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CMMI®

Why Should I Switch to CMMI®? Initial Evidence about Impact and Value Added

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Overall Objectives

Provide credible, objective evidence about organizations' experiences with CMMI based process improvement.

Focus:

- Impact and value added
- Investment and costs incurred
- Conditions of successful adoption, transition, and documented improvement
- Pitfalls and obstacles to successful adoption and use

Conduct objective studies that inform the development and evolution of the CMMI product suite

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Current Work

Collaborative case studies

- Early adopters with credible quantitative evidence of impact and benefits of CMMI
- Selected supplementary evidence

SEI Special Report

- *Demonstrating the Impact and Benefits of CMMI®: An Update and Preliminary Results*
- Based on case studies, supplementary materials, and comprehensive literature review

Track at 3rd Annual CMMI Technology Conference and User Group

- 14 case study presentations & keystone summary presentation
- Roundtable panel with discussion of next steps

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Organizations

Conference Presenters	Others
Accenture	Boeing Ltd, Australia
CMS Information Services, Inc.	Bosch Gasoline Systems
Lockheed Martin Management and Data Systems	Fort Sill Fire Support Software Engineering Center
Lockheed Martin Maritime Systems and Sensors – Undersea Systems	General Motors Corporation
Lockheed Martin Systems Integration	J.P. Morgan Chase & Co.
Motorola Global Software Group, India	Sanchez Computer Associates, Inc.
Northrop Grumman Defense Enterprise Systems	Thales Air Traffic Management
Raytheon North Texas Software Engineering	Thales Research & Technology
	Thales Training & Simulation
	Siemens Information Systems Ltd, India

Plus 2 Anonymous

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Why Do We Need Objective Evidence?

Increasing numbers of organizations are considering using CMMI models

Trustworthy evidence is essential for

- Addressing skepticism about model-based process improvement in general
- Demonstrate the value of CMMI over its source models
- Building commitment and obtaining resources within an organization
- Enhancing ongoing quantitative management
- Providing input for improving organizational processes and technologies
- Comparing results with those of comparable organizations

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What is Legitimate Evidence of Impact?

Evidence based on:

- New processes or changes to existing processes due to CMMI
- Broadened organizational scope across disciplines
  - Especially for software intensive systems
- Process changes that are consistent with, but predate, CMMI
  - Especially in organizations appraised early at higher CMMI maturity levels
- Recent evidence based on the SW-CMM
  - Much of the same content is present in CMMI models
  - And, such evidence can be compelling to skeptics about any CMM-based process improvement

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Generalizability

Case studies

- Offer a great deal of valuable detail and context
- Provide lessons learned which can be used to guide future improvement efforts
- Demonstrate what can happen under the right organizational and technical circumstances

- However, results from individual case studies cannot be generalized

Our task is to design studies that better reflect the experiences of the wider CMMI community

