Sizing System Tests for Estimating Test Execution Effort

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Agenda

- Motivation
- Sizing system tests
- Effort estimation
- Tool support
- Empirical study
- Conclusions
System Tests

- Concerned with the behaviour of the whole system
- Based on high level description of system behaviour
  - Requirements specification, use cases, business process, etc.
  - Black box testing
Test Planning

- System tests are often carried out by dedicated test teams
  - May support several development teams at the same time
  - How to estimate the effort to execute the tests?
- Most effort estimation models are based on project size
  - How to size tests?
Sizing System Tests

- Amount of steps required to execute the test
- Test execution complexity
  - Complexity of interaction between the tester and all the components of the system (software and hardware)
Execution Points

- Measure of test size and execution complexity

- Test Specifications
  - 880 ep
  - 445 ep
  - 700 ep
Measurement Method

Test Specification

System Characteristics Exercised by the Test Step

- $C_1$
- $C_2$
- ...
- $C_n$

Influence Levels

- Screen navigation
- File manipulation
- Pressed keys
- Network usage
- ...

Contribution of the Test Step:

- 30
- ...
- 60

Points Assigned to the Test Case:

- 880

Guidelines

- Calibration
- Automation

Points Assigned to the Test Case:

- 350
- ...
- 220
- ...
- 175

Notes:

- $a$
- $b$
- $c$
- $d$
- $e$
Test Specification Language

<table>
<thead>
<tr>
<th>NL</th>
<th>Guidelines</th>
<th>CNL</th>
<th>Formal Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>common way to write tests</td>
<td>good results with reduced improvement costs</td>
<td>quality of the interpretation of test specifications</td>
<td></td>
</tr>
</tbody>
</table>

NL – Natural Language
CNL – Controlled Natural Language
Calibration Techniques

- Identification of system characteristics
  - Delphi panel
  - Survey

- Guidelines
  - Delphi panel
  - Clustering algorithms

- Weights
  - Delphi panel
  - Analysis of Variance
Tool Support

- We developed a Test Effort Estimation Tool
  - Management of the exercised system characteristics, guidelines and weights
  - Process test specifications written in NL or CNL
  - Test actions identified by the main verb of each sentence of the specification
  - Measures the size and execution complexity of test specifications
  - Estimates execution effort based on risk factors
Test Execution Effort Estimation

- Based on the test size and execution complexity
- COCOMO-based model
  - Risk factors related to test execution effort
  - Equation defined by using regression analysis
- Others possible techniques
  - Analogy
  - Case-based reasoning
  - Regression trees
  - ...
Empirical Study on the Mobile Application Domain

- Analysis of a historical database
  - 6-month database
  - More than 10 thousands of test executions
  - Tests executed by more than 50 testers
  - Several features involved

- Model calibration
  - Delphi panel with 6 experienced testers
The Test Specification Language

- 237 verbs were identified and analyzed in less than 4 hours

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Start the message center.</strong></td>
<td>The phone is in message center.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Select the new message option.</strong></td>
<td>The phone is in message composer.</td>
</tr>
</tbody>
</table>
Correlation Between Effort, Execution Points and Number of Tests

Matrix Plot of EFFORT; EXEC POINTS; TOTAL OF TESTS
Conclusions

- New measurement method for sizing tests based on:
  - The test specification
  - Number of test steps and their execution complexity
- We defined techniques to calibrate a model for a specific application domain
- A test effort estimation tool was developed
- We run an empirical studies in the mobile application domain
  - High correlation between effort and test size and execution complexity measure


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Questions?

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