Capability Maturity Model Integration (CMMI) for Software Development: From Ad Hoc to Institutionalized Processes

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Models, Frameworks and Methodologies

- Lean
- Six Sigma
- International Organization for Standardization (ISO) standards and guidelines
- Baldrige National Quality Program (BNQP)

- Project Management Institute (PMI) Project Management Book of Knowledge (PMBOK)
- Information Technology Institute Library (ITIL)

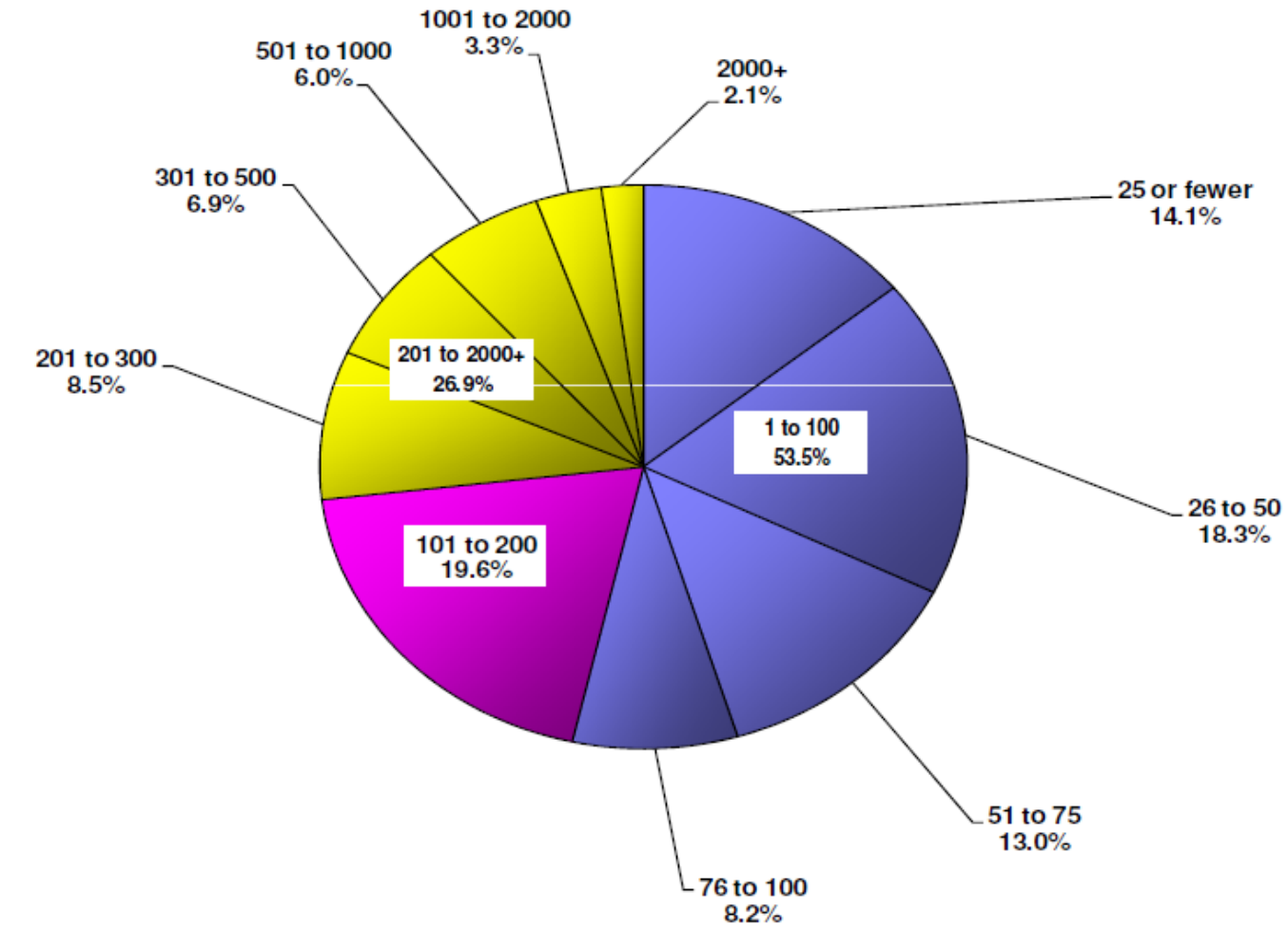
- **Software Engineering Institute (SEI) Capability Maturity Model Integration (CMMI)**

CMMI Overview

- SW-CMM released in 1991
- CMMI v 1.0 published in 2000
- CMMI v 1.3 released on November 3rd, 2010