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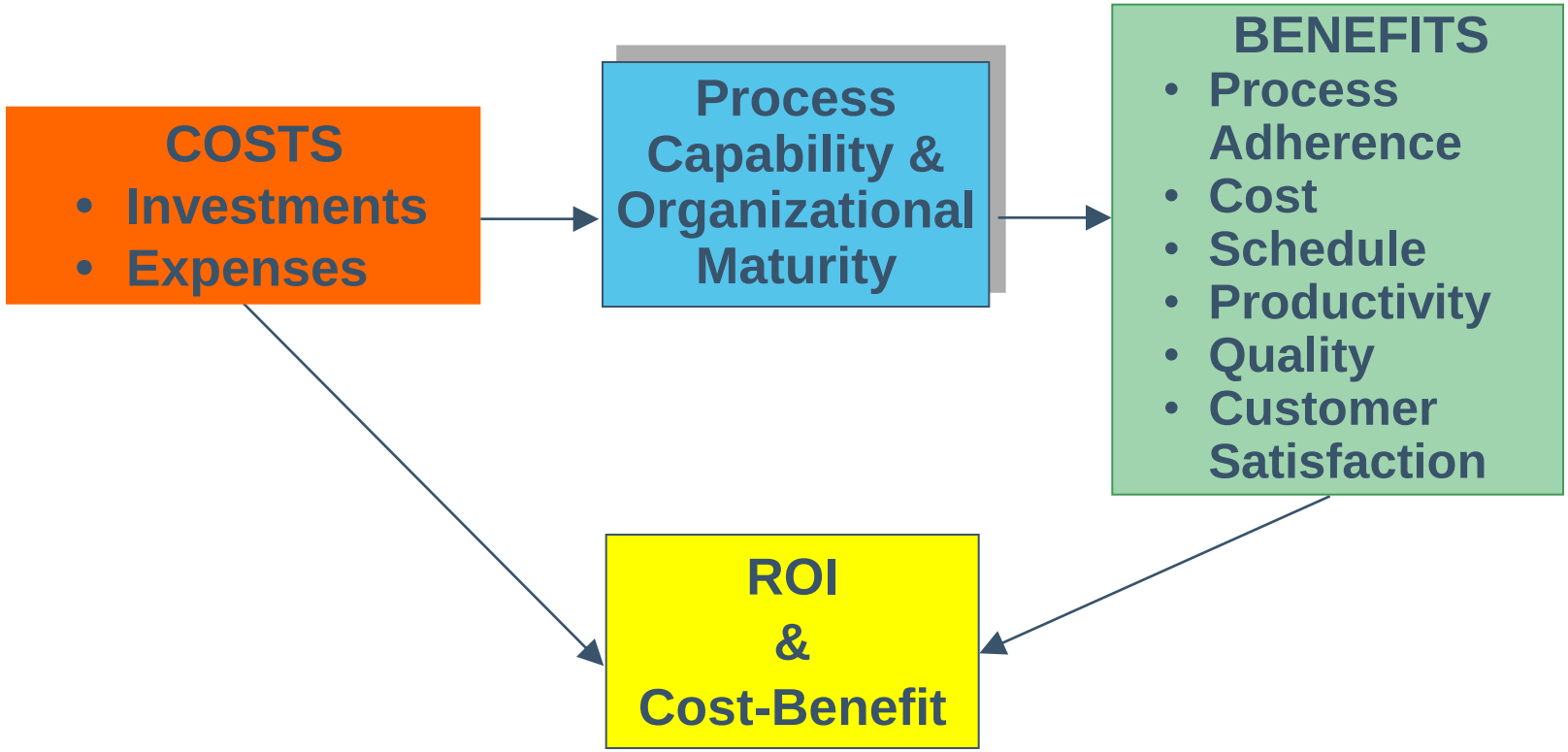
Impacts: Costs and Benefits of CMMI



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Seven Kinds of Performance Measures

From the previous set, we found examples of 7 different categories of performance measures

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

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Impact: Process Adherence and Cost of Quality

- Work product completion improved dramatically (CMS Information Services, Inc.)
- Exceeded goal for reduction in cost of poor quality (Motorola Global Software Group, India)
- Improved adherence to quantitative management practices (Raytheon North Texas Software Engineering)
- Reduced cost of poor quality from over 45 percent to under 30 percent (Siemens Information Systems Ltd, India)
- Used Measurement and Analysis to significantly reduce the cost of quality in one year (reported under non disclosure)

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Impact: Cost$_1$

- 33 percent decrease in the average cost to fix a defect (Boeing, Australia)
- 20 percent reduction in unit software costs (Lockheed Martin Management and Data Systems)
- 15 percent decrease in defect find and fix costs (Lockheed Martin Management and Data Systems)
- 4.5 percent decline in overhead rate (Lockheed Martin Management and Data Systems)
- Improved and stabilized Cost Performance Index (Northrop Grumman Defense Enterprise Systems)

