Why is Quality Important?
• Clients & users expect quality
  – What if jetliners crashed as often as Microsoft Windows?
• Poor quality results in “rework” at additional cost
• Poor quality results in problems that can be difficult to diagnose and solve
• Poor quality can cost lives

Definition
• Quality is the degree to which a set of inherent characteristics fulfill requirements. (PMBOK)

Testing Doesn’t Give us Quality
• Testing only shows if we have quality
• The more we test, the more we know if we have quality
• Testing doesn’t improve quality
• So…  
  – Is testing a waste of time?

The Response to Poor Quality
• If we are having quality problems, we won’t solve them by testing more.
• We will only solve them by fixing the problem.
• But we need to measure failures—we can only value and change what we can measure.
What is Quality?

- Quality is delivering what you said you would deliver.
  - Quality must be written into the project requirements and project scope.
  - Eg. We’re asked to build a web application. After it’s built, the client complains that it can’t handle 100,000 simultaneous users. Is this a quality problem?

Quality Methods

- Business is abuzz with quality keywords:
  - Six Sigma (and Six Sigma Black Belts)
  - Total Quality Management (TQM)
  - Continuous Process Improvement (CPI)
  - Business Process Reengineering (BPR)
  - Cost of Quality (COQ)
  - And others

The Measure of Quality

- We don’t have a right to give a client more than she needs.
  - If we overbuild more than the client needs, who picks up the bill? Who approved it?
  - The client has to define their level of quality for us.
  - Put quality metrics into the requirements/design/project plan

Managing Quality

- Quality goes back to customer needs. We need to probe the client for her needs and expectations even if the client hasn’t raised the issue.
- Work to prevent rather than correct problems. Prevention is cheaper than rework and correction.
- Shewart model of “Plan-Do-Check-Act” is the key cycle to Continuous Process Improvement

How do we ensure Quality?

- **Plan**: Determine the standards we need and how to achieve them
- **Perform**: Apply the planned activities to ensure that they are achieved
- **Monitor**: Measure results to ensure that they meet the standards. Identify and eliminate problems that impact quality

From the Project Management Body of Knowledge (PMBOK)
Quality Planning: Inputs

• Determine what quality standards are relevant using input from:
  – Enterprise Environmental Factors include government regulations, industry best practices
  – Organization Process Assets are policies, procedures, guidelines, lessons learned from previous activities
  – Project Plan Scope Statement includes a definition of the requirements and deliverables and acceptable thresholds

Quality Planning: Tools and Techniques

• Decide on Tools and Techniques:
  – Cost-Benefit Analysis: Don’t spend more on better quality if the cost of poor quality isn’t worth it
  – Benchmarking: Compare results with those of other projects
  – Design of Experiment: Similar to prototyping, except that it tests a concept before committing to it.

More Tools & Techniques

• Cost of Quality is the total cost incurred to ensure the project/product meets requirements, testing it to make sure it does, and correcting any failures. By measuring and classifying COQ components, we can work to reduce the cost.

Quality Planning: Outputs

• A Quality Management Plan (QMP) describes how the team will implement the quality goals and addresses Quality Control (QC), Quality Assurance (QA), and Continuous Process Improvement
• Quality Metrics describes in very specific terms what is quality and how it will be measured.
• Quality Checklists “Do this!” “Have you done this?”
• Process Improvement Plan identifies waste and non value steps

Quality Assurance: Inputs

• The Quality Management Plan
• Quality Metrics
• Process Improvement Plan
• All sorts of work performance data including bug reports, deliverable status, performance audits
• Approved Change Requests
Quality Assurance: Tools and Techniques

• Quality Planning Tools can also be used for QA purposes
• Quality Audits are structured reviews by a third party
• Process Analysis such as BPR activities

Quality Assurance: Outputs

• Requested Changes to the project or environment
• Recommended Corrective Actions
• Updates to the Organization Process Assets
• Updates to the Project Management Plan

Quality Control: Inputs

• Quality Management Plan
• Quality Metrics
• Quality Checklists
• Organizational Process Assets
• Work Performance Information
• Approved Change Requests
• Deliverables List

Quality Control: Tools and Techniques

• Cause and Effect Diagrams

More Quality Control Tools

• Control Charts
  – Using a Statistical model of mean and standard deviation, can figure out how often we will fail
  – Also gives us trending so we can anticipate failures and respond proactively

QC Tools: Control Charts
A Control Chart Example

- Assume we want to ensure the quality of computer power supplies
- Supplies need to take in line voltage at 110-120VAC (NA) or 220-240VAC (International) and supply 5VDC output.
- Assume that computer hardware can handle 5±0.1V without problem.

By random sampling a selection of each day’s production, we can construct a control chart of the measured voltage output of our sample set.

