Dr. Richard D. Stutzke

Richard D. Stutzke, Ph.D. was Vice-President, Science Applications International Corp. (SAIC), and has more than 40 years experience with software development and project management in the military and industry, including scientific, embedded real-time, and commercial systems. He has authored over fifty papers and articles on software estimation and management, and the book "Estimating Software-Intensive Systems: Projects, Products, and Processes" published by Addison-Wesley in 2005.

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DEFINING THE FUTURE

Extracting Strategic Value from CMMI

CMMI Technology Conference & User Group
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Background

- **Many organizations have implemented the Capability Maturity Model Integrated (CMMI)**
- **Although they have achieved their desired maturity level and improvement goals, some organizations have seen little or no financial benefits**

What are the underlying principles of CMMI as they relate to productivity, predictability, and speed?

What is the return on investment?

What are the timelines for realizing these benefits?

Agenda

- How Do Mature Processes Help?
- Knox Cost of Quality model
- Industry ROI data for CMMI
- Why ROI data doesn't always help
- Extracting strategic value from CMMI

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Projects Have Historically Suffered from Mistakes

People-Related Mistakes

1. Undermined motivation
2. Weak personnel
3. Uncontrolled problem employees
4. Heroics
5. Adding people to a late project
6. Noisy, crowded offices
7. Friction between developers and customers
8. Unrealistic expectations
9. Lack of effective project sponsorship
10. Lack of stakeholder buy-in
11. Lack of user input
12. Politics placed over substance
13. Wishful thinking

Process-Related Mistakes

14. Overly optimistic schedules
15. Insufficient Risk Management
16. Contractor failure Insufficient planning
17. Abandonment of planning under pressure
18. Wasted time during the fuzzy front end
19. Shortchanged upstream activities
20. Inadequate design
21. Shortchanged quality assurance
22. Insufficient management controls
23. Premature or too frequent convergence
25. Omitting necessary tasks from estimates
26. Planning to catch up later
27. Code-like-hell programming

Product-Related Mistakes

28. Requirements gold-plating
29. Feature creep
30. Developer gold-plating
31. Push me, pull me negotiation
32. Research-oriented development

Technology-Related Mistakes

33. Silver-bullet syndrome
34. Overestimated savings from new tools or methods
35. Switching tools in the middle of a project
36. Lack of automated source-code control