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Impact: Cost$_2$

- Increased accuracy in cost estimation (Raytheon North Texas Software Engineering)
- 5 percent improvement in average cost performance index with a decline in variation (Raytheon North Texas Software Engineering)
  - As the organization improved from SW-CMM level 4 to CMMI level 5
- $2.1 Million in savings in hardware engineering processes (reported under non disclosure)

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Impact: Schedule$_1$

- 50% reduction in release turn around time (Boeing, Australia)
- 60 percent reduction in work and fewer outstanding actions following pre-test and post-test audits (Boeing, Australia)
- Increased the percentage of milestones met from approximately 50 percent to approximately 95 percent (General Motors)
- Decreased the average number of days late from approximately 50 to fewer than 10 (General Motors)
- Increased through-put resulting in more releases per year (JP Morgan Chase)

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Impact: Schedule$_2$

- Improved and stabilized Schedule Performance Index (Northrop Grumman Defense Enterprise Systems)
- Met every milestone (25 in a row) on time, with high quality and customer satisfaction (Northrop Grumman Defense Enterprise Systems)
- Reduced variation in schedule performance index (Raytheon North Texas Software Engineering)
- Reduced schedule variance over 20 percent (reported under non disclosure)
- Achieved 95 percent on time delivery (reported under non disclosure)

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Impact: Productivity

- Improved productivity substantially, with “significantly more rigorous engineering practices” due to CMMI (Fort Sill Fire Support Software Engineering Center)
- 30 percent increase in software productivity (Lockheed Martin Management and Data Systems)
- Improved software productivity (including reuse) from approximately 80 percent in 1992 baseline to over 140 percent at CMMI ML 5 (Lockheed Martin Systems Integration)
- 25 percent productivity improvement in 3 years (Siemens Information Systems Ltd, India)

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Impact: Quality$_1$

- Reduced software defects substantially, with “significantly more rigorous engineering practices” due to CMMI (Fort Sill Fire Support Software Engineering Center)
- Reduced software-defects-per-million-delivered-SLOC by over 50 percent compared to defects prior to CMMI (Lockheed Martin Systems Integration)
- Reduced defect rate at CMMI ML5 approximately one third compared to performance at SW-CMM ML5 (Lockheed Martin Maritime Systems & Sensors – Undersea Systems)
- Met goal of 20 +/- 5 defects per KLOC (Northrop Grumman Defense Enterprise Systems)

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Impact: Quality$_2$

- Only 2 percent of all defects found in the fielded system (Northrop Grumman Defense Enterprise Systems)
- Reduced identified defects from 6.6 per KLOC to 2.1 over 5 causal analysis cycles (Northrop Grumman Defense Enterprise Systems)
- Increased focus on quality by developers (Northrop Grumman Defense Enterprise Systems)
- Improved defect removal before test from 50 percent to 70 percent, leaving 0.35 post release defects per KLOC (Siemens Information Systems Ltd, India)
- 44 percent defect reduction following causal analysis cycle at maturity level 2 (reported under non disclosure)

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Impact: Customer Satisfaction

- Increased award fees by 55 percent compared to an earlier SW-CMM baseline at maturity level 2 (Lockheed Martin Management and Data Systems)
- Received more than 98 percent of possible customer award fees (Northrop Grumman Defense Enterprise Systems)
- Earned a rating of “Exceptional” in every applicable category on their Contractor Performance Evaluation Survey (Northrop Grumman Defense Enterprise Systems)
- Improved average customer satisfaction rating 10 percent (Siemens Information Systems Ltd, India)

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Impact: Return on Investment

- 5:1 ROI for quality activities (Accenture)
- 13:1 ROI calculated as defects avoided per hour spent in training and defect prevention (Northrop Grumman Defense Enterprise Systems)
- Avoided $3.72M in costs due to better cost performance (Raytheon North Texas Software Engineering)
  - As the organization improved from SW-CMM level 4 to CMMI level 5
- 2:1 ROI over 3 years (Siemens Information Systems Ltd, India)
- Processes for earlier defect detection, improved risk management, and better project control implemented after showing positive return on investment during pilot (Thales TT&S)

