Process Improvement
Based on
Best Practices

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May 1, 2012
Carnegie Mellon, MSE Analysis of Software Artifacts

Two Paradigms

Analytic
• based on measurement, principles
  - Deming, Juran, Crosby, Lean, Six Sigma, ...

Best Practice Frameworks
• practices that consistently demonstrate significant improvements to the bottom line

Important best practice frameworks
• ISO 9001, ISO 9004 (Quality management systems)
• CMMI for Development, Services, Acquisition
• ISO/IEC 15504, ISO/IEC 330nn (Process assessment)
• Project Management BOK
• ISO 20000, ITIL, eSCM-SP (Service management)
• ValIT
The Quagmire...

315 standards, models, guidelines developed by 46 different organizations
- Moore, 1999

- Baldrige
- CBA IPI
- CMMI
- CobiT
- DOD-STD-2167A
- DOD-STD-2168
- DOD-STD-7935A
- EIA 632
- EIA 731
- eSCM
- FAA iCMM
- IEEE 1220
- IEEE/EIA 12207
- IPD-CMM
- ISO 15939
- ISO 9000

ISO/IEC 12207
ISO/IEC 15288
ISO/IEC TR 15504
J-STD-016
MIL-STD-498
MIL-STD-499B
People CMM
PSM
PSP
Q9000
QS 9000
RTCA DO-178B
SA-CMM
SCAMPI
SCE
SDC/CR
SDCE
SECAM
SE-CMM
SW-CMM
TL 9000
TSP
...

Accenture’s Holistic Approach to Quality
SIG Conference, 3 May 2006

<table>
<thead>
<tr>
<th>Quality Management</th>
<th>Outsourcing</th>
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<tbody>
<tr>
<td>ISO 9001 – focus on process standards and process management</td>
<td>eSCM-SP – focus on sourcing life cycle and best practices</td>
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<tr>
<td>Six Sigma – focus on data-driven decision making and improvement</td>
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<thead>
<tr>
<th>Systems Integration</th>
<th>Outsourcing</th>
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<tr>
<td>CMMI – focus on systems development/maintenance</td>
<td>eSCM-SP – focus on sourcing life cycle and best practices</td>
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<tr>
<th>AO</th>
<th>BPO</th>
<th>IO</th>
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<tr>
<td>CMMI – systems dev/maint.</td>
<td>COPC – call centers</td>
<td>ITIL – IT service mgmt</td>
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Pfeffer’s One-Eighth Rule

Why aren’t “best practices” that are known to be effective implemented by all organizations?

• One half of all people, in spite of the evidence, don’t believe the connection between the practices and the results.

• One half of those who see the connection try to make isolated changes rather than using a comprehensive and systemic approach.

• Only about half of those who make systemic changes persist long enough to derive the benefits.
Humphrey’s Motivational Speech

Do you believe that management is a good idea that adds value to your organization?

Do you believe that organization learning makes for more effective and efficient work?

Do you believe that using measurement and data to drive decisions is better than intuition?

Do you believe that continual improvement builds business value?

... Then why don’t you do any of those things?

Evidence-Based Software Engineering (& Management)


Evidence-based management

and so forth...
### Software CMM v1.1 (1987-2005)

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
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</thead>
<tbody>
<tr>
<td>5</td>
<td>Optimizing Continuous process improvement</td>
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<td></td>
<td></td>
<td>Defect Prevention</td>
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<td>Technology Change Management</td>
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<td></td>
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<td>Process Change Management</td>
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<tr>
<td>4</td>
<td>Managed Product and process quality</td>
<td>Quantitative Process Management</td>
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<tr>
<td></td>
<td></td>
<td>Software Quality Management</td>
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<tr>
<td>3</td>
<td>Defined Engineering processes and organizational support</td>
<td>Organization Process Focus</td>
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<tr>
<td></td>
<td></td>
<td>Organization Process Definition</td>
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<td>Training Program</td>
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<td>Integrated Software Management</td>
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<td>Software Product Engineering</td>
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<td>Intergroup Coordination</td>
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<td>Peer Reviews</td>
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<tr>
<td>2</td>
<td>Repeatable Project management processes</td>
<td>Requirements Management</td>
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<td>Software Project Planning</td>
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<td>Software Project Tracking &amp; Oversight</td>
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<td>Software Subcontract Management</td>
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<td>Software Quality Assurance</td>
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<td>Software Configuration Management</td>
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<tr>
<td>1</td>
<td>Initial Competent people (and heroics)</td>
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### Implications of Maturity

