The Importance of Software Process Management for Software Quality, Testing and Industry Development

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Issues at the Seminar

- Software Quality
- Scope of Testing
- Requirement Analysis
What I will cover in this presentation

- The Significance of Software Quality
- The Importance of Software Testing
- Quality in Delivering Offshore IT Services
- State of Practice Versus SEI’s Vision in Software Engineering
- Software Process Management
  - CMMI
  - Capability Levels
  - Maturity Levels
  - How CMMI can help an organization
- Conclusions
Software Quality Assurance

- Defining Software Quality Assurance
  - Monitoring the software development process
  - Complying with standards and accepted methods
  - Anticipating errors --- prevention
Software Quality Assurance

- Computer system failures are caused by software defects
- Defects caused not only by Programming errors, but by:
  - Not clear application requirements or changing requirements
- Software complexity may also induce errors
- Other causes of errors may be:
  - Time pressure because of unrealistic schedules
  - Not well documented code
  - Defective and/or poorly documented development tools
Introducing Software QA processes in an organization

- In large organizations involving high risk projects, formalized QA processes are mandatory.
- For lower risks, QA processes are to be balanced with productivity.
- For small groups or projects, ad-hoc processes may be appropriate, depending on customers and projects.

Dependence on:
- Team leaders or managers
- Feedback to developers
- Communication between customers, managers, developers, and testers
Significant payoff from investment in QA comes from:

- Processes in management of requirements aiming at
  - Testable requirement specifications as part of requirements or design documentation
  - Or in agile-type environments coordination with end users
  - Inspections of the design and code
  - Evaluation of past projects
Management can play a key role in:

- Recognizing:
  - The importance of Verification and Validation
  - The use of Walkthrough and Inspection
  - Different testing methods to be considered
  - An understanding of the typical problems arising in the software development process and
    - An appreciation of potential solutions
  - An understanding of the true meaning of Software Quality and what it entails
Software Quality entails:

- Recognition that Quality Software is:
  - Reasonably bug-free,
  - delivered on time and within budget,
  - meets requirements and/or expectations,
  - and can be maintained

- Quality software incorporates
  - Good code
  - Good design

- The vision of the SEI regarding Quality emphasizes:
  - Software Process Management, in order to:
    - Minimize Testing
      - We will talk about this later
The Software Life Cycle

Starts when application is conceived and ends when it is no longer in use. It includes:

- Initial concept
- Requirements analysis
- Functional design
- Internal design
- Documentation planning
- Test planning
- Coding
- Document preparation
- Integration
- Testing
- Maintenance
- Updates
- Retesting
- Phase-out
Software Testing

- Defining Software Testing
  - Testing involves operation of a system or application under control conditions and evaluating the results
  - Controlled conditions should be both normal and abnormal
  - Testing should attempt to make things go wrong
  - The emphasis is in detection
Software Testing Engineering

- The role of the Software Test engineer
- The role of the Software QA engineer
- The role of the QA or Test manager
- The role of Documentation in QA
- The importance of Requirements
- Developing and running software tests
  - The test plan
  - The test case
- Actions needed after defects are found
- Configuration management
- Actions when software has many defects
Considerations in Testing

- The end of the testing process
- Time allotted for comprehensive testing
- The size of the project and extensive testing
- Coping with changing requirements
- When the application has functionality that was not in the requirements
- Software QA processes vis-a-vis productivity
- Coping with fast growth and QA processes
Other considerations in Testing

- Client/Server Environments and Testing
- Testing World Wide Web sites
- Testing and object-oriented designs
- Extreme Programming and Testing

Reference for QA and Testing: http://www.softwareqatest.com/
Software QA and Testing Resource Center

http://www.softwareqatest.com/
Software Quality Engineering

- Collocated with **STARWEST 2004**.
- Sponsors useful courses
  - Software Testing Foundations course
  - Certification training course
  - Writing Testable Requirements
  - Essential Software Requirements
    - *Balancing Plan-Driven and Agile Approaches*
Quality in Delivering Offshore IT Services

- The Delivery of Offshore Services
- Quality Framework and its Business Benefits
  - Organizational Effectiveness
  - Service delivery
  - Quality Certifications:
    - CMM, CMMI, Six Sigma

Quality influences Business Results

- Organizational Effectiveness
  - Commitment to quality
  - Highly skilled employees
  - Responsiveness and flexibility
  - Strong work ethic
  - Lower turnover of employees
  - Robust project management processes
  - Strong communication flow between client and services firm
Outcomes-Benefits to the customer

- Lower maintenance cost
- Lower schedule overrun cost
- Lower development cost

IDC Recommendations *
  - Separate the forest from the trees
  - Deepen understanding of organizational effectiveness
  - Quantify the benefits to the business
  - Use a balance of onsite and offshore resources

* IDC is a leading provider of data driven research analysis
The Importance of Quality Certifications

- The Capability Maturity Model (CMM)
- The People Capability Maturity Model (PCMM)
- The Capability Maturity Model Integrated (CMMI)
  - We will talk about these later
- Six Sigma ISO, IEEE, ANSI Standards
SEI Strategic Themes
- Predictably better, faster, and cheaper by -

- Moving to the left
  - Embrace a systems engineering approach and make better decisions before coding to predictably improve quality, cost, and schedule.