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CMMI and CMM Results

The following are results from organizations who did not present at the 3rd Annual CMMI Technology Conference and User Group

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General Motors Corporation

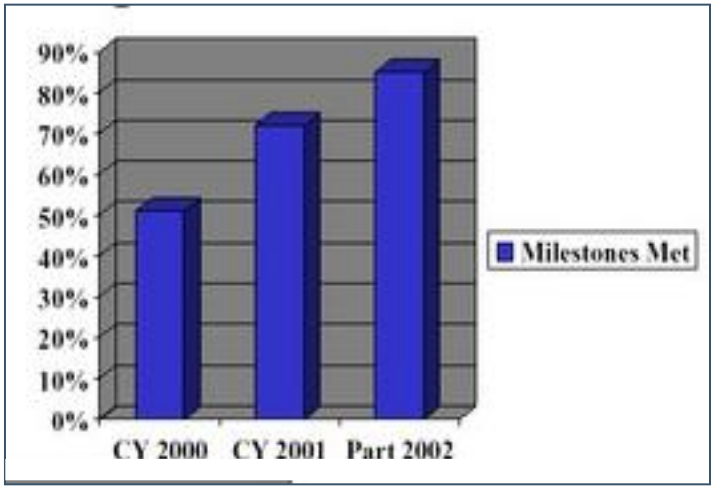
CMMI focus 2001

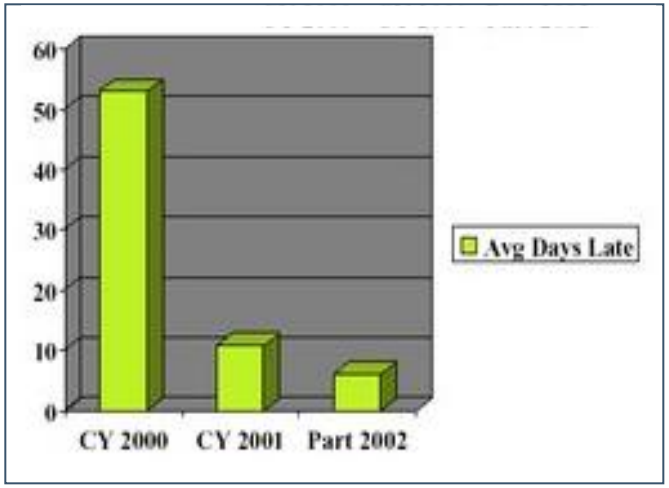
Goal is Integration of Supplier Work and GM Project Execution

Results:

Improvements in:

- Improved schedule – projects met milestones and were fewer days late





Schedule / cycle time

Camping on a Seesaw: GM's IS&S Process Improvement Approach. Hoffman, Moore & Schatz, SEPG 2003.

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Boeing Ltd, Australia

Making transition to CMMI from SW-CMM and EIA 731; early CMMI pilot in Australia

Improvements in:

RESULTS on One Project

- 33% decrease in the average cost to fix a defect
- Turnaround time for releases cut in half
- 60% reduction in work from Pre-Test and Post-Test Audits; passed with few outstanding actions

Product cost

Schedule / cycle time

Quality

- Increased focus on product quality
- Increased focus on eliminating defects
- Developers seeking improvement opportunities

In Processes is there a Pay-Off? Terry Stevenson, Boeing Australia, Software Engineering Australia 2003 conference.

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Thales ATM

CMMI Level 4 helps THALES meet their business objectives.

- Ability to see into the future with a known level of confidence
- Increasing number of processes under statistical control
- Measurement based process improvement
- **Return on investment due to**
  - earlier defect detection
  - improved risk management
  - better control of projects

Improvements in:

Quality

Predictability

CMMI® Level 4 Preparation: The Story of the Chicken and the Egg. Anne De Goeyse and Anne Sophie Luce, Thales ATM; and Annie Kuntzmann-Combelles, Q-Labs France, ESEPG 2003.