**Better predictability... Less variability... Improved performance...**

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Predicted Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Process improvement is institutionalized</td>
<td><img src="image1.png" alt="Graph" /></td>
</tr>
<tr>
<td>4</td>
<td>Product and process are quantitatively controlled</td>
<td><img src="image2.png" alt="Graph" /></td>
</tr>
<tr>
<td>3</td>
<td>Software engineering and management processes are defined and integrated</td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
<tr>
<td>2</td>
<td>Project management system in place; performance is repeatable</td>
<td><img src="image4.png" alt="Graph" /></td>
</tr>
<tr>
<td>1</td>
<td>Process is informal and unpredictable</td>
<td><img src="image5.png" alt="Graph" /></td>
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Risks of Model-Based Improvement

- Models are simplifications of the real world.
- Models are not comprehensive.
- Interpretation and tailoring must be aligned to business objectives.
- Judgement is necessary to use models correctly and with insight.
- Potential for dysfunctional behavior to get a maturity level rating.

Prioritizing Business Objectives

Treacy and Wiersma define three values that a company can focus on to drive business success.

Product leadership – features, innovation
  • typical focus of commercial shrinkwrap companies

Customer intimacy – niche products, relationships
  • typical focus of IT service providers

Operational excellence – promised features, on schedule, on budget
  • typical focus of custom software development

Personal Software Process (PSP)

Applies the CMM concepts of process discipline and quantitative management to the work of the individual software professional in a classroom setting.

Focuses on planning, quality, and productivity.

Typically involves developing programs using increasingly sophisticated processes.

*Humphrey, A Discipline for Software Engineering, 1995.*

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Improvements in PSP Quality

Team Software Process (TSP)

Build teams of PSP-trained professionals, launched in an industry project context.

Provide
• a supportive environment
• management standards
• peers doing similar work
• coaching support

Note that CMMI tells “what” to do but not how. PSP and TSP tell “how.”

Effective Teams

Group thinking is usually better, less variable, and more precise than individual thinking.


Range of team performance, rather than being an order of magnitude, tends to be between 85% and 115% of the norm.


Intuit TSP Results

Over 40 TSP teams

Post code-complete effort cut from 33% to 8% of the project

Standard test times cut from four months to one month

Twice the functionality in less time with higher quality
Microsoft TSP Results

Four releases for one team
Delivered on time
Increased productivity by 81%
Reduced system test defects by a factor of 133
Cut acceptance test and production defects to zero

CMMI-DEV v1.3

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<th>Level</th>
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<th>Process Areas</th>
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</table>
| 5 Optimizing        | Focus is on quantitative continuous process improvement    | Causal Analysis & Resolution
                                                          | Organizational Performance Management                                        |
| 4 Quantitatively    | Process is measured and controlled                          | Organizational Process Performance
                                                          | Quantitative Project Management                                               |
| Managed             |                                                             |                                                                                |
| 3 Defined           | Process is characterized for the organization and is proactive | Requirements Development
                                                          | Technical Solution
                                                          | Product Integration
                                                          | Verification
                                                          | Validation
                                                          | Organizational Process Focus
                                                          | Organization Process Definition
                                                          | Organizational Training
                                                          | Integrated Project Management
                                                          | Risk Management
                                                          | Decision Analysis & Resolution |
| 2 Managed           | Process is characterized for projects and is often reactive | Requirements Management
                                                          | Project Planning
                                                          | Project Monitoring & Control
                                                          | Supplier Agreement Management
                                                          | Product & Process Quality Assurance                                           |
| 1 Initial           | Process is unpredictable, poorly controlled, and reactive   | Configuration Management
                                                          | Measurement & Analysis                                                        |
                                                          |                                                                                |
**ISO/IEC 15504 aka SPICE (Process Assessment)**

Continuous representation
- processes (purpose + outcomes)
- capability dimension (six levels)

Process Reference Models
- ISO/IEC 12207 (Software life cycle processes)
- ISO/IEC 15288 (Systems life cycle processes)

Process Assessment Models
- ISO/IEC 15504-5 (Software process assessment – Part 5: An assessment model and indicator guidance)


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**ISO 15504 Capability Dimension**

Apply generic process management attributes to rate selected processes
- processes from ISO 12207, ISO 15288, ISO 15504-5
- aka “continuous architecture”

