The Impact of a Requirements Specification on Software Defects and Other Quality Indicators

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Agenda

• Premise
• Background: Gen 1 vs. Gen 2
• Software Defect Potential Analysis
• Gen 2 Project Requirements Details
• Validation (QA) Results
• Conclusions
• Questions & Answers
Premise

Is there any correlation between a well-written, properly reviewed requirements specification and software defect levels and other quality indicators?
Background: Gen 1 vs. Gen 2

• First Generation Software (Gen 1):
  • No formal requirements specification (emails, design documents, web sites, etc.) or RM tool
  • No reviews of requirements by requirements subject matter expert
  • Runs on older Intel processor and motherboard

• Second Generation Software (Gen 2):
  • Requirements Specification stored in a RM tool
  • All specification revisions reviewed by requirements subject matter expert
  • Runs on newer Intel processor and motherboard
## Software Defect Potential Analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gen 1</th>
<th>Gen 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Maturity</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td># of New Features</td>
<td>N/A</td>
<td>&gt; 50</td>
</tr>
<tr>
<td>Complexity of New Features</td>
<td>N/A</td>
<td>Moderate</td>
</tr>
<tr>
<td>Stability of Code Base</td>
<td>Stable</td>
<td>Merge with Gen 1 &amp; other group</td>
</tr>
<tr>
<td>Hardware Changes</td>
<td>Older generation Intel Processor</td>
<td>Newer generation Intel Processor</td>
</tr>
<tr>
<td>Development Practices</td>
<td>Waterfall</td>
<td>Waterfall</td>
</tr>
</tbody>
</table>

**Defect Potential Should Be *Higher* for Gen 2 vs. Gen 1**
Gen 2 Project Requirements Details

• Requirements Subject Matter Expert (SME) assigned to work with requirements author
• Author trained on writing requirements
• SME mentored requirements author through all revisions of the requirements specification
• Six revisions of the requirements specification:
  • Revision 0.3 requirements defect density: > 10 defects/page
  • Revision 1.0 requirements defect density: < 1 defect/page
• All downstream work products based on requirements specification
## Validation (QA) Results

### Total Number of Software Defects (by type)

<table>
<thead>
<tr>
<th>Defect Type</th>
<th>Gen 1</th>
<th>Gen 2</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>21</td>
<td>3</td>
<td>-86%</td>
</tr>
<tr>
<td>High</td>
<td>137</td>
<td>69</td>
<td>-50%</td>
</tr>
<tr>
<td>Medium</td>
<td>111</td>
<td>62</td>
<td>-44%</td>
</tr>
<tr>
<td>Low</td>
<td>24</td>
<td>6</td>
<td>-75%</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td>293</td>
<td>140</td>
<td><strong>-52%</strong></td>
</tr>
</tbody>
</table>

Total # of SW Defects *Decreased* by over 50%
# Validation (QA) Results

## Requirements Volatility at Major Milestones

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Gen 1</th>
<th>Gen 2</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>0.4</td>
<td>0.4</td>
<td>0%</td>
</tr>
<tr>
<td>Beta</td>
<td>1.2</td>
<td>0.7</td>
<td>-42%</td>
</tr>
<tr>
<td>Release</td>
<td>1.7</td>
<td>0.9</td>
<td>-47%</td>
</tr>
</tbody>
</table>

Requirements Volatility *Decreased* by almost 50%  

Volatility = (# of added requirements + # of changed requirements + # of deleted requirements) / Total # requirements
### Validation (QA) Results

#### Feature Variance at Major Milestones

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Gen 1</th>
<th>Gen 2</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>0.05</td>
<td>0.15</td>
<td>+300%</td>
</tr>
<tr>
<td>Beta</td>
<td>0.15</td>
<td>0.25</td>
<td>+167%</td>
</tr>
<tr>
<td>Release</td>
<td>0.15</td>
<td>0.35</td>
<td>+233%</td>
</tr>
</tbody>
</table>

Feature Variance More Than \textit{Doubled}

Feature Variance = \frac{\text{(Current \# Features) - (# Planned Features)}}{\text{(# Planned Features)}}
Validation (QA) Results

SW Defect Closure Efficiency at Release

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Gen 1</th>
<th>Gen 2</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release</td>
<td>69%</td>
<td>87%</td>
<td>+26%</td>
</tr>
</tbody>
</table>

SW Defect Closure Efficiency *Improved* by over 25%

software defect closure efficiency = (cumulative SW defects closed / cumulative SW defects submitted)
Conclusions

Possible factors positively impacting SW quality indicators:

1. Applying lessons learned from Gen 1 development effort
2. Augmented developer experience and maturity
3. Improved unit testing prior to validation
4. Formalized and reviewed requirements

Recall that the software defect potential for Gen 2 should have been *higher* than that of Gen 1.

In actual testing, software defects were *dramatically lower* and other quality indicators *improved significantly* for Gen 2.
Conclusions

While factors 1-3 had some impact on requirements quality indicators for Gen 2, their impact should have been *minimal* given the added complexity of Gen 2.

Clearly, a well-written, properly reviewed requirements specification was the *major* contributing factor to these improvements in software defect levels and other quality indicators on Gen 2.
Question & Answer
Contact Information

Thank You!

For more information, please contact:

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