- Reusing everything
  - Reuse code, but also the architecture and knowledge from building similar systems.

- Never making the same mistake twice
  - Leverage lessons learned.
State of Practice Versus SEI’s Vision

Software state of practice ("test in" quality)

- 60 - 80 % of effort and cost
- Development
- Integration and System Test

World-class developers
"design in" quality

- move to the left!
- reuse everything
- never make the same mistake twice

SEI Technical Program

The right software delivered
defect free, on cost, on time, every time

High confidence, evolvable, product lines

Integration
Software Intensive Systems

Survivable Systems
Product Line Practice

Performance Critical Systems
Software Architecture Technology

Predictable Assembly with Certifiable Components

with predictable and improved cost, schedule, and quality

Capability Maturity Model Integration
Team Software Process

Acquisition Support Systems
Software Engineering Measurement & Analysis

Technical Practice Initiatives

Management Practice Initiatives
A process is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/or people.
Quality Leverage Points

While process is often described as a leg of the process-people-technology triad, it may also be considered the “glue” that unifies the other aspects.

Everyone realizes the importance of having a motivated, quality work force but even our finest people can’t perform at their best when the process is not understood or operating “at its best.”

Major determinants of product cost, schedule, and quality
Why Focus on Process?

- Process provides a constructive, high-leverage focus...

- **as opposed to a focus on people**
  - The experience and training of your work force is not always enough.
  - Working harder is not the answer.
  - A well defined process can provide the means to work smarter.
  - Shifts the “blame” for problems from people to the process

- **as opposed to a focus on technology**
  - Technology, by itself, will most likely not be used effectively.
  - Technology, in the context of an appropriate process roadmap, can provide the most benefit.
The Process Management
Premise

- The quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it.

- This premise implies a focus on processes as well as on products.
  - This is a long-established premise in manufacturing.
  - Belief in this premise is visible worldwide in quality movements in manufacturing and service industries (e.g., ISO standards).
Process Improvement Involves Dealing with Multiple Dimensions at One Time

CMMI based improvement is Much More than simply asking people to use a different template.
Simple Improvement Processes

- Determine where you want to be.
- Make a plan.
- Execute the plan.
- Learn lessons and do it again.

- Another improvement process is **Plan Do Check Act**.

- **IDEAL**
- Determine where you are.
The IDEAL\textsuperscript{SM} Model

SM IDEAL is a service mark of Carnegie Mellon University.

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Documented Results of CMM-based PI

- Process improvement benefits fall into one or more of these general categories:
  - improved schedule and budget predictability
  - reduction of rework
  - improved cycle time
  - increased productivity
  - improved quality (as measured by defects)
  - increased customer satisfaction
  - improved employee morale
  - increased return on investment
  - decreased cost of quality

- All this is in addition to meeting your customer’s requirement....
CMMI Transition Status

- 234 Introduction to CMMI instructors trained
- 402 SCAMPI Lead Appraisers trained
- 830 students trained in Intermediate Concepts of CMMI
- 179 Introduction to CMMI instructors authorized
- 16,161 students trained in Introduction in CMMI
- 293 SCAMPI Lead Appraisers authorized
- 80 active transition partners that offer Introduction to CMMI training
- 147 active transition partners that offer SCAMPI appraisal services
Number of Appraisals Conducted by Year
Reported as of 2 March 2004
What is CMMI?

CMMI

- is **not** a process; does not tell you **How** to do your work
- is a model of **best practices in systems and software development** and in **product development**
- **does** tell you **What** to do
- is based on the **process management premise**
An organization may choose an approach to process improvement from either of the following:

- process area capability
- organizational maturity

CMMI models support each approach with a *representation*.