Six capability levels
- level 0 = incomplete
- level 1 = performed
- level 2 = managed
- level 3 = established
- level 4 = predictable
- level 5 = optimizing
ISO/IEC 12207
“Software Life Cycle Processes”

A common framework for software life cycle processes
• with well-defined terminology

Contains processes, activities, and tasks that are to be applied during the acquisition of
• a system that contains software
• a stand-alone software product
• software service
• during the supply, development, operation, and maintenance of software products

ISO 12207 Development Processes

5.3.1 Process implementation
5.3.2 System requirements analysis
5.3.3 System architectural design
5.3.4 Software requirements analysis
5.3.5 Software architectural design
5.3.6 Software detailed design
5.3.7 Software coding and testing
5.3.8 Software integration
5.3.9 Software qualification testing
5.3.10 System integration
5.3.11 System qualification testing
5.3.12 Software installation
5.3.13 Software acceptance support
The ISO/IEC 15504 series of standards is being replaced by the ISO/IEC 33001-99 series of standards.

**Core Elements**
- 33001 Concepts & Terminology
- 33002 Requirements for Process Assessment
- 33003 Requirements for Process Measurement Frameworks
- 33004 Requirements for Process Reference, Process Assessment and Organizational Maturity Models

**ISO 9001**
*(Quality Management Systems)*

Demonstrate the ability to provide product that consistently meets customer, regulatory, and statutory requirements.

Enhance customer satisfaction by continual improvement and conformance to requirements.

**Main clauses:**
- 4 Quality management system
- 5 Management responsibility
- 6 Resource management
- 7 Product realization
- 8 Measurement, analysis and improvement
**Quality Management Principles**
*ISO 9004:2000*

- Customer focus
- Leadership
- Involvement of people
- Process approach

<table>
<thead>
<tr>
<th>System approach to management</th>
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<tbody>
<tr>
<td>Continual improvement</td>
</tr>
<tr>
<td>Factual approach to decision making</td>
</tr>
<tr>
<td>Mutually beneficial supplier relationships</td>
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ISO 9004:2009 emphasizes sustainability.

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**PMBOK**

- Knowledge Areas (project xxx management)
  - integration
  - scope
  - time
  - cost
  - quality
  - human resource
  - communications
  - risk
  - procurement

- Process Groups
  - Initiating
  - Planning
  - Executing
  - Monitoring & controlling
  - Closing

Val IT

A governance framework that can be used to create business value from IT investments. 
• a set of guiding principles and a number of processes and best practices 
• tightly integrated with COBIT, also from the Information Systems Audit and Control Association (ISACA) 
• Enterprise Value: Governance of IT Investments, The Val IT Framework 2.0

Domains 
• Value Governance 
• Portfolio Management 
• Investment Management

To Be Blunt...

Many – perhaps most – software process improvement efforts fail.

• Approximately two thirds of respondents on SPI surveys do not report marked changes in their organizations as a consequence of their assessments. 
• Organizations seem to have (unrealistically) high expectations from assessment-based SPI, and these need to be managed better.
Managing Improvement

Do you have improvement objectives?

Do you measure progress toward achieving those objectives?

Can you forecast whether you will achieve the objectives?
  - If yes, are you considering what new objectives to establish?
  - If no, what are you doing to take corrective action? Revise plans? Develop a new strategy?

Variations on
  - Plan-Do-Check-Act (PDCA) or Plan-Do-Study-Act (PDSA)
  - Define-Measure-Analyze-Improved-Control (DMAIC)

Capturing Knowledge Effectively

High frequency / high predictability → reduce variability with rules, templates, decision algorithms, and process manuals

Frequent / unpredictable → suggestions based on case examples, a Q&A database, or a set of heuristics

Unpredictable / infrequent → provide access to expert advice

Lean Thinking

Lean ➔ minimize waste

Five principles of lean thinking:
• precisely specify value by specific product
• identify the value stream for each product
• make value flow without interruptions
• let the customer pull value from the producer
• pursue perfection

Focus on value:
• emphasize customer-added value
• minimize business-added value
• remove no-added value

Womack and Jones, Lean Thinking, 1996.

Adding Business Value

“Business orientation, that is, the extent to which SPI goals and actions are aligned with explicit and implicit business goals and strategies, was identified as one of the factors with the strongest influence on SPI success.”

“Management is mainly concerned with the successful implementation of PI in the sense that it proves useful to the organization. It is also interested in whether the new processes are in fact used homogeneously across the business unit.”
Questions and Answers

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