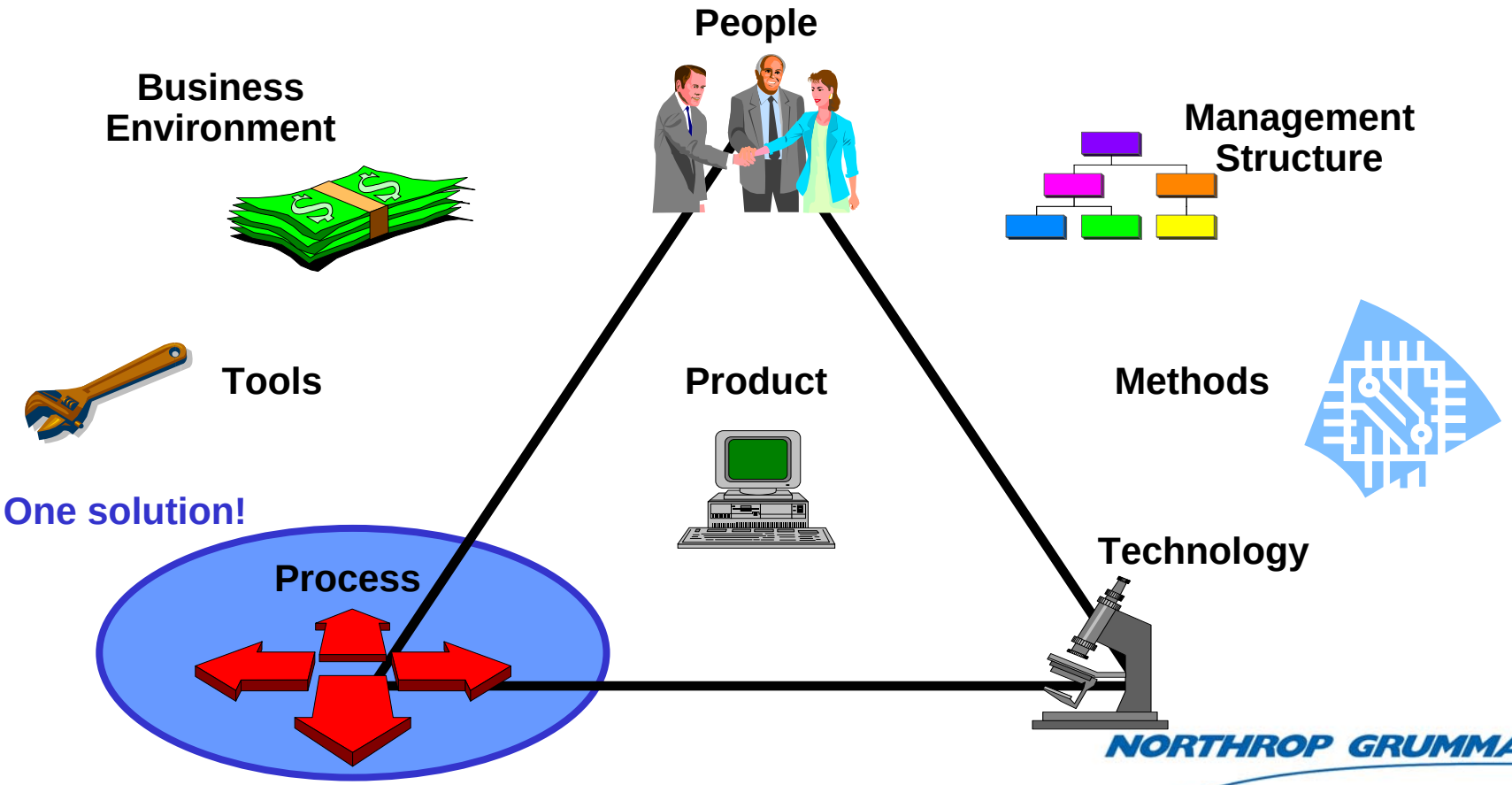
Standish Group, 2003
survey of 13,000 projects

- 34% successes
- 15% failures
- 51% overruns

Reference: Steve McConnell, Rapid Development

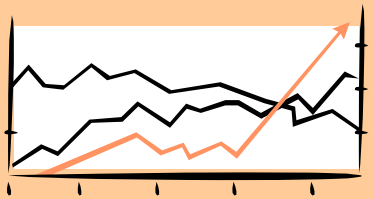
Many Approaches to Solving the Problem

- Which weaknesses are causing my problems?
- Which strengths may mitigate my problems?
- Which improvement investments offer the best return?



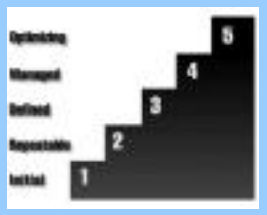
Approaches to Process Improvement

Data-Driven (e.g., Six Sigma, Lean)



- **Clarify what your customer wants (Voice of Customer)**
  - Critical to Quality (CTQs)
- **Determine what your processes can do (Voice of Process)**
  - Statistical Process Control
- **Identify and prioritize improvement opportunities**
  - Causal analysis of data
- **Determine where your customers/competitors are going (Voice of Business)**
  - Design for Six Sigma

Model-Driven (e.g., CMM, CMMI)



- **Determine the industry best practice**
  - Benchmarking, models
- **Compare your current practices to the model**
  - Appraisal, education
- **Identify and prioritize improvement opportunities**
  - Implementation
  - Institutionalization
- **Look for ways to optimize the processes**

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How Do Mature Processes Help?

