Software Quality Assurance

- *Quality*-the extent to which a software product satisfies customer requirements
  - Quality of design
  - Quality of conformance (to specifications)
- SQA is (or should be) an umbrella activity applied at all stages of the software process.
- Goal of SQA is to avoid (or reduce) life-cycle costs

The case for SQA

- Boehm: Relative cost of repairing defects:

![Graph showing relative cost of repairing defects from requirements to field.](image-url)
The case for SQA

• IBM, Rochester (Kaplan)
• Study of project involving 200 KLOC
  – SQA activities required approx. 7,000 hours and cost approx. $282K
  – 3112 defects detected--approx $91 per defect.
  – Estimated that without SQA 200 defects would have made it to the field.
  – Estimated cost to repair defect in field: $25K
  – Estimated cost avoided by SQA: $5M

Elements of SQA

• Quality management plan
• Effective software engineering technology
• Formal reviews
• Well-conceived testing strategies
• Configuration control and change management
• Enforcement of standards
• Measurement and reporting mechanisms
SQA Activities

• SQA Plan
  – evaluations, reviews and audits to be performed
  – applicable standards and practices
  – procedures for defect reporting and tracking
  – Test Plan and associated procedures
  – SQA documents to be produced

SQA Activities

• Technical reviews
  – informal
  – formal
• Formal reviews
  – walkthrough
  – inspections
Elements of a Walkthrough

• Small group, including responsible project leader
• Well-defined, controlled agenda
• Typically the project leader “walks through” the work product.
• Reviewers raise issues and identify potential problems
• A written record is maintained
• At conclusion, the group decides on the status of the product: accept, reject, accept provisionally.

Metrics for SQA

• Error Indices
  – $E_i$ - total errors detected at ith step of process
    • $S_i$ - serious errors
    • $M_i$ - moderate errors
    • $T_i$ - minor errors
• Error Density:
  – $E_i/KLOC$
SQA--Primary Error Causes
From: Pressman (Fourth Edition), Chapter 8)

- Incomplete specification (IES)
- Misinterpretation of customer requirements (MCC)
- Error in data representation (EDR)
- Incomplete or erroneous testing (IET)
- Inconsistent module interface
- Error in design logic (EDL)
- Error in program language translation of design (PLT)
- Other (OTH)

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Frequency of Various Error Types

<table>
<thead>
<tr>
<th>Error type</th>
<th>% of total</th>
<th>% of serious</th>
<th>% of moderate</th>
<th>% of minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>IES</td>
<td>22%</td>
<td>27%</td>
<td>18%</td>
<td>24%</td>
</tr>
<tr>
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<td>20%</td>
<td>18%</td>
<td>8%</td>
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<tr>
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<td>6%</td>
<td>7%</td>
<td>5%</td>
<td>7%</td>
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<tr>
<td>EDL</td>
<td>5%</td>
<td>11%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>IET</td>
<td>10%</td>
<td>9%</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>PLT</td>
<td>6%</td>
<td>12%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>OTH</td>
<td>20%</td>
<td>5%</td>
<td>24%</td>
<td>23%</td>
</tr>
</tbody>
</table>
Statistical Approach to Quality Management

• Phase index ($PI_i$) for a SE process step:
  – $PI_i = w_s(S_i/E_i) + w_m(M_i/E_i) + w_t(T_i/E_i)$
  – Typical values of weighting factors:
    • $w_s = 10$, $w_m = 3$, $w_t = 1$

• The overall error index (EI) for a project:
  – $EI = \sum (i(PI_i))/KLOC$

References--Life Cycle Models


References--Project Planning and Management

- Pfleeger, Chapter 3

References--Cost-estimation Models

- Pressman, chapters 4, 5.
References--Cost estimation Models (Continued)

• COCOMO web site:
  http://sunset.usc.edu/COCOMOII/suite.html (This is the best source of information on both COCOMO, COCOMO II and other cost estimation models/tools)
• Sommerville, chapter 26.
• Pfleeger, chapter 3.

References--Risk Management

• Pfleeger, chapter 3.
• Pressman, chapter 6.
• McConnell, Chapter 5
References -SQA & Metrics

- Pressman, chapter 8.
- Schach, chapter 5.
- Boehm (1981)

Requirements Analysis

- Process of determining and codifying the requirements of all major *stakeholders* in the project.
- First step: Determine the stakeholders and the nature of their stake in the project/product
  - customer
  - end-user
  - developers
  - management
  - marketing/sales org.
  - maintenance and support org.
  - etc.
Requirements Analysis-Continued

• Second Step: Identify the needs of each stakeholder.
  – Note that the perspectives of various stakeholders may be very different.
  – Needs of various stakeholders may be at odds with one another and may need to be negotiated.
  – Failure to adequately consider the needs of certain stakeholders at the requirements phase can have major negative implications on project success.