- process area capability - continuous representation
- organizational maturity - staged representation
Some benefits of choosing the continuous representation are:

- It allows you to select the order of improvement that best meets your organization’s business objectives and mitigates your organization’s areas of risk.
- It enables comparisons across and among organizations on a process area by process area basis.
- It provides an easy migration from EIA/IS-731 to CMMI.
<table>
<thead>
<tr>
<th>Category</th>
<th>Process Areas</th>
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| Process Management  | Organizational Process Focus  
                      | Organizational Process Definition 
                      | Organizational Training 
                      | Organizational Process Performance 
                      | Organizational Innovation and Deployment |
|                     | Project Planning 
                      | Project Monitoring and Control 
                      | Supplier Agreement Management 
                      | Integrated Project Management for IPPD 
                      | Risk Management 
                      | Integrated Teaming 
                      | Integrated Supplier Management 
                      | Quantitative Project Management |
| Engineering         | Requirements Management 
                      | Requirements Development 
                      | Technical Solution 
                      | Product Integration 
                      | Verification 
                      | Validation |
| Support             | Configuration Management 
                      | Process and Product Quality Assurance 
                      | Measurement and Analysis 
                      | Decision Analysis and Resolution 
                      | Organizational Environment for Integration 
                      | Causal Analysis and Resolution |
Capability Levels

- **Capability levels**, used in the continuous representation, describe a sequential order for approaching process improvement within each process area.

- Capability levels build on each other, providing a recommended order for approaching process improvement within a selected process area.

- Capability levels enable you to track, evaluate, and demonstrate your organization’s progress as you improve processes associated with a process area.
Staged Representation

- Some benefits of choosing the staged representation are
  - It provides a proven sequence of improvements, each serving as a foundation for the next.
  - It permits comparisons across and among organizations by the use of maturity levels.
  - It provides an easy migration from the SW-CMM to CMMI.
  - It provides a single rating that summarizes appraisal results and allows comparisons among organizations.
<table>
<thead>
<tr>
<th>Level</th>
<th>Focus</th>
<th>Process Areas for SE/SW/IPPD/SS</th>
</tr>
</thead>
</table>
| 5 Optimizing | **Continuous Process Improvement** | Organizational Innovation and Deployment  
Causal Analysis and Resolution                                                                 |
| 4 Quantitatively Managed | **Quantitative Management** | Organizational Process Performance  
Quantitative Project Management                                                               |
| 3 Defined   | **Process Standardization**   | Requirements Development  
Technical Solution  
Product Integration  
Verification  
Validation  
Organizational Process Focus  
Organizational Process Definition  
Organizational Training  
Integrated Project Management for IPPD  
Risk Management  
Integrated Teaming  
Integrated Supplier Management  
Decision Analysis and Resolution  
Organizational Environment for Integration                                                      |
| 2 Managed   | **Basic Project Management**  | Requirements Management  
Project Planning  
Project Monitoring and Control  
Supplier Agreement Management  
Measurement and Analysis  
Process and Product Quality Assurance  
Configuration Management                                                                |
| 1 Initial   |                                |                                                                                               |
Maturity Levels

- Maturity levels, used in the staged representation, organize selected process areas into five evolutionary plateaus to support and guide process improvement across the organization.

- Maturity levels are defined evolutionary plateaus of process improvement, in which each level is supported by the characteristics of the process areas implemented within the lower levels.

- Maturity levels represent a process improvement evolution for the entire organization.
Maturity Levels

1. Initial: Process unpredictable, poorly controlled and reactive.
2. Managed: Process characterized for projects and is often reactive.
3. Defined: Process characterized for the organization and is proactive.
5. Optimizing: Focus on continuous improvement.

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Continuous

...for a single process area or a set of process areas

Staged

...for a specified set of process areas across an organization
Comparing the Different Representations

- Both representations provide ways of implementing process improvement to achieve business goals.

- Both representations provide essentially the same content but are organized in different ways.

- There is nothing that requires that you use one or the other representation – you can use them both concurrently if that suits your business needs.
The continuous representation provides additional \textit{de facto} granularity in support of a staged-focus initiative:
- as a guide for detailed \textit{tactical} planning
- to demonstrate \textit{intermediate progress} short of process area or maturity level
- to \textit{allay concerns} and build support among stakeholders

The staged representation can provide structure for a continuous-focus initiative:
- as a guide for \textit{big picture} “strategic” planning
- to “\textit{chunk}” higher-granularity activities for senior management
- as a means for representing \textit{high-level success} in “industry standard” terms key stakeholders will more readily understand
CMMI Can Benefit You

- CMMI provides
  - Efficient, effective assessment and improvement across multiple process disciplines in an organization
  - Improvements to best practices incorporated from the Software CMM
  - A common, integrated vision of improvement for all elements of an organization
  - A means of representing new discipline-specific information in a standard, proven process-improvement context
Conclusions

- Developing Quality Software is essential in any software enterprise
- Software Testing is a close companion of Software Quality
- Quality is essential in Delivering Offshore IT Services
- Quality Impacts Business Results
- Quality Certifications are highly recommended
- The SEI vision is to develop software reducing the testing effort
- The importance of “Process” in Software Development
- CMMI can benefit any Software enterprise
Questions?
Comments?