- **Process maturity gets at one source of the problem, e.g.,**
  - Are we using proven industry practices?
  - Does the staff have the resources needed to execute the process?
  - Is the organization providing effective project support?
- **The main benefits typically seen are:**
  - Improved predictability of project budgets and schedules
  - Improved management awareness of problems
  - Reduced re-work, which improves predictability, cost, and schedule

J. Herbsleb and D. Zubrow, "Software Process Improvement: An Analysis of Assessment Data and Outcomes"

- 13 organizations
- ROI of 4:1 to 9:1
- Improved quality, error rates, time to market, productivity

R. Dion, "Process Improvement and the Corporate Balance Sheet"

- ROI of 7.7:1: Reduced re-work, improved quality
- Two-fold increase in productivity

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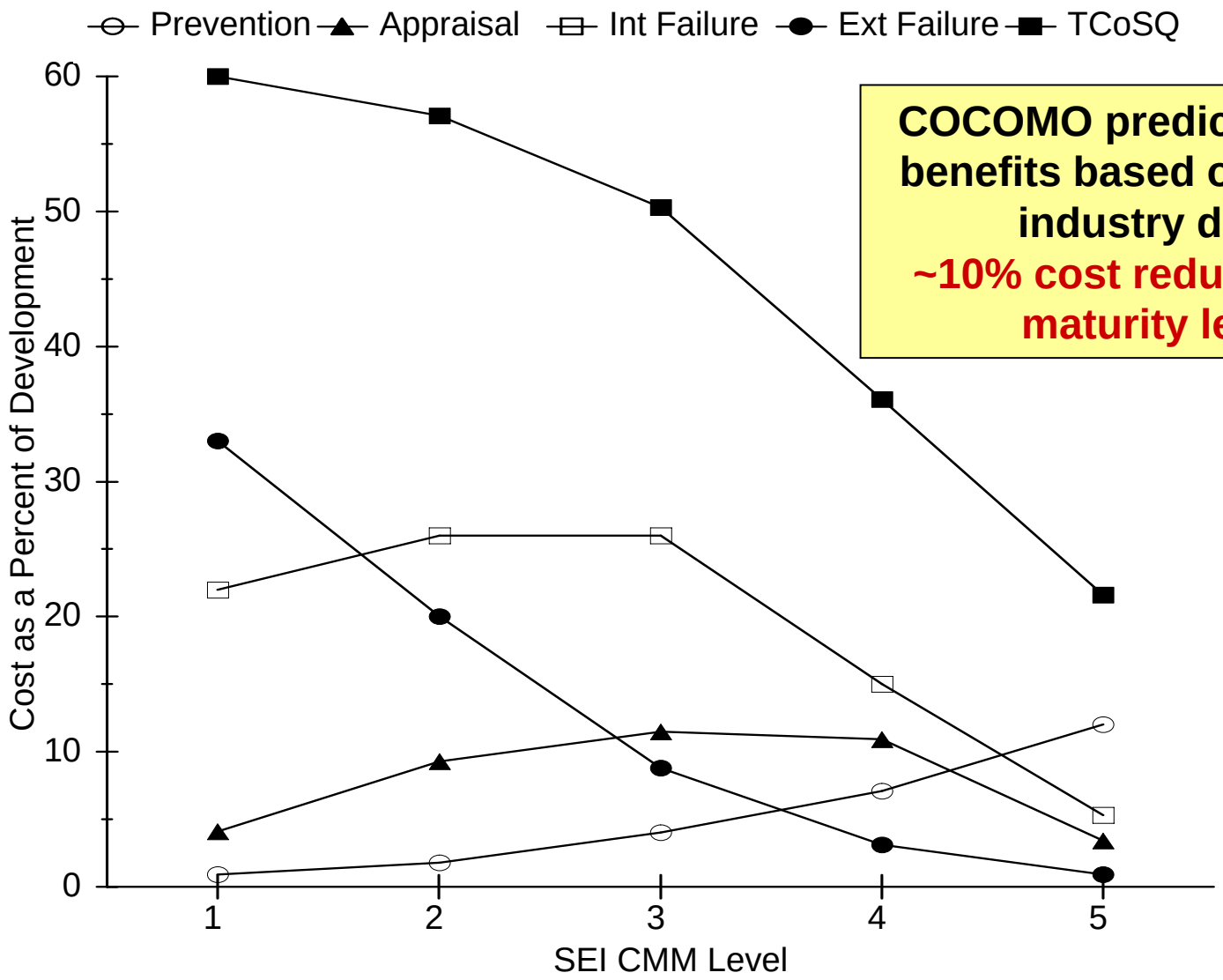
The Knox Cost of Quality Model