- Best practices and guidelines for quality processes
- Point of references for appraising current processes
- Guides process improvement across projects, divisions and entire organization

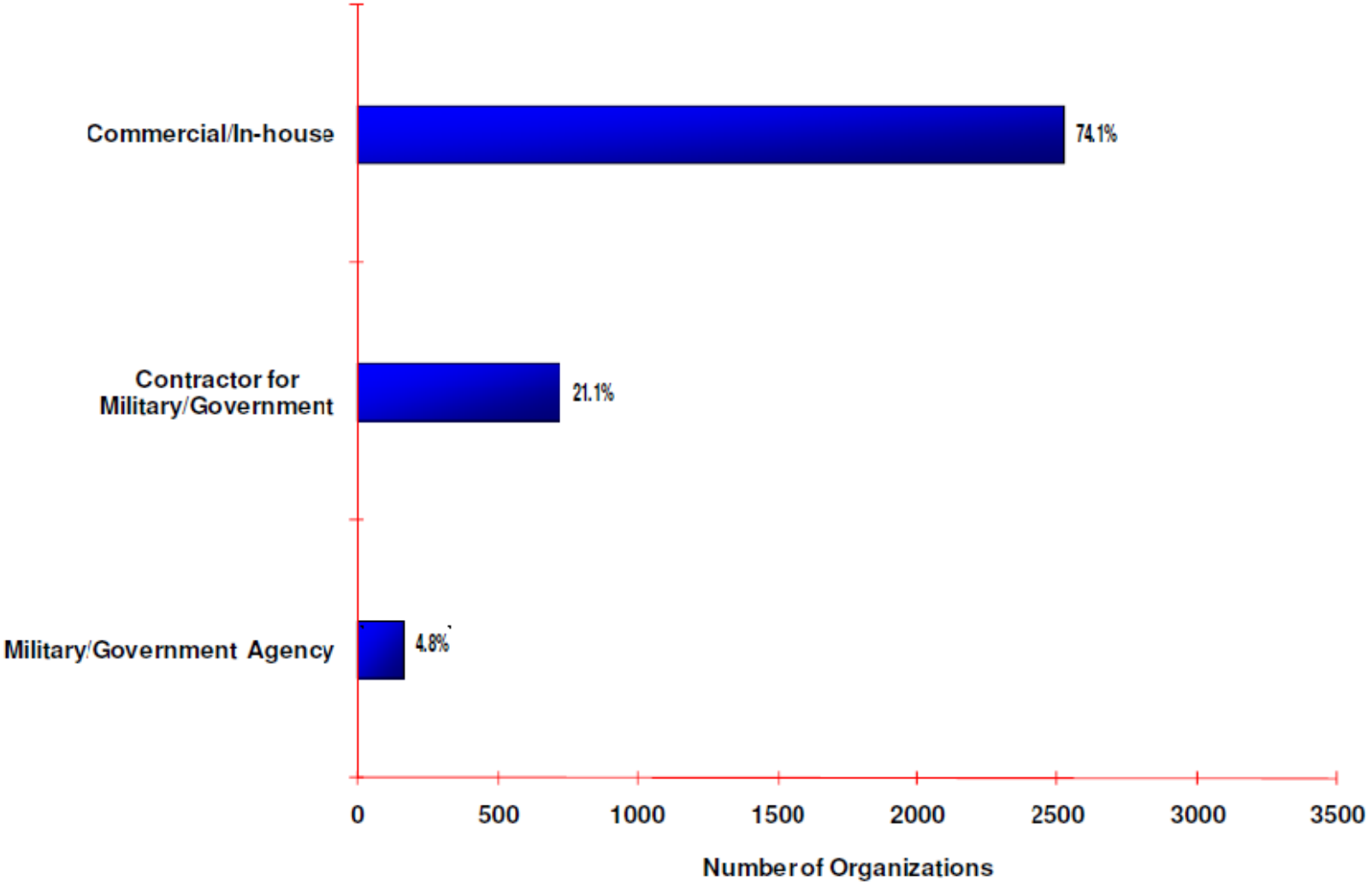
CMMI Appraised Organizations



Based on **3407** organizations reporting size data

http://www.sei.cmu.edu/library/assets/2009MarCMMI.pdf

CMMI Appraised Organizations



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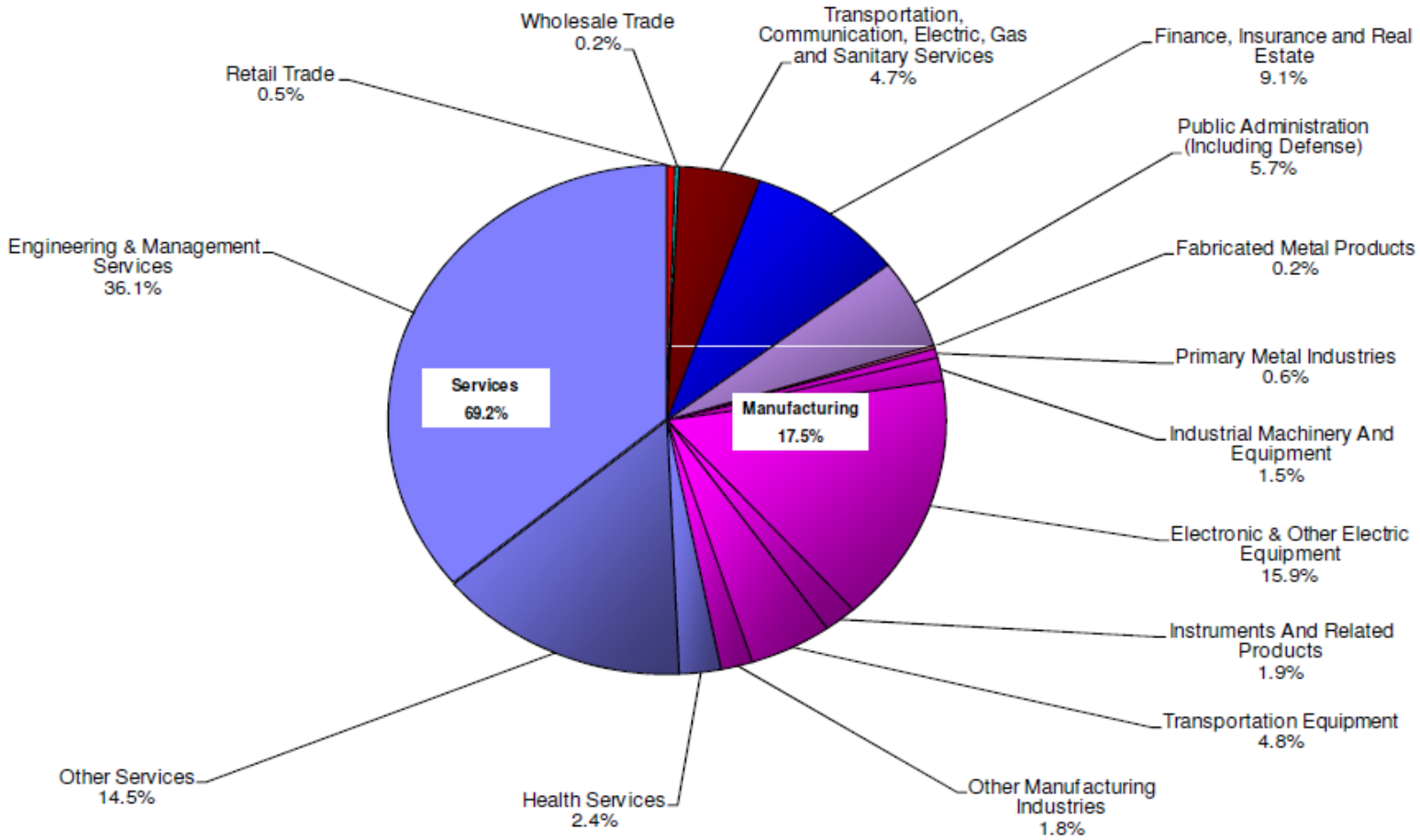

Based on **2652** organizations reporting SIC code. For more information visit: http://www.osha.gov/oshstats/sicser.html

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CMMI Components

- Process Area
- Specific Goal
- Specific Practice
- Typical Work Product
- Subpractices

Process Areas

- Process Management
  - Organizational Process Management (OPM)
  - Organizational Process Definition (OPD)
  - Organizational Training (OT)
  - Organizational Process Performance (OPP)
  - Organizational Innovation and Deployment (OID)
- Project Management
  - Project Planning (PP)
  - Project Monitoring and Control (PMC)
  - Supplier Agreement Management (SAM)
  - Integrated Project Management (IPM)
  - Risk Management (RSKM)
  - Quantitative Project Management (QPM)
- Engineering
  - Requirements Management (RM)
  - Requirements Development (RD)
  - Technical Solution (TS)
  - Product Integration (PI)
  - Verification (VER)
  - Validation (VAL)
- Support
  - Configuration Management (CM)
  - Process and Product Quality Assurance (PPQA)
  - Measurement and Analysis (MA)
  - Decision Analysis and Resolution (DAR)
  - Causal Analysis and Resolution (CAR)

