Technical Data Package	SP2.1: Review Interface Descriptions for Completeness	SP2.1: Prepare for Peer Reviews
SP2.3: Identify Interface Requirements	SP2.3: Design Interfaces Using Criteria	SP2.2: Manage Interfaces	SP2.2: Conduct Peer Reviews
*SG3: Analyze and Validate Requirements	SP2.4: Perform Make, Buy, or Reuse Analyses	*SG3: Assemble Product Components and Deliver the Product	SP2.3: Analyze Peer Review Data
SP3.1: Establish Operational Concepts and Scenarios	*SG3: Implement the Product Design	SP3.1: Confirm Readiness of Product Components for Integration	*SG3: Verify Selected Work Products
SP3.2: Establish a Definition of Required Functionality	SP3.1: Implement the Design	SP3.2: Assemble Product Components	SP3.1: Perform Verification
SP3.3: Analyze Requirements	SP3.2: Develop Product Support Documentation	SP3.3: Evaluate Assembled Product Components	SP3.2: Analyze Verification Results
SP3.4: Analyze Requirements to Achieve Balance		SP3.4: Package and Deliver the Product or Product Component	
SP3.5: Validate Requirements			

Generic Goals (Capability Level 1 & 2)	Generic Goals (Capability Level 2 & 3)
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ML2 & ML3 Goals & Practices (cont'd)

Validation	Organizational Process Focus	Organizational Process Definition	Organizational Training
*SG1: Prepare for Validation	*SG1: Determine Process Improvement Opportunities	*SG1: Establish Organizational Process Assets	*SG1: Establish an Organizational Training Capability
SP1.1: Select Products for Validation	SP1.1: Establish Organizational Process Needs	SP1.1: Establish Standard Processes	SP1.1: Establish the Strategic Training Needs
SP1.2: Establish the Validation Environment	SP1.2: Appraise the Organization's Processes	SP1.2: Establish Lifecycle Model Descriptions	SP1.2: Determine Which Training Needs Are the Responsibility of the Organization
SP1.3: Establish Validation Procedures and Criteria	SP1.3: Identify the Organization's Process Improvements	SP1.3: Establish Tailoring Criteria and Guidelines	SP1.3: Establish an Organizational Training Tactical Plan
*SG2: Validate Product or Product Components	*SG2: Plan and Implement Process Improvements	SP1.4: Establish the Organization's Measurement Repository	SP1.4: Establish Training Capability
SP2.1: Perform Validation	SP2.1: Establish Process Action Plans	SP1.5: Establish the Organization's Process Asset Library	*SG2: Provide Necessary Training
SP2.2: Analyze Validation Results	SP2.2: Implement Process Action Plans	SP1.6: Establish Work Environment Standards	SP2.1: Deliver Training
	*SG3: Deploy Organizational Process Assets and Incorporate Lessons Learned		SP2.2: Establish Training Records
	SP3.1: Deploy Organizational Process Assets		SP2.3: Assess Training Effectiveness
	SP3.2: Deploy Standard Processes		
	SP3.3: Monitor Implementation		
	SP3.4: Incorporate Process-Related Experiences into the Organizational Process Assets		
Generic Goals (Capability Level 1 & 2)		Generic Goals (Capability Level 2 & 3)	
*GG1: Achieve Specific Goals		GP2.6: Manage Configurations	
GP1.1: Perform Specific Practices		GP2.7: Identify and Involve Relevant Stakeholders	
*GG2: Institutionalize a Managed Process		GP2.8: Monitor and Control the Process	
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ML2 & ML3 Goals & Practices (cont'd)