- **Extension of the Cost of Quality model used in manufacturing**

Cost	Category	Definition	Typical Costs for Software
Conformance	Appraisal	Discovering the condition of the product	Testing and associated activities, product quality audits
	Prevention	Efforts to ensure product quality	SQA administration, inspections, process improvements, metrics collection and analysis
Non-conformance	Internal failures	Quality failures detected prior to product shipment	Defect management, rework, retesting
	External failures	Quality failures detected after product shipment	Technical support, complaint investigation, defect notification

"Knox's Theoretical Model for Cost of Software Quality," Digital Technical Journal, vol.5, No. 4., Fall 1993, Stephen T. Knox.

Knox Model – Theoretical Benefits



COCOMO predicts similar benefits based on current industry data:
~10% cost reduction per maturity level

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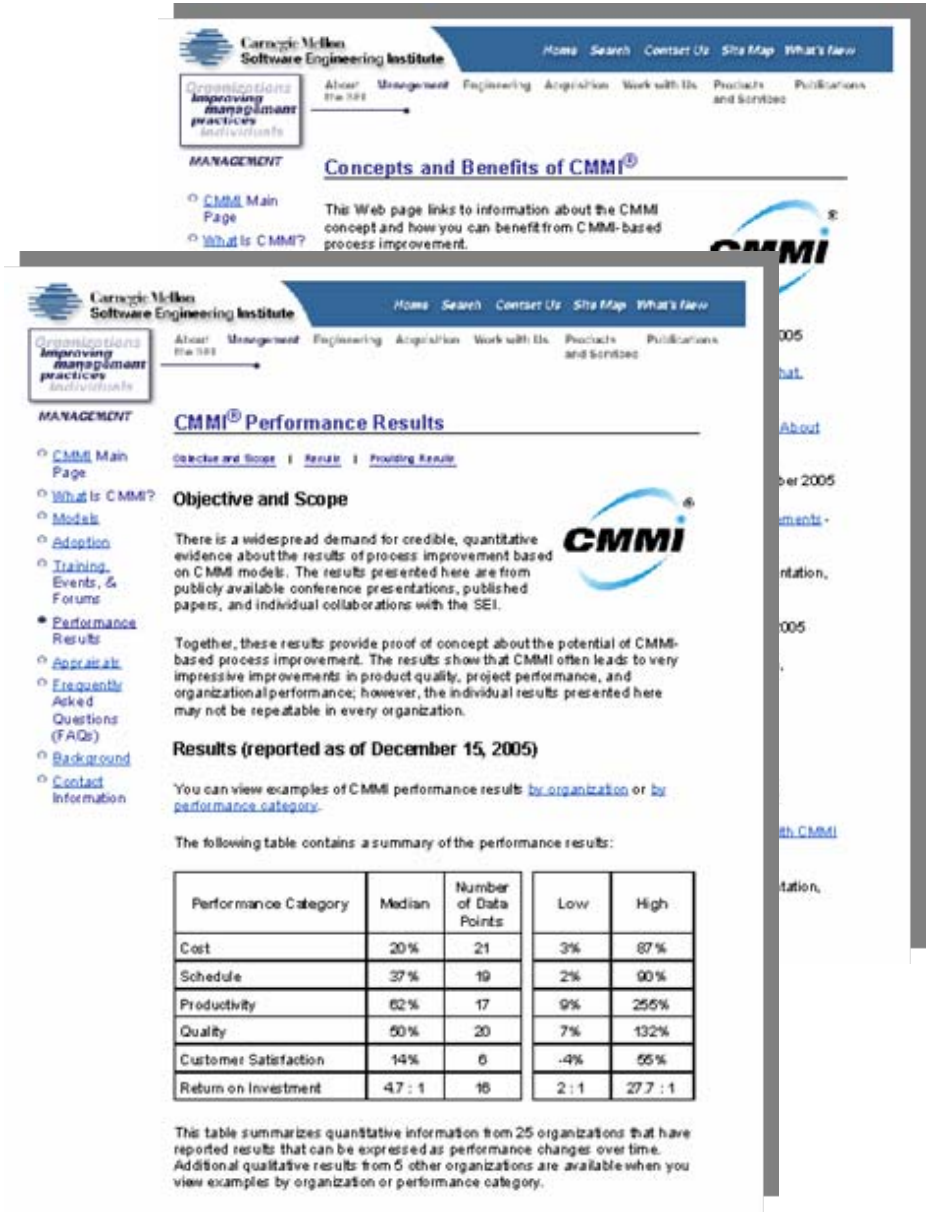
Benefits