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Thales Training & Simulation

- Began process improvement with SW-CMM in 1992; Level 3 achieved in 1996
- Refocused on CMMI to broaden effort to systems engineering

- Lessons Learned:
  - quarterly internal "CBA IPI like" assessments measure progress and help avoid regression
  - experience gained during implementation of SW-CMM was a key factor in CMMI success
  - data collected on software has shown decreases in project cost and schedule variances as maturity increased

Improvements in:

Product cost

Schedule / cycle time

Achieving CMMI level 2: Keys to success. Robert Richard. ESEPG 2003.

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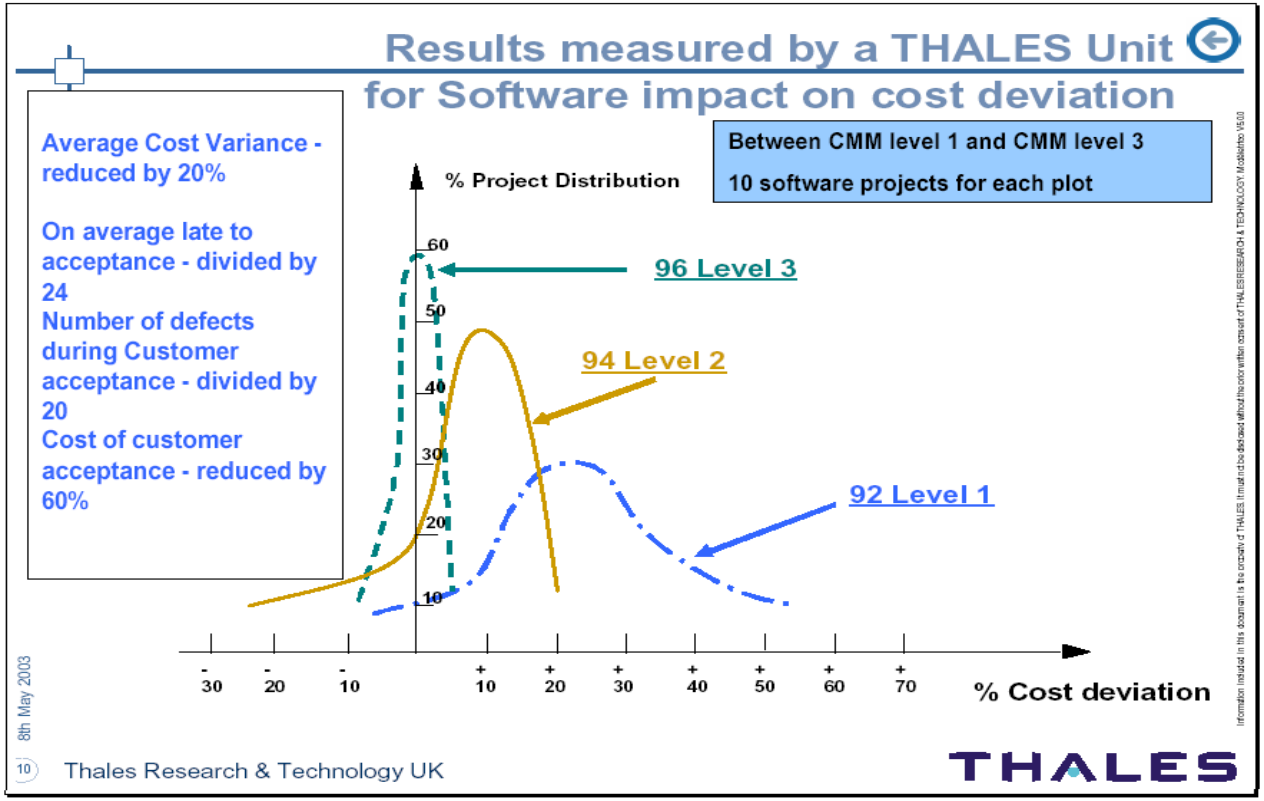
Thales Research & Technology

CMM data from another Thales Unit used by Thales Research & Technology as part of rationale to begin PI with CMMI.



