Test Optimization Through Risk Based Validation Approach

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PNSQC 2021
Biography

**Felix Eu** is a **Software Quality Engineer** at **Intel Corporation** based in Penang, Malaysia and is responsible for software release qualification and process improvement. Prior to this role, he was a Software Test Engineer and Test Project Lead at Motorola Solutions responsible for two-way radio software related functional testing, test planning, defect prediction, escaped defect analysis and test project management. He was a Supplier Software Development Engineer in the same organization and responsible for supplier engagement in software development and process improvement. In these roles, his efforts focus on software product quality and business process improvement. He has held the Digital Six Sigma Green Badge since 2019 and holds a Degree in Computer Science from University of Bolton in the UK.
AGENDA

- Software Testing and Constraints
- Testing Techniques Selection
- Software Validation Transformation
- Source of Impact Analysis
- Risk Management
- Validation Tasks Traceability
- Gap Analysis and Maintenance
- Implementation Results
- Conclusion
What is software testing?

According to ISTQB Certified Tester Foundation Level Syllabus, 1.1. What is Testing? “Software testing is a way to assess the quality of the software and to reduce the risk of software failure in operation.”
Test Constraints

Two main factors:

- **Resource**: Limited human efforts to conduct manual validation along with increasing validation scope.

- **Time**: Time consuming to conduct regression testing every time there is a small change in code to ensure functional integrity of the software.
Testing Techniques Selection

- Fulfilling testing goal

Diagram:

- Test everything as you can
- Perform certain tests
  - Full test coverage
  - Minimize testing time/resources
  - Efficient & Effective Testing
Testing Techniques Selection

- Risk analysis

1. Risk Analysis
   - Which are the impacted areas of the defect fixes?
   - What is the critical level of the impacted areas?
   - Are the required test resources available?

2. Test Base
   - Select a technique that covers the right domain
   - Select a technique with suitable strength
   - Select a technique for which necessary information is available

3. Selected technique (Risk-based validation)
What is Risk-Based Validation (RBV)?

An approach in the validation strategy

- Input from software development team
- Software code change areas and impacts
- Perform risk assessment
- Test prioritization based on impact analysis
- Enhance with Defect Prediction Model

• Enhance with Defect Prediction Model
Objectives

• The analysis of the impact-based risk assessment is critical to the success of the project commitment and minimizing escape defects to the fields.

• Achieve a project outcome that balances risks with quality, features, budget and schedule for the time, resources and efforts that have been invested in a program.
Process Transformation

Software validation transformation:

- Risk Analysis
  - Risk identification and assessment
  - Risk control and mitigation
  - Risk communication and action

- Identify a defect prediction model
- Develop a monitoring and control plan
- Build up Subject Matter Experts (SME)
Risk Analysis

- Risk Identification
- Risk Strategy
- Risk Assessment
- Risk Mitigation
- Risk Report
- Risk Prediction
Defect Prediction Model

- Historical defect data
- Benchmarking
- Actual vs Prediction
- Confident level
Monitoring and Control Plan

- Identify potential problem
- Resource evaluation
- Buffer allocation
- Risk analysis on action plan
- Defect detection rate based on Actual vs Plan
Subject Matter Expert (SME)

- Retain competency
- Knowledge, skill and ability requirements
- Different features different SMEs
- Judgement on test
Source of Impact Analysis

- Business needs adjustment
- Customer requests
- New requirements, new technologies
- Defect fixing
Risk Management

Manage product risk level with RBV in the following ways:

- Early Commencement
- Test Prioritization
- Mitigation and contingency
- Measurements
- Continuous risk assessment
RBV Strategy

Risk-based validation aligns the validation activities with business priority
Validation Outcome

Optimal risk coverage with focused validation

![Graph showing the relationship between number of defects and test hours, highlighting the impact of defects.]
Validation Tasks Traceability

- Impact analysis (IA) Table
- Defect tracking systems
  - Improve accuracy
  - Completeness
Impact Analysis Table

- **Key Success:** The efficiency and effectiveness to convert the impact analysis information into the validation tasks

### Impact Analysis

<table>
<thead>
<tr>
<th>Features → Features</th>
<th>Feature-1</th>
<th>Feature-2</th>
<th>Feature-3</th>
<th>Feature-4</th>
<th>Feature-5</th>
<th>Feature-6</th>
<th>Feature-7</th>
<th>Feature-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feature-1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Feature-2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feature-3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
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</tr>
<tr>
<td>Feature-4</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Feature-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
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<tr>
<td>Feature-6</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Feature-7</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Feature-8</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td>2</td>
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</tbody>
</table>

**Legend:**
- 1: High
- 2: Medium
- 3: Low
## Validation Tasks

### Validation Strategy for Milestone X

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Defect ID</th>
<th>Priority</th>
<th>Total Test Cases Count</th>
<th>Test Cases to be tested</th>
<th>Effort (Staff Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Execute 20% regression test of Feature-1</td>
<td>12345</td>
<td>1</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Execute 5 specific testing for Feature-4</td>
<td>26472</td>
<td>3</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Execute 30% regression test of Feature-10</td>
<td>12121</td>
<td>2</td>
<td>28</td>
<td>8</td>
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<tr>
<td>4</td>
<td>Execute 8 test cases from Feature-2 on Function-1</td>
<td>15462</td>
<td>2</td>
<td>56</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Execute feature interaction between Feature-5 and Feature-6</td>
<td>12358</td>
<td>1</td>
<td>NA</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Execute stress test for Feature-3 for 10 hours</td>
<td>19540</td>
<td>1</td>
<td>3</td>
<td>3</td>
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</tbody>
</table>

**Total Effort:** 7 days
Gap Analysis & Maintenance

Identify miss in interpretation of IA
- Incorrect entries in the impact analysis table
- Misalignment between defect prediction and defect arrival
- Inaccurate risk assessment
- Ambiguous or wrong definition of the validation
- Improper test prioritization
- Duplicate entry of validation tasks
- Insufficient/redundant test coverage
Gap Analysis & Maintenance (Cont’d)

Improvement Actions:
- Turn the findings into action plans
- Develop plans to address the gaps
- Assign and track the action plans

Aim:

Maintain risk-based validation as one of the most competitive approaches to meet the organization’s needs, utilizing all the possible best practices to leverage the risks, quality and all other resources.
Implementation Results

Full regression vs RBV:

- ~ 50% Test Efficiency
- ~ 30% Test Cycle Time
- ~ 20% Risks
Conclusion

- More efficient way of doing testing
- Optimize risk coverage
- Risks tracking throughout SPLC
- Return of Investment (ROI)

Ultimate Goal:

Achieve a project outcome that balances risks with quality, features, budget and schedule for the time, resources and efforts that have been invested in a program.
Key Takeaways

- The importance of RBV approach to overcome time and resource constraints.
- Process transition from conventional full regression test to RBV
- Understand how’s the RBV approach aligns the validation activities with business priority
- Understand how’s the functional areas of the code change may impact validation strategy
- Understand how to manage product risk level with RBV
- Test Prioritization based on impact analysis
- Enhance RBV approach with Defect Prediction Model
- Gap analysis for future process improvement
THANK YOU

Special Recognition:
Tan Chin Pei, Vijaya Kalyanapuram, Upendra Puntambekar, Jeffrey Hicks
Intel IOTG Software Quality Team
Questions?