An Executive Introduction to Software Process Improvement

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SPI from a Business Perspective

Is our current software development and maintenance performance satisfactory?

Is there a problem that needs to be addressed?

Is SPI required by customers? Regulatory agencies? Markets?

Are there areas other than process that should be the top priority?

What impact can SPI have?

Should I use CMMI for Development, ISO 15504, some other framework…?
Addressing the “Software Crisis”

Why should an executive care about software process improvement (SPI)?
- Many software projects fail...
- Many software projects are significantly
  - over budget
  - over schedule
  - fail to deliver an acceptable product

What can be done to address this problem?
- Hire smarter (or more competent) people...
- Buy more powerful tools and technology...
- Use “best practices” that have been demonstrated to work...
Practical Prerequisites for SPI

Are you unhappy with the status quo with respect to software in your organization?
- or just paranoid about surviving...

Are your customers dissatisfied?

Is the competition using software superiority to gain competitive advantage?

*If the answers are “No,” it is unlikely that*
- your behavior will change …
- … or that your “sponsorship” will inspire change
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.”
(Dyba, 2005)

“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.”
(Johansen, 2007)
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

How important are quality and predictability (meeting expectations) in your business environment?

Standish CHAOS Trends

Successful | Challenged | Canceled

2012
2010
2008
2006
2004
2002
2000
1998
1996
1994
Improvements in Project Outcomes

The Standish Group credits improvements to
- better project management
- emerging Web infrastructure
- iterative development

Are improvements really happening?

Are the Standish Group numbers credible?
- other researchers have found similar results

There is ample opportunity for improvement.
- simply adopt the good engineering and management practices that we know work
- stop doing things we know lead to disaster
“A Replicated Survey of IT Software Project Failures”
El Emam and Koru (2008)

26-34% of software projects cancelled or unsuccessful

Existing evidence is consistent and shows a decreasing trend in project failures (we’re improving as an industry)

Problems
• estimating the schedule and managing to that estimate
• changes in requirements and scope
• going over budget
• lack of senior management commitment
  - misalignment between IT and the business
• inappropriate management skills
“A Study in Project Failure”  
(McManus and Wood-Harper 2008)

Only one in eight IT projects can be considered truly successful.  
- failure being described as those projects that do not meet the original time, cost and (quality) requirements criteria

The cost of project failure across the European Union was €142 billion in 2004.  
- average duration of a project was just over 26 months (115 weeks) and the average budget was approximate 6M €  
- of the initial 214 projects studied 51 (23.8%) were cancelled
Process Management Premise

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

This premise implies focus on process as well as product.

The value of this premise is visible world-wide in the Total Quality Management movements in the manufacturing and service industries.

- performance excellence against business objectives
- doing more with less
- increasing customer satisfaction (and delight)
- improving shareholder equity
TQM Philosophies and Strategies

Deming, Juran, Crosby

Six Sigma, Lean

ISO 9004 Quality Management Principles

Baldrige Award

“One Integrated Collection of Software Engineering Standards” (Moore, 1999)

One survey discovered 315 standards, guides, handbooks, and other prescriptive documents maintained by 46 different organizations.

Also see (Sheard, 2001) and (Paulk, 2004).
Analytic vs Best Practice Approaches

Analytic approach
• relies on quantitative evidence
• applies sweeping principles, such as Deming’s Fourteen Points
• the analytic aspect grounds the principles in measurable improvement

Best practices approach
• a best practice is a management or technical practice that consistently demonstrates significant improvements to the bottom line
• captured in a reference model or standard (improvement framework)
• typically describe “what” to do without prescribing “how” to do it
## Analytic vs Best Practice Strategies

<table>
<thead>
<tr>
<th>Analytic strategies</th>
<th>Best practice strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deming</td>
<td>ISO 9001 QMS Requirements</td>
</tr>
<tr>
<td>Juran</td>
<td>ISO/IEC/IEEE 15504 / 330nn</td>
</tr>
<tr>
<td>Crosby</td>
<td>ISO/IEC/IEEE 12207 / 15288</td>
</tr>
<tr>
<td>Six Sigma</td>
<td>Software CMM</td>
</tr>
<tr>
<td>Lean</td>
<td>CMM Integration (CMMI)</td>
</tr>
<tr>
<td>ISO 9004 Quality</td>
<td>- for Development</td>
</tr>
<tr>
<td>Management Principles</td>
<td>- for Services</td>
</tr>
<tr>
<td></td>
<td>- for Acquisition</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
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</tbody>
</table>
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 these things?
# Software CMM v1.1 (1987-2005)

<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Key Process Areas</th>
</tr>
</thead>
</table>
| 5 Optimizing | **Continuous process improvement** | Defect Prevention  
Technology Change Management  
Process Change Management |
| 4 Managed | **Product and process quality** | Quantitative Process Management  
Software Quality Management |
| 3 Defined | **Engineering processes and organizational support** | Organization Process Focus  
Organization Process Definition  
Training Program  
Integrated Software Management  
Software Product Engineering  
Intergroup Coordination  
Peer Reviews |
| 2 Repeatable | **Project management processes** | Requirements Management  
Software Project Planning  
Software Project Tracking & Oversight  
Software Subcontract Management  
Software Quality Assurance  
Software Configuration Management |
| 1 Initial | **Competent people (and heroics)** | |
# 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 Optimizing</td>
<td>Process improvement is institutionalized</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>4 Managed</td>
<td>Product and process are quantitatively controlled</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>3 Defined</td>
<td>Software engineering and management processes defined and integrated</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>2 Repeatable</td>
<td>Project management system in place; performance is repeatable</td>
<td><img src="image" alt="Graph" /></td>
</tr>
<tr>
<td>1 Initial</td>
<td>Process is informal and unpredictable</td>
<td><img src="image" alt="Graph" /></td>
</tr>
</tbody>
</table>
AFIT Study

Cost Performance Index

Trends in Effort

In COCOMO II, the PMAT variable factors in maturity level in terms of decreasing effort/cost.