- **Numerous studies have been published on the benefits of CMMI**
- ***Performance Results of CMMI-Based Process Improvement (CMU/SEI-2006-TR-004)***
- **CMMI Performance Results website: http://www.sei.cmu.edu/cmmi/results.html.**

Typical CMMI Benefits Cited in Literature

- **Reduced Costs**
  - 33% decrease in the average cost to fix a defect (Boeing)
  - 20% reduction in unit software costs (Lockheed Martin)
  - Reduced cost of poor quality from over 45 percent to under 30 percent over a three year period (Siemens)
  - 10% decrease in overall cost per maturity level (Northrop Grumman)
- **Faster Schedules**
  - 50% reduction in release turnaround time (Boeing)
  - 60% reduction in re-work following test (Boeing)
  - Increase from 50% to 95% the number of milestones met (General Motors)
- **Greater Productivity**
  - 25-30% increase in productivity within 3 years (Lockheed Martin, Harris, Siemens)
- **Higher Quality**
  - 50% reduction of software defects (Lockheed Martin)
- **Customer Satisfaction**
  - 55% increase in award fees (Lockheed Martin)

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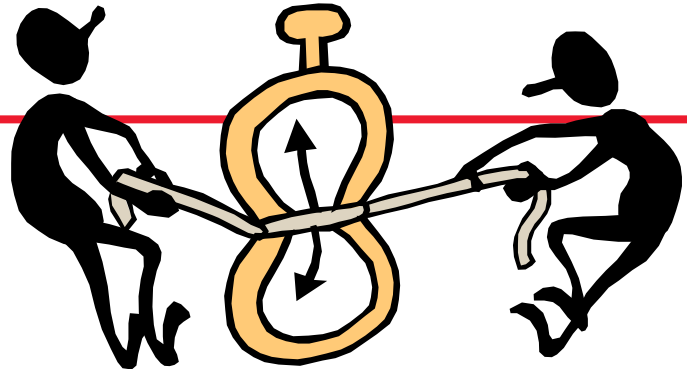
Why Do We Need ROI Data?

- **Management wants to invest overhead resources wisely**
  - Similar investment decisions are often based on “gut feel”, not hard data – does anything else seem more likely to yield results?
  - Investment decisions may be more driven by balance of short-term performance tactics and long-term marketing strategy
  - The key question is whether you could make similar progress with less resources (or more/faster progress with the same resources doing something else)
- **Projects want to justify the investment to their customers**
  - Difficult to convince process skeptics
  - People view the problem from their own experiences and skills

Beware of ROI as a smokescreen for process skepticism

Establishing ROI



- **It is difficult to quantify the value of an improvement initiative**
- **How do you measure the change?**
  - Multiple levels – organizational, management, engineering, support
  - Multiple causes – awareness, knowledge, infrastructure
  - Short-term vs. long-term – Hawthorne effect
- **How do you measure the investment?**
  - What would we have done instead?
- **How do you determine the value of the measured change?**
  - Increased predictability – what's the value?
  - Increased productivity – who gets the benefit?
  - Better competitive position – how measured?
  - Time-frame