Example: Risk Management

- Purpose

  The purpose of Risk Management (RSKM) is to identify potential problems before they occur so that risk-handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

- Specific Goals and Practices

  SG 1 Prepare for Risk Management

  - SP 1.1 Determine Risk Sources and Categories
  - SP 1.2 Define Risk Parameters
    - **Typical Work Products**
      - 1. Risk source lists (external and internal)
      - 2. Risk management requirements (e.g., control and approval levels, and reassessment intervals)
    - **Subpractices**
      - 1. Define consistent criteria for evaluating and quantifying risk likelihood and severity levels.
      - 2. Define thresholds for each risk category.
      - 3. Define boundary conditions on the extent to which thresholds are applied against or within a category.
  - SP 1.3 Establish a Risk Management Strategy

  SG 2 Identify and Analyze Risks

  - SP 2.1 Identify Risks
  - SP 2.2 Evaluate, Categorize, and Prioritize Risks

  SG 3 Mitigate Risks

  - SP 3.1 Develop Risk Mitigation Plans
  - SP 3.2 Implement Risk Mitigation Plans

Process Institutionalization

- Performed Process
  - Accomplishes the work necessary to produce work products
  - Every person / group takes a different route to produce a work product
- Managed Process
  - Planned, monitored and controlled to achieve consistent performance
  - The managed processes of two projects in one organization may be different
- Defined Process
  - Purpose, inputs, entry criteria, activities, roles, measures, verification steps, outputs, exit criteria
  - Standard processes across all projects in a business unit / organization
- Quantitatively Managed Process
  - Controlled using statistical and other quantitative techniques
  - Quantitative predictability of process performance
  - Removal of special causes of process variation
- Optimizing Process
  - Focuses on continually improving process performance
  - Continuously improved by addressing common causes of process variation