Improvements in:

- Product cost
- Schedule / cycle time
- Quality
- Customer satisfaction

Getting Started with Process Improvement Using the CMMI®. Carol Marsh, Patrick Vigier. ESEPG 2003.

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Bosch Gasoline Systems

Improvements in:

Schedule / cycle time

Predictability

- Rework

Quality

CMM based improvements

- **Predictability** -- Internal On-Time Delivery improved by 15%
- **Less Rework** – first pass yield improved by 10%
- **Product Quality** – reduction in error cases in the factory by one order of magnitude

Next Steps include

- Move to CMMI and applying it to software, system and hardware
- Expand process improvement program to include sales, hardware and component development

Critical success factors for improvement in a large embedded systems organisation. Wolfgang Stolz, Robert Bosch GmbH Gasoline Systems GS-EC/ESP and Hans-Jürgen Kugler, Q-Labs Software Engineering, ESEPG 2003.

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Sanchez Computer Associates, Inc.

CMM Level 1 to Level 3 in 15 months. 6 Months later,

- saved $2 million in first 6 months, most through early detection and removal of defects

Improvements in:

Quality

+ REVENUE / SAVINGS

In addition,

- improved quality of code
- robust training program
- applicability of process outside of software programming

Financial Services Software Developer Saves $2 Million in Six Months with CMM® Implementation. David Consulting Group, News Release.

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J.P. Morgan Chase & Co

1st CMM success 2001

today, 28 teams at CMM Level 2

CMMI success – 1st team ML3 in 2003

Investment in PI = $4 million

Improvements in:

Predictability

Quality

Schedule / cycle time

Results:

- Improved predictability of delivery schedule
- Reduction of post-release defects
- Reduced severity of post-release defects

And, from CMMI specifically

- Increased through-put = more releases per year

Goal to achieve CMMI throughout organization

With permission from presentation to the SEI, September 2003.

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Proposed for FY2004 and Beyond$_1$

Impact and benefits of systems engineering

- Processes with heritage in EIA 731 and precursors
- Organizational integration

Additional case studies

- In-depth collaboration with the SEI
- Self reported *via* the SEIR

Broadly based studies

- State-of-the-practice surveys of CMMI impact and transition
- Analyses using existing commercial databases
- Community benchmarking of process and performance

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Proposed for FY2004 and Beyond$_2$

Related studies

- Research and development on costs and benefits of CMMI appraisal methods
- Guidance on calculating cost-benefit, cost effectiveness, ROI, and cost of quality
- CMMI adoption and impact in small and medium enterprises

Decision support

- Proactive guidance for Decision Analysis and Resolution
- Combining computer modeling and simulation with empirical results
- Validating predictions empirically

Guidance on using measurement effectively

Technical Report, conference presentations and journal articles

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Performance Measures Summary$_1$

Of 20 organizations/cases:

Process Adherence: Five cases show improvements in process adherence and cost of quality

Cost: Five cases provide eight examples of cost-related benefits, including reductions in the cost to find and fix a defect, and overall cost savings

Schedule: Six cases (ten examples) show evidence of schedule-related benefits, including decreased time needed to complete tasks and increased predictability in meeting schedules

Productivity: Four cases provide evidence of increased productivity

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Performance Measures Summary$_2$

Of 20 organizations/cases:

Quality: Six cases provide nine examples of measured improvements in quality, mostly related to reducing defects over time or by product life cycle

Customer Satisfaction: Three cases show four examples of improvements in customer satisfaction, including demonstration of customer satisfaction through award fees

Return on Investment: Five cases report positive returns on investment from their CMMI-based process improvement