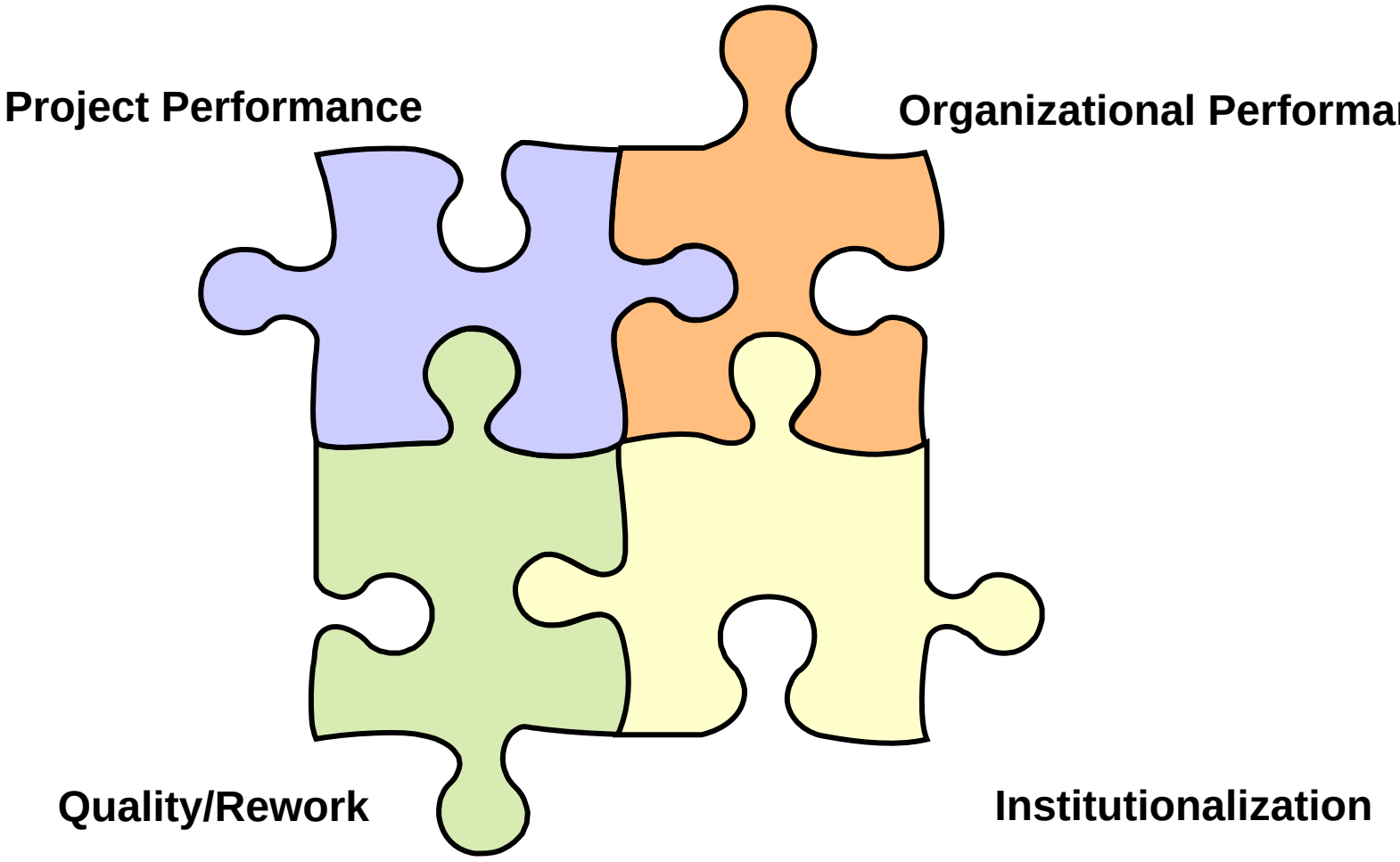
See also: S. Sheard and C.L. Miller , "The Shangri-La of ROI," Software Productivity Consortium, 2000

Where the Problem Sometimes Arises

- **Some organizations are driven to achieve a maturity level only for it's marketing value**