• one level change results in 15-21% decrease in effort


Trends in Software Quality

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Design Faults / KSLOC (Keene)</th>
<th>Delivered Defects / FP (Jones)</th>
<th>Shipped Defects / KSLOC (Krasner)</th>
<th>Relative Defect Density (Williams)</th>
<th>Shipped Defects (Rifkin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.5</td>
<td>0.05</td>
<td>0.5</td>
<td>0.05</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.14</td>
<td>2.5</td>
<td>0.1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0.27</td>
<td>3.5</td>
<td>0.2</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.44</td>
<td>6</td>
<td>0.4</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>5-6</td>
<td>0.75</td>
<td>30</td>
<td>1.0</td>
<td>61</td>
</tr>
</tbody>
</table>

Karl D. Williams, "The Value of Software Improvement... Results! Results! Results!" SPIRE97, June 1997.
**Trends in Productivity**

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Business Systems PI</th>
<th>Engineering Systems PI</th>
<th>Real-Time Systems PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>17</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>19.5</td>
<td>18</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>20.5</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>23</td>
<td>16.5</td>
</tr>
</tbody>
</table>

*Lawrence H. Putnam, “Linking the QSM Productivity Index with the SEI Maturity Level,” QSM, 2000.*
Impact of SPI: Boeing Data

### Impact of SPI: Motorola Global Software Groups

<table>
<thead>
<tr>
<th>Attribute</th>
<th>1993</th>
<th>1995</th>
<th>2000</th>
<th>Industry Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivered Quality Level</td>
<td>5.1σ</td>
<td>5.7σ</td>
<td>5.9σ</td>
<td>4.3σ</td>
</tr>
<tr>
<td>Cost of Poor Quality</td>
<td>35%</td>
<td>17%</td>
<td>6-8%</td>
<td>40%</td>
</tr>
<tr>
<td>Relative Productivity</td>
<td>1.5X</td>
<td>2.2X</td>
<td>2.6-6X</td>
<td>1X</td>
</tr>
<tr>
<td>Cycle Time Improvement</td>
<td>2.75X</td>
<td>4.4X</td>
<td>6X+</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## CMMI-DEV v1.3

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Optimizing</td>
<td><em>Focus is on quantitative continuous process improvement</em></td>
<td>Causal Analysis &amp; Resolution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organizational Performance Management</td>
</tr>
<tr>
<td>4 Quantitatively Managed</td>
<td><em>Process is measured and controlled</em></td>
<td>Organizational Process Performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quantitative Project Management</td>
</tr>
<tr>
<td>3 Defined</td>
<td><em>Process is characterized for the organization and is proactive</em></td>
<td>Requirements Development</td>
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<tr>
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<td></td>
<td>Technical Solution</td>
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<td></td>
<td></td>
<td>Product Integration</td>
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<td></td>
<td></td>
<td>Verification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Validation</td>
</tr>
<tr>
<td>2 Managed</td>
<td><em>Process is characterized for projects and is often reactive</em></td>
<td>Requirements Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Planning</td>
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<tr>
<td></td>
<td></td>
<td>Project Monitoring &amp; Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplier Agreement Management</td>
</tr>
<tr>
<td>1 Initial</td>
<td><em>Process is unpredictable, poorly controlled, and reactive</em></td>
<td>Requirements Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Planning</td>
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<tr>
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<td></td>
<td>Supplier Agreement Management</td>
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<tr>
<td></td>
<td></td>
<td>Product &amp; Process Quality Assurance</td>
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<td></td>
<td></td>
<td>Configuration Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measurement &amp; Analysis</td>
</tr>
</tbody>
</table>
Benefits of Model-Based Improvement

Establish a common language of process and software engineering
  • forge a shared vision for improvement

Build on a set of processes and practices developed with input from a broad section of the software community

Provide a framework for prioritizing actions

Provide a framework for performing reliable and consistent appraisals

Support industry-wide comparisons
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.

Judgment is necessary to use models correctly and with insight.

Potential for dysfunctional behavior to get a maturity level rating.
Results Oriented

If the business results are not measurably visible as improvement trends...

... then the lack of results signals an approach or deployment problem...

... perhaps resulting from a focus on getting a “level” or “certificate” rather than achieving business objectives.
Critical Success Factors (Niazi, 2006)

From the literature:
- Senior management commitment
- Staff involvement
- Training and mentoring
- Staff time and resources
- Creating process action teams/change agents and opinion leaders
- Reviews
- Experienced staff
- Clear and relevant SPI goals

From empirical research:
- Senior management commitment
- Training
- Awareness
- Allocation of resources
- Experienced staff
- Defined SPI implementation methodology
- Staff involvement
- Facilitation
Questions and Answers