Patterns can emerge from Control Charts:
- A slow deterioration of quality over time can indicate equipment wearing out or equipment needing calibration
- Unstable quality can result from parts from different vendors
- Sudden changes in quality need explaining

More Quality Control Tools

- Flowcharting helps to analyze how problems occur
- Histograms/ Pareto Graphs
- Other graphs & statistics
- Bug/defect report and review

Quality Control: Outputs

- QC Measurements
- Validated Defect/Bug Repair
- Recommended Corrective Actions
- Recommended Preventative Actions
- Requested Changes
- Recommended Defect Repair

More Outputs

- Organization Process Assets:
  - Completed Checklist
  - Lessons Learned Documentation
- Validated (signed-off) Deliverables
- Project Management Plan updates
Quality Assurance Programs

Total Quality Management

Total Quality Management (TQM)
- Created by Japan in the post WWII years and introduced to North America in the 1970’s and 1980’s
- In the Post-War years, Japan’s manufacturing sector had a very poor reputation for quality and value
- Today, Japanese goods are rated as some of the best quality and most reliable in the world

Four Stages to TQM: Kaizen
- Stage 1: Kaizen
  - A system of continuous process improvement
  - Develop a process that is visible, repeatable and measurable

Four Stages to TQM: Atarimae Hinshitsu
- Stage 2: Atarimae Hinshitsu
  - Possible only after Kaizen is reached
  - Addresses intangibles that affect the processes
  - Work to optimize the environment for success

Example:
- We document a process so we can consistently repeat it (Kaizen)
- Then we find that the company reorganizes so frequently that we have high staff turnover
- High turnover means that we are constantly training new people on how to perform the process. This is Atarimae Hinshitsu

Four Steps to TQM: Kansei
- Stage 3: Kansei literally means “the five senses”
- It concentrates on the user of the product/software
- By examining how a user applies the product, kansei leads to improvements in the product itself
Four Steps to TQM: *Miryokuteki Hinshitsu*

- Stage 4: *Miryokuteki Hinshitsu* broadens the management concern past the immediate product
- We look for opportunities in related areas by watching how the product is used in the workplace
- Are there other industries/markets for our software?

Quality Assurance Programs

**Capability Maturity Model (CMM)**

SEI CMM

- The idea of *kaizen* was incorporated by the Software Engineering Institute (SEI) in developing the Software Capability Maturity Model (SW-CMM)
- According to CMM, there are 5 levels in establishing a mature Software development discipline

**CMM Level 1: Initial**

- Software development process is characterized as *ad hoc* and sometimes even chaotic
- Few processes are defined
- People fly by the seat of their pants
- Success depends on individual effort
- Sometimes even heroic efforts by competent individuals aren’t enough

**CMM Level 2: Repeatable**

- Project Management processes are established to track cost, schedule, scope
- The necessary discipline is in place to repeat earlier successes on projects with similar applications
- Lessons learned are recorded and remembered

**CMM Level 3: Defined**

- All processes are repeatable as discussed in Level 2
- Software processes are documented and standardized for both managers and developers
- All projects use a documented process that people know
CMM Level 4: Managed

- All processes are defined as discussed in level 3
- Detailed measures of the software process and product quality are collected
- Process and products are quantitatively understood and controlled using detailed measures

CMM Level 5: Optimizing

- All processes are managed as discussed in level 4
- Continuous process improvement (CPI) is enabled
- CPI uses quantitative feedback from the process
- CPI tests innovative ideas and technologies

Key Process Areas

- The SEI CMM has Key Process Areas (KPAs) associated with each maturity level
- The KPAs describe those Software Engineering Practices that must be present to satisfy good practice for that level

Level 2 KPAs

- Software Configuration Management
- Software Quality Assurance
- Software Subcontract Management
- Software Project Tracking and Oversight
- Software Project Planning
- Requirements Management

Level 3 KPAs

- Peer Reviews
- Intergroup coordination
- Software Product Engineering
- Integrated Software Management
- Training Program
- Organization Process Definition
- Organization Process Focus

Level 4 KPAs

- Software Quality Management
- Quantitative Process Management
Level 5 KPAs

- Process Change Management
- Technology Change Management
- Defect Prevention

CMM: An Software Example

- Level 1: Ad Hoc-We do our best to write the code
  - Everyone works independently
  - We all think we know what the customer wants
  - Those who are good success
  - Those who are bad are left to their own abilities

A CMM Example (cont)

- Level 2: Repeatable-We have a Project Manager!
  - The Project Manager is certified by PMP
  - We mark down our learnings and “gotchas” for others (maybe using a Helpdesk software package, or bug-tracking/knowledgebase system)
  - Those who know spend time helping those who don’t

A CMM Example (cont)

- Level 3: Defined-We have a Process (and a Manual)
  - People have defined roles: System Architect, Developer, Test Analyst
  - There is a solid mentoring program
  - We have standards for how we write code, test code, manage the team
  - We know the processes and roles

A CMM Example (cont)

- Level 4: Managed-We can measure what we do
  - We have ways to estimate how long things will take. Our estimates are accurate
  - We can measure how much processes cost
  - We can recommend decisions based on costs

A CMM Example (cont)

- Level 5: Optimizing-We Look for Ways to Improve
  - We ask customers for feedback: How did we do?
  - We refine our estimating techniques
  - We research new ideas and technologies to see if they will help us
  - We create an environment where people make suggestions for improvement
References


References (cont.)