Improvement goals are not set realistically ("Level 5 in '05")	**No one takes the improvement effort seriously**
Only some of the projects participate in the improvement effort	**Personnel perceive CMMI as more expensive**
Only some of the projects get appraised	**Others don't implement; perceived as "done for show"**
Insufficient resources (e.g., training, QA, metrics, consultants)	**People don't learn the new behaviors or become proficient**
Management doesn't enforce the process	**Perceived as "done for show"; benefits are not realized**

Extracting Strategic Value from CMMI



Project Performance

- **Project performance problems often arise because of incomplete or unrealistic planning**
  - Forgotten activities
  - Unconscious decisions
  - Overly-optimistic estimates
- **When cost/schedule pressure arises, people abandon the plans, leading to more problems**
  - Individual judgment versus best use of resources

CMMI

- **Identifies the elements of good planning**
  - Proven engineering processes
  - Estimates based on historical data, using these processes
- **When cost/schedule pressure arises, CMMI practices track and correct**
  - Reactive (L2)
  - Proactive, risk management (L3)
  - Quantitative management (L4)
- **QA, management ensures processes/plans are followed**

- ***Train project managers on how to use the tools (estimation, earned value, risk management)***
- ***Project managers (not organizational staff) must be responsible for implementing the improved processes***
- ***Demand realistic, data-driven estimates***

"Project Implementation Strategies in the CMMI," R. Hefner, Wednesday, 3:30

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Organizational Performance

- **Each project's processes are unique**
  - Personnel must re-learn with each project
  - Difficulty moving people from project to project
  - Historical data of little use in estimation
- **No way to compare project-to-project**
  - Which process was best?
  - What did we learn?

CMMI

- **Standard organizational process, tailored to fit each project**
  - Can be documented, trained, supported by templates
  - Over time, people learn the process
- **Common processes/measures allow better use of historical data**
  - Calibrate cost estimation models
  - Project to project comparisons
  - Over time, the organization can optimize the process

- ***Develop an organizational process(es) which fits the full range of your projects (small/large, all life cycles and project types)***
- ***Capture and use historical data (measurement repository)***
- ***Capture and share project documents (process asset library)***

Rework / Quality

- **Focus on "faster and cheaper" leads to skipping of essential steps**
  - Key steps are not obvious, often counter intuitive
- **Fixing latent defects often accounts for 30-40% of project cost**
  - The cost of defects (rework) is seldom measured

CMMI

- **A disciplined engineering and management process**
  - Do it right the first time
  - CMMI identifies the essential steps
- **Peer reviews find defects early, where it is cost effective to fix them**
  - Requirements, designs, code, plans, etc.
  - Often more efficient and effective than testing
  - Many types (Fagan inspections, walkthroughs, desk checks, etc.)

- ***Focus on eliminating defects, not on faster and cheaper***
- ***Measure the cost of finding and fixing defects***
- ***Invest time in learning different methods of peer review and when each is effective***

Institutionalization

- **Some improvement efforts focus on quick fixes**
  - Driven by yearly budget cycles
  - Expectation that results will be immediate
- **It is tempting to reduce overhead to reduce cost**
  - Training
  - Staff support to projects
  - Use of outside process experts

CMMI

- **Short-term investment for long-term gain**
  - Initial investment in the cost of change, learning curve, new overhead structures
  - Long-term benefits in increased productivity
- **Organizational infrastructure exists to support the policies and process**
  - Measurement repositories

- ***Expect 18-24 months before benefits begin to be realized***
- ***Senior management must demand that <u>everyone</u> follow the new processes***
- ***QA can be the organization's strongest tool – if they are focused!***

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"Sustaining CMMI Compliance," R. Hefner, Thursday, 10:15

Lessons Learned

- **Process improvement means changing the process**
  - More important to learn the new behaviors than to “go through the motions”
- **Resistance often comes from fear of failure**
  - Walk the talk -- management at all levels must communicate the need for continuous improvement
  - Focus on learning from your mistakes and getting better
  - Training and assistance helps people in trying new processes
- **Six Sigma is a strong enabler for process improvement**
  - Focus on data, measurement systems, process improvement
  - Tying improvements to business goals
  - Allows the projects and organization to optimize the CMMI practices for maximum customer benefit

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