<i>Integrated Project Management</i>	<i>Risk Management</i>	<i>Decision Analysis and Resolution</i>
*SG1: Use the Project's Defined Process	*SG1: Prepare for Risk Management	*SG1: Evaluate Alternatives
SP1.1: Establish the Project's Defined Process	SP1.1: Determine Risk Sources and Categories	SP1.1: Establish Guidelines for Decision Analysis
SP1.2: Use Organizational Process Assets for Planning Project Activities	SP1.2: Define Risk Parameters	SP1.2: Establish Evaluation Criteria
SP1.3: Establish the Project's Work Environment	SP1.3: Establish a Risk Management Strategy	SP1.3: Identify Alternative Solutions
SP1.4: Integrate Plans	*SG2: Identify and Analyze Risks	SP1.4: Select Evaluation Methods
SP1.5: Manage the Project Using the Integrated Plans	SP2.1: Identify Risks	SP1.5: Evaluate Alternatives
SP1.6: Contribute to the Organizational Process Assets	SP2.2: Evaluate, Categorize, and Prioritize Risks	SP1.6: Select Solutions
*SG2: Coordinate and Collaborate with Relevant Stakeholders	*SG3: Mitigate Risks	
SP2.1: Manage Stakeholder Involvement	SP3.1: Develop Risk Mitigation Plans	
SP2.2: Manage Dependencies	SP3.2: Implement Risk Mitigation Plans	
SP2.3: Resolve Coordination Issues		

<i>Generic Goals (Capability Level 1 & 2)</i>
*GG1: Achieve Specific Goals
GP1.1: Perform Specific Practices
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GP2.1: Establish an Organizational Policy
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<i>Generic Goals (Capability Level 2 & 3)</i>
GP2.6: Manage Configurations
GP2.7: Identify and Involve Relevant Stakeholders
GP2.8: Monitor and Control the Process
GP 2.9: Objectively Evaluate Adherence
GP2.10: Review Status with Higher Level Management
*GG3: Institutionalize a Managed Process
GP3.1: Establish a Defined Process
GP3.2: Collect Improvement Information

Continuous Representation

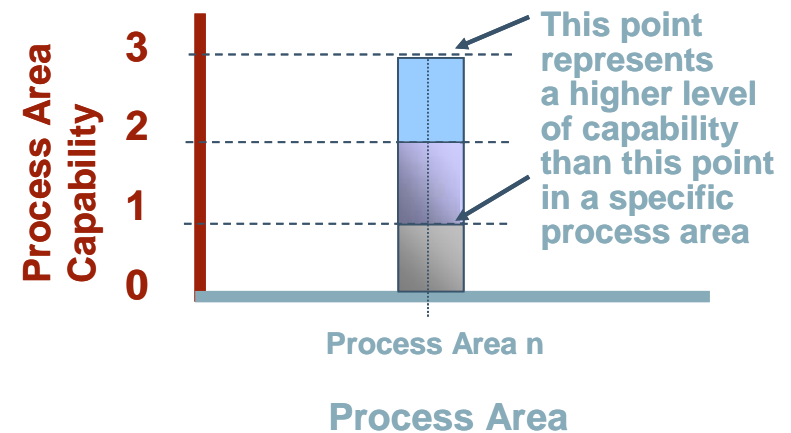
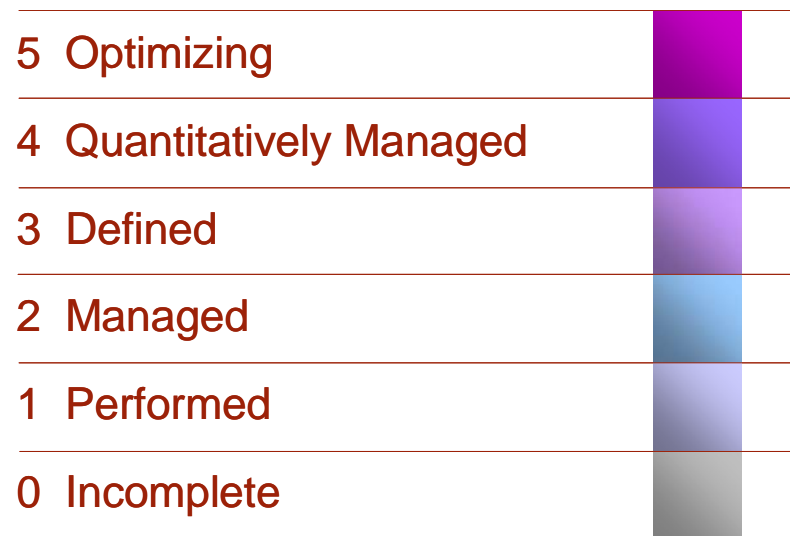
- We have addressed the 'Staged' representation thus far
- One can look at each process area independently
 - Known as a process area's capability level
- Exactly the same processes