Stakeholder Needs Example
Own An On-Line Auction House

Your customers will marvel at the
- Custom auction categories
- Custom news groups and chat rooms
- Easy registration
- Credit card security
- Easy sale submission
- Easy bidding
- A history of their personal transactions

Auction Administrator

- Enforce fair payment policies
- Collect auction fees
- Track customer profiles and transactions
- Manage auctions, chat rooms and new groups
Auction Administrator

- Check for credit card fraud
- Document your revenue stream
- Add links and advertisements to key web pages
- Profile the popularity of every clickable item on your site
- Recovery software for server failures and power loss

Stakeholders in Both Net Franchise Corp and Auction Owner

- Management leadership
- Sales
- Engineering
- Information systems
- Support services
- Financial
- Legal
Additional

• Customers
  – Sellers of Merchandise
  – Buyers of Merchandise
• Federal, State, and Local Governments

Net Franchise Corp Needs

• Management Leadership
  • Sales of Net Franchise to reach $250M per year
  • Minimize capital investment by manufacturing no hardware
  • Outsource software development to keep workforce costs low
  • Highly responsive customer support staff
Net Franchise Corp Needs

• **Sales**
  • Demonstrate Net Auctioneer to Customer over the web on a lap top computer
  • Taylor Auction type and chat rooms as demonstrations to customer
  • Customer success stories

Net Franchise Corp Needs

• **Engineering**
  • Well defined extensible software architecture with interfaces that minimize the cost of future changes
  • Both Unix and Windows server compatible
  • Use commercially available and widely supported application frameworks
  • Independence from hardware
Net Franchise Corp Needs

• **Engineering**
  • SQL database for long term, large data stores
  • Allow for growth in number of customers, number of servers, sizes for databases, and performance
  • Use third party software components when feasible
  • The best development, testing, and component integration tools available

Net Franchise Corp Needs

• **Information Systems**
  • Access to franchise sites all over the world
  • Franchise data collection, tracking and reporting
  • To know the trends in customers, revenue, and types of auctions for each franchise
  • Produce accounting and billing records for every franchise
Net Franchise Corp Needs

• **Information Systems**
  - Provide trend and summary reports for all franchises
  - Timely billing for franchise licenses, custom software, training and services
  - Problem reporting system and help desk support

Net Franchise Corp Needs

• **Support Services**
  - Easy to use interfaces for customer administration of their franchise
  - Problem reporting system with help desk support 24 hours a day
Net Franchise Corp Needs

- **Financial Accounting**
  - Number of franchises active, contracts, data on franchise owners
  - Current and projected revenue from each franchise
  - For each auction, the number of auctions and each gross auction revenue
  - Service and custom software contracts
  - Installation costs for each franchise

Net Franchise Corp Needs

- **Legal Services**
  - Access contracts and ownership information for each franchise
  - Notification of legal problems
  - History of previous agreements
Net Auctioneer Customers

- **Management Leadership**
  - 100 times increase in auction revenue
  - High reliability with quick fixes when problems occur
  - Move from manual auctions to on-line auctions
  - Increase auction customer base
  - Minimize installation and service costs
  - Avoid legal entanglements

Net Auctioneer Customers

- **Auction Administration**
  - Interface with existing databases of buyers and sellers
  - Rapid definition of new auction categories and policies for those auctions
  - Customize the look of the web-pages
  - Change and upgrade the customer interface
Net Auctioneer Customers

• **Auction Administration**
  • Provide historical search data for the customers
  • Reports on the success of auctions and analysis of what makes them successful
  • Policing of auctions for underhanded sellers
  • Ability to hold money for buyers until transaction is complete
  • Financial reports

Net Auctioneer Customers

• **Auction Administration**
  • Creation and management of news or chat groups
  • Profile customers
  • Plug-in advertising selection, profiling, and display components
  • Switch database support systems
  • Interface with existing customer and accounts databases
  • Increase the hardware performance for communication, dial-in, and the servers
Net Auctioneer Customers

• **Sales**
  - On-line tutorials for selling and buying
  - Easy to use interfaces for registration, selling, and purchasing
  - Reliability without misrepresentation

Net Auctioneer Customers

• **Engineering**
  - Integration with existing databases
  - Use of standard platforms and installation tools
  - Identification of problems that can be fixed locally
  - Help-line from vendor
  - Ability to design web site, add links, add advertising, etc
  - Integrate third party web applications
  - Bring new versions on line seamlessly
Net Auctioneer Customers

• Information Systems
  • Track financial data with audit trails
  • Access history and profiles of customers
  • Produce reports for taxes
  • Project growth of revenues

Net Auctioneer Customers

• Customer Services
  • Frequently asked question pages
  • Email based customer support
  • On-line help
  • Problem diagnosis
  • Track customer records and transactions
Net Auctioneer Customers

• **Financial Accounting**
  • Audit auction records
  • Track transactions, fees, and margin from sales
  • Predict net and gross revenues
  • Automatic transfer of financial data to/from Net Franchise Corp

Net Auctioneer Customers

• **Legal Services**
  • Secure records of sales and purchases
  • Conformity to all federal and state regulations
Boehm’s WinWin Approach to Determining Requirements

1. Identify next-level stakeholders
2. Identify stakeholders’ win conditions
5. Define next level of product and process--including partitions
6. Validate product, process definitions
7. Review, commitment

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