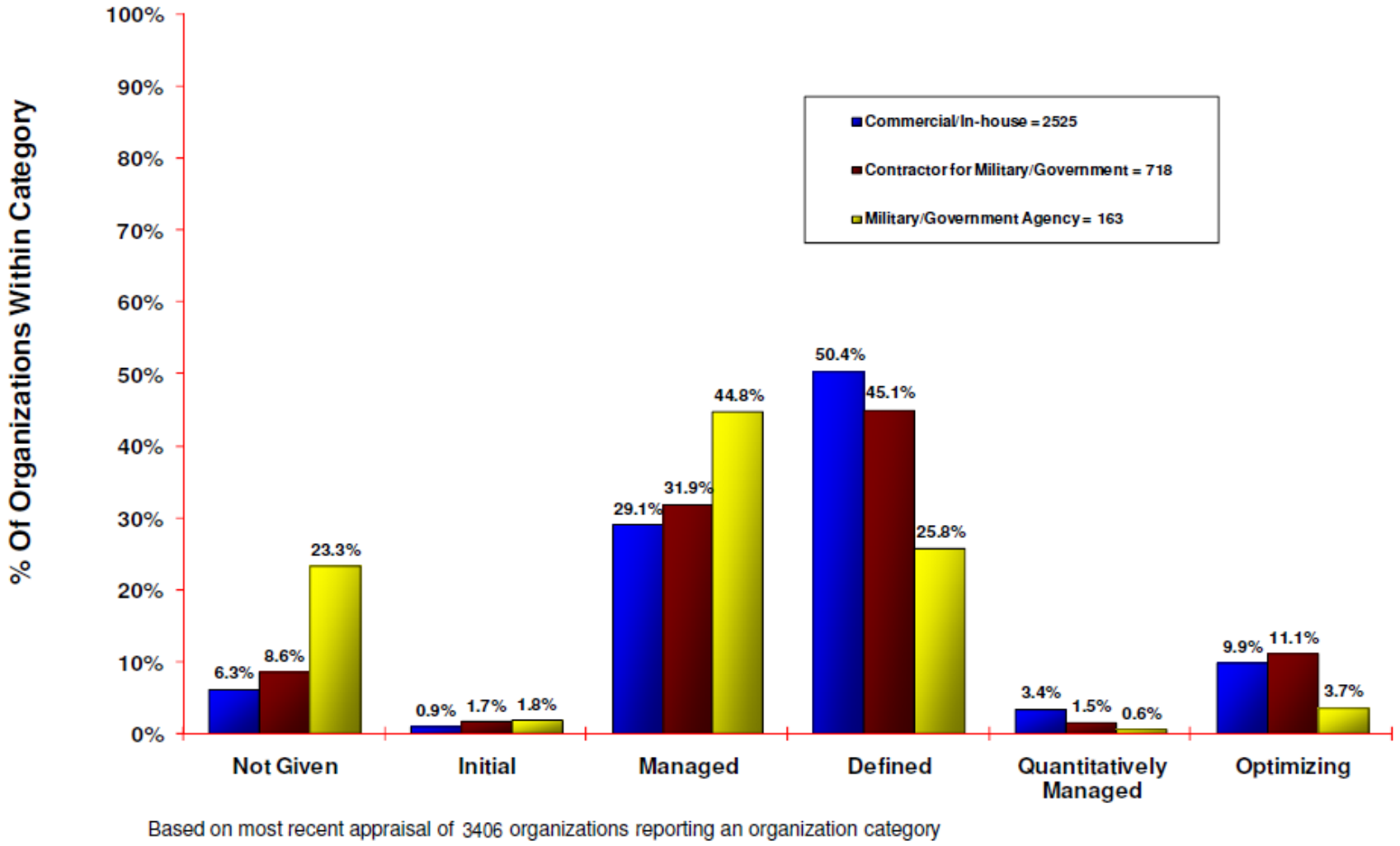
Generic Goals

- Managed Process
  - Perform Specific Practices
- Defined Process
  - Establish an Organizational Policy
  - Plan the Process
  - Provide Resources
  - Assign Responsibility
  - Train People
  - Manage Configurations
  - Identify and Involve Relevant Stakeholders
  - Monitor and Control the Process
  - Objectively Evaluate Adherence
  - Review Status with Higher Level Management
  - Establish a Defined Process
  - Collect Improvement Information
- Quantitatively Managed Process
  - Establish Quantitative Objectives for the Process
  - Stabilize Subprocess Performance
- Optimizing Process
  - Ensure Continuous Process Improvement
  - Correct Root Causes of Problems

CMMI Maturity Levels

- Level 1: Initial
  - Performed Process
- Level 2: Managed
  - Managed Process
  - REQM, PP, PMC, SAM, MA, PPQA, CM
- Level 3: Defined
  - Defined Process
  - REQM, PP, PMC, SAM, MA, PPQA, CM
  - + RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR
- Level 4: Quantitatively Managed
  - Quantitatively Managed Process
  - REQM, PP, PMC, SAM, MA, PPQA, CM
  - + RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR
  - + OPP, QPM
- Level 5: Optimizing
  - Optimizing Process
  - REQM, PP, PMC, SAM, MA, PPQA, CM
  - + RD, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR
  - + OPP, QPM
  - + OID, CAR

CMMI Maturity Levels



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CMMI Maturity Levels

- For organizations that began their CMMI-based SCAMPI effort in 2002 or later, the median time to move from:
  - maturity level 1 to 2 is 4 months
  - maturity level 2 to 3 is 18 months
  - maturity level 3 to 4 is 19 months
  - maturity level 4 to 5 is 13 months

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CMMI Results

Performance Category	Median Improvement	Number of Data Points	Lowest Improvement	Highest Improvement
Cost	34%	29	3%	87%
Schedule	50%	22	2%	95%
Productivity	61%	20	11%	329%
Quality	48%	34	2%	132%
Customer Satisfaction	14%	7	-4%	55%
Return on Investment	4.0 : 1	22	1.7 : 1	27.7 : 1

Improvement Achievements	Organization
70 to 80 percent reduction in average slippage of project delivery dates as the organization achieved CMMI maturity level 2	JP Morgan Chase
CMMI maturity level 3 site **reduced its costs of rework by 42 percent** over several years	Raytheon Corp Anonymous site
Estimation accuracy improved by 72 percent on average in three technical areas from 1996 through 2004	Siemens Information Systems Ltd.
On-time deliveries improved from 79 percent to 89 percent as the organization moved from SW-CMM maturity level 3 toward CMMI maturity level 4	Systematic Software Engineering
Over 20 percent improvement in account productivity as the organization moved from SW-CMM maturity level 3 toward CMMI maturity level 5	IBM Australia Application Management Services

SEI technical report issued in Aug 2006
Performance Results of CMMI – Based Process Improvement
Diane Gibson, Dennis Goldenson, Keith Kost


ASQ
American Society for Quality St. Petersburg - Tampa Section 1508

SUMMARY

Summary

- A “what” not a “how”
- 22 process areas with specific goals, practices and subpractices
- Generic goals and practices to institutionalize processes
- 5 maturity levels
- Point of references for appraising current processes
- Process improvement infrastructure

- Cost
- Schedule
- Productivity
- Quality
- Customer Satisfaction
- Return on Investment

THANK YOU

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