An Introduction to Software Quality

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Defining Quality

- Defect density, mean-time-to-failure (MTTF)
- Garvin: performance, features, functionality, safety, conformance, reliability, durability, service, and aesthetics
- ISO 9126: functionality, reliability, usability, efficiency, maintainability, and portability
The State of the Practice?

• "I'd rather have it wrong than have it late. We can always fix it later."
  • A senior software manager (industry)

• "The bottom line is schedule. My promotions and raises are based on meeting schedule first and foremost."
  • A program manager (government)

Empirical Observations

  – 32% of software projects successful, 44% challenged, 24% failures

• El Emam and Koru (2008)
  – 26-34% of software projects cancelled or unsuccessful

• McManus and Wood-Harper (2008)
  – Only one in eight IT projects can be considered truly successful
Process Management Premise

- The quality of a (software) system is largely governed by the quality of the process used to develop and maintain it.

Defining Process

- Process - a sequence of steps performed for a given purpose (IEEE)
Discipline vs Maturity

- Discipline ⇒ consistency of performance
- Maturity ⇒ discipline + focus on improvement
- Effectiveness ⇒ achieving an intended result
- Efficiency ⇒ acting effectively with minimum waste

Frequency and Predictability

- 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
Process Is Not the Only Value!

- Operational excellence is one possible value system to drive business success.
- There are other values than reliability and meeting commitments, though all are important.
  - product leadership: features, innovation
  - customer intimacy: customization, service

What Was the Software CMM?

- Common-sense application of Total Quality Management
- A model for transforming organizations
- Community-developed guide
- Prescription for changing organizational behavior
- Basis for reliable and consistent appraisals
Evolution of Process Capability

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Predicted Performance</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>Optimizing</td>
<td>Process improvement is institutionalized</td>
</tr>
<tr>
<td>4</td>
<td>Managed</td>
<td>Product and process are quantitatively controlled</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Software engineering and management processes defined and integrated</td>
</tr>
<tr>
<td>2</td>
<td>Repeatable</td>
<td>Project management system in place, performance is repeatable</td>
</tr>
<tr>
<td>1</td>
<td>Initial</td>
<td>Process is informal and unpredictable</td>
</tr>
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Software CMM v1.1

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Optimizing</td>
<td>Defect Prevention, Technology Change Management, Process Change Management</td>
</tr>
<tr>
<td>4</td>
<td>Quantitatively Managed</td>
<td>Product and process quality</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Organization Process Focus, Organization Process Definition, Training Program, Integrated Software Management, Software Product Engineering, Intergroup Coordination, Peer Reviews</td>
</tr>
<tr>
<td>2</td>
<td>Repeatable</td>
<td>Requirements Management, Software Project Planning, Software Project Tracking &amp; Oversight, Software Subcontract Management, Software Quality Assurance, Software Configuration Management</td>
</tr>
<tr>
<td>1</td>
<td>Initial</td>
<td>Competent people and heroics</td>
</tr>
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“M” is for Model

Models are simplified views of the real world.

Process descriptions, models, and instantiations are below the level of detail of the CMM.

“All models are wrong; some models are useful.” George Box

A Quagmire of Models and Standards

- Software CMM
- CMMI for Development
- ISO/IEC 15504 (Process Assessment)
- ISO 9001 (Quality Management Systems)
- Industry specific
  - Trillium, DO 178B, MediSPICE, …
- …
- Baldrige Award, Six Sigma, Lean, TQM, …
Analytic vs Best Practice Approaches

• Analytic approach
  – relies on quantitative evidence
  – applies sweeping principles, such as Deming’s Fourteen Points

• Best practices approach
  – a best practice is a management or technical practice that consistently demonstrates significant improvements to the bottom line

Balancing Innovation with the Routine

• Driving out variation makes sense when organizations do proven things in proven ways that still work.
• Variance in people, knowledge, activities, and organizational structures is crucial to creativity and innovation.
Important Assessment Observations

• The objective of process assessment is not to evaluate “goodness.”
  – It is necessary to judge “adequacy.”
• Consider business objectives, measures, trends
• Select framework(s) that address improvement objectives and customer/market requirements

Important Improvement Observations

• Start with the “as is” process rather than the “should be” process.
• There is no “one right way” to implement most processes.
• Keep processes simple and usable.
• Institutionalization and improvement happen at the same time.
ISO/IEC 15504 (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)

Six Sigma

- Three complementary “flavors” of Six Sigma
  - Process management: managing existing processes
  - DMAIC: improving existing processes
  - Design for Six Sigma: designing new processes, products, and services
Baldrige Award

- Leadership (120)
- Strategic Planning (85)
- Customer and Market Focus (85)
- Measurement, Analysis, & Knowledge Management (90)
- Human Resource Focus (85)
- Process Management (85)
- Results (450)

Questions?

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