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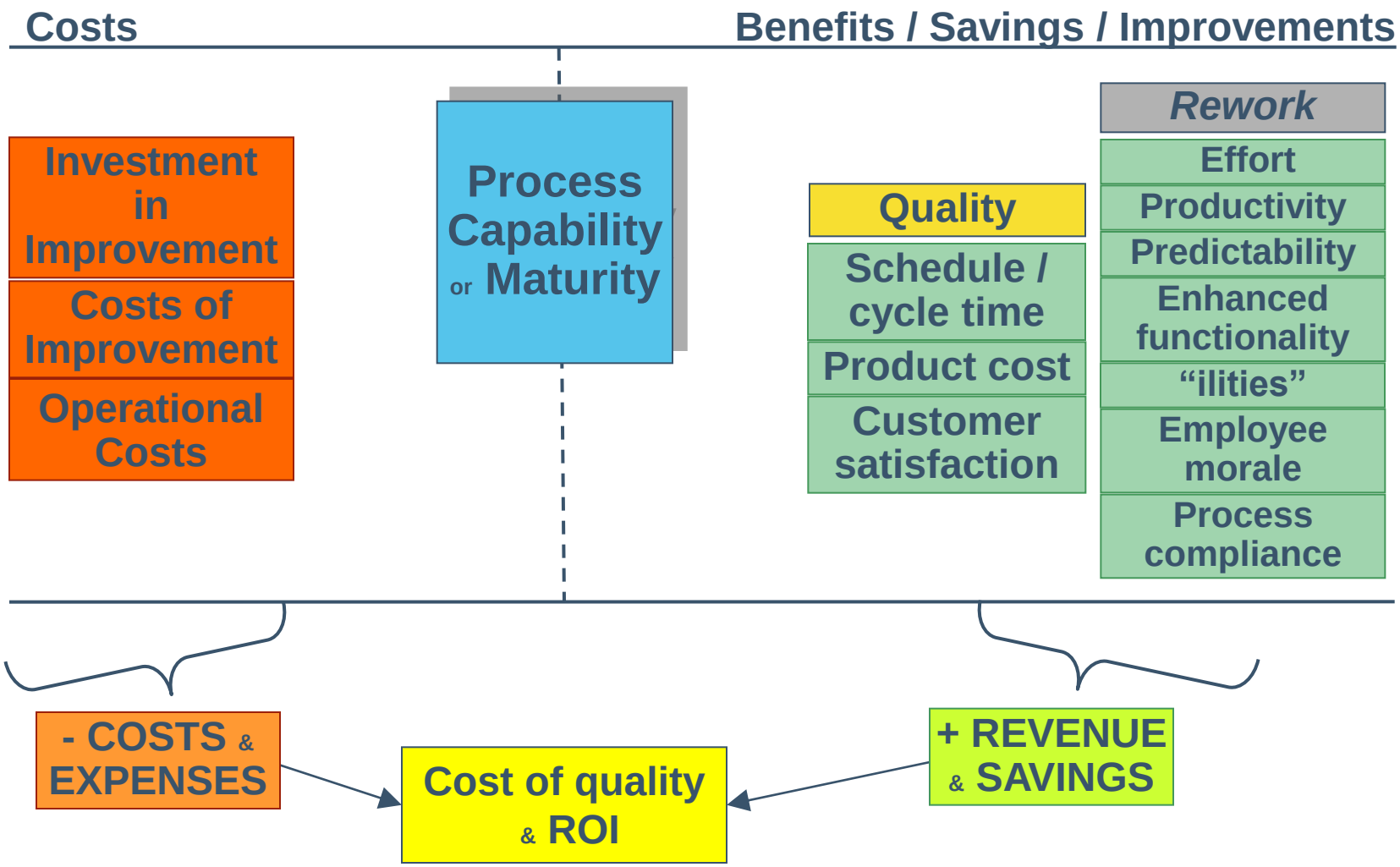

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