Both representations provide essentially the same content

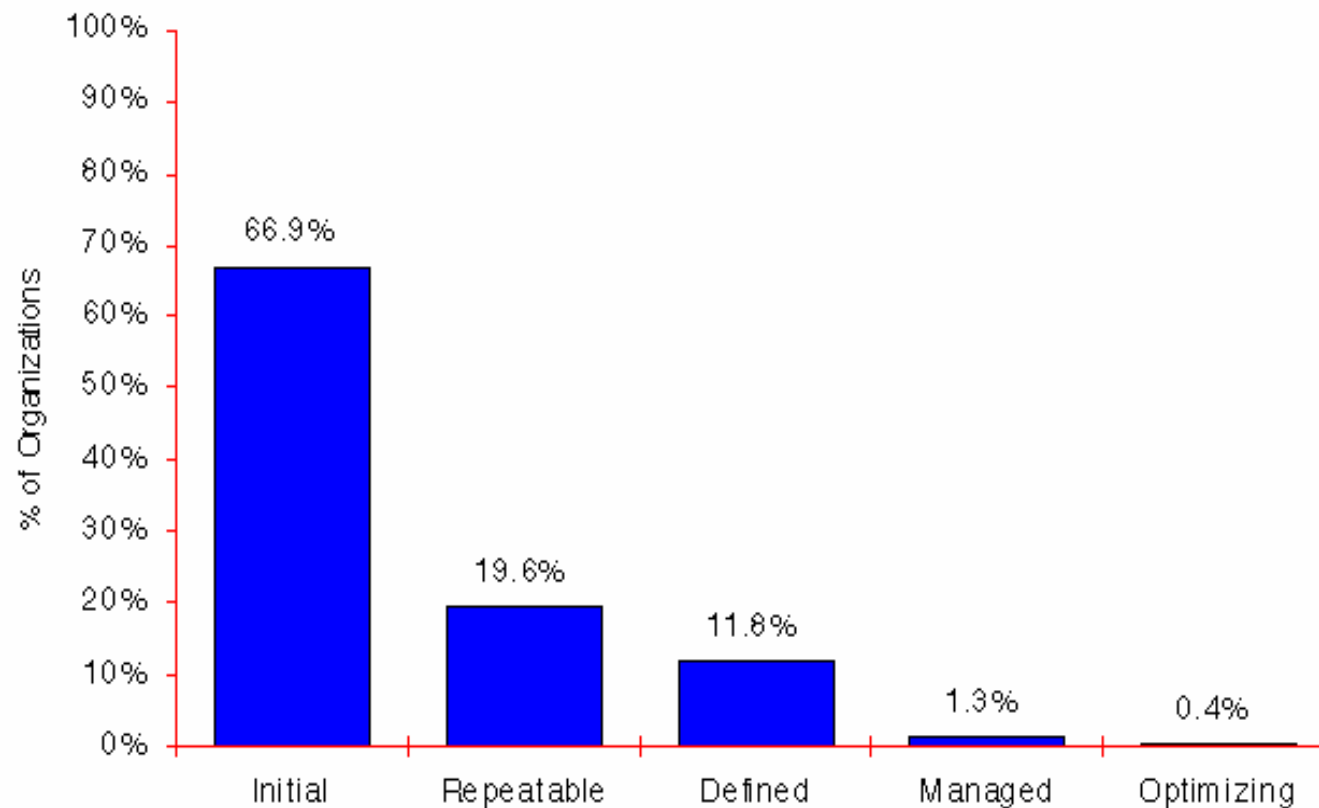
Continuous Representation

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

Capability Levels

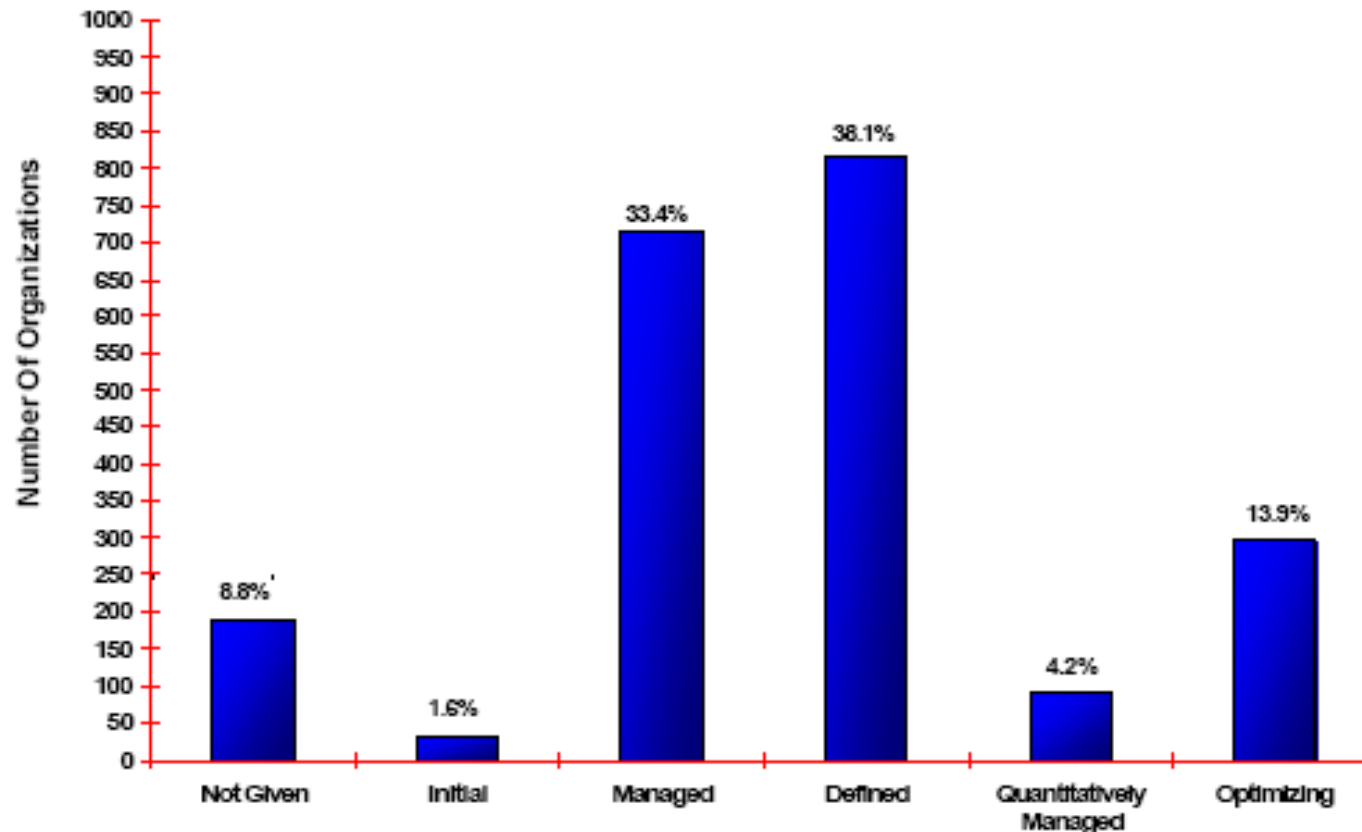


Process Maturity Profile by all reporting organizations – Nov 1996



Based on most recent assessments of 542 organizations

Process Maturity Profile by all reporting organizations – Sept 2007



Based on most recent appraisal of 2140 organizations

Summary

- Appraisals verify both Required and Expected CMMI components
 - Goals and practices
- There are 22 Process Areas
 - Each process area can have a ‘Capability Level’ from 0 - 5
- Predefined *sets* of process areas make up a Maturity Level (1-5)
- Degree of institutionalization is embodied in the generic goals and expressed through generic practices.

Further Information

- ISBN 0-321-27967-0 (textbook)
 - informative tips and hints on margins
- www.sei.cmu.edu (Software Engineering Institute – custodian of CMMI)
- seir.sei.cmu.edu (Information repository)
- Mraftus@grafp.com
- (416) 276-9777

Process improvement benefits

The performance results in the following table are from 30 different organizations that achieved percentage change in one or more of the six categories of performance measures below

Performance Category	Median Improvement
Cost	34%
Schedule	50%
Productivity	61%
Quality	48%
Customer Satisfaction	14%
Return on Investment	4:1