TOWARDS THE DEVELOPMENT OF A DEFECT DETECTION TOOL FOR COSMIC FUNCTIONAL SIZE MEASUREMENT
Content

- Purpose of the Study
- Literature Review
- Research Methodology
- Case Study
- Results
- Threats to Validity
- Future Work
Purpose of the Study

- To increase the reliability of functional size measurements,
- To decrease the effort and time required for detecting the defects of functional size measurements manually
  - Development of the FSM Defect Detection Tool
In 2009 Ungan et al made an experimental study. It showed that different knowledge and experience level of different measurers may result in variations of the size measurement of the same software projects.

In 2011 Tunalilar; created a Effort Estimation Methodolgy, EFES to improve the measurement process.

EFES recommend company specific measurement procedures, templates and tailoring notes.
Literature Review

- In 2011 COSMIC; Guideline for assuring the Accuracy of COSMIC FSMs;
  - Error Prevention: Include guidelines for preventing the defects
  - Defect Detection: A checklist that is composed of mostly encountered COSMIC errors
- In 2011 Yilmaz et al; made a study about the effect of the quality of SRS on the FSM.
- Additionally, taking COSMIC’s accuracy guideline as reference; identified the most commonly made COSMIC errors and defined them clearly.
Taking into account our previous study (Yilmaz, G., Ungan, E., Demirors, O., 2011) this research is composed of two steps:

- Development of the defect detection tool for COSMIC FSMs
- To investigate the effectiveness of the tool correctness
Research Methodology

1. Building the Environment
2. Development of the Defect Detection Approach
3. Development of the Algorithms
4. Development of the Defect Detection Tool R-COVER

Error Categories:
- Duplicate FP
- Redundant DM type W in list FPs
- OOI sub types are not considered
- Lack of List Before Update

-Yilmaz, G., Ungan, E., Demirors, O., 2011
Building the Environment

- CUBIT is a web based tool that provides easy means;
  - To measure software project
  - To store measurement reports
  - To store software project benchmark data

## Error Categories

<table>
<thead>
<tr>
<th>EC</th>
<th>DDL</th>
<th>Error Categories</th>
<th>RS</th>
<th>Scope</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-R</td>
<td>Sem</td>
<td>1</td>
<td></td>
<td>Generic</td>
<td>If two different FPs have exactly same (DG, DM) tuple and representing the same functionality of the system, one of these two FPs is redundant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FP duplication</td>
<td>[9]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP-R</td>
<td>Sem</td>
<td>2</td>
<td>[7][9]</td>
<td>MIS specific</td>
<td>For an Update FP, measurer forgets to measure its related List FP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of list before update FP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stat</td>
<td>11</td>
<td>[7]</td>
<td>MIS specific</td>
<td>List FP is measured within any update or delete FP not as a separate FP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>List is included in Update/Delete FPs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M-R</td>
<td>Syn</td>
<td>14</td>
<td></td>
<td>Generic</td>
<td>Measurers use user interface components such as &quot;command&quot;, &quot;menu&quot;, &quot;button&quot;, and &quot;screen&quot; for naming OOs and DGs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>User interface components and system users are considered as DG/OOI.</td>
<td>[9]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRS-R</td>
<td>NA</td>
<td>23</td>
<td>[7][9]</td>
<td>NA</td>
<td>E-R diagram do not represent the related system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Errors in data analysis and OOI identification</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Defect Detection Approach
Algorithms of R-COVER

- Error pattern: If the same error category introduces the same defect with the same pattern in two different measurement documents.

- Error patterns defect detection algorithms
  - Sample pseudo code of EC1

- Defect detection algorithms are created for only 15 of the 23 error categories

- Some error categories do not constitute a pattern and they can only be detected by manual inspection with SRS knowledge
R-COVER Tool

R-COVER produces two types of outputs;
Warning: Found defect may not be an error.
Ex. Lack of list before update.
Error: Found defect is an error.
Ex. Each functional process is composed of at least two data movements.
Case Study

- Measurement Cases
- Expert Review
- Tool Utilization
- Results Found by Tool
- Results of Expert Review

Compared
# Case Study

<table>
<thead>
<tr>
<th>Grp</th>
<th>No and Name of Prjt</th>
<th>Ref. Key</th>
<th>Company</th>
<th>App. Type</th>
<th>No of Meas.</th>
<th>Level</th>
<th>Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>1, Project1</td>
<td>Key1</td>
<td>METU</td>
<td>MIS</td>
<td>10</td>
<td>Limited experience, trained</td>
<td>Creating a # of errors</td>
</tr>
<tr>
<td>G2</td>
<td>1, Project2</td>
<td>Key2</td>
<td>METU</td>
<td>MIS</td>
<td>11</td>
<td>Limited experience, trained</td>
<td>Creating a # of errors</td>
</tr>
<tr>
<td>G3</td>
<td>5, Project [3-7]</td>
<td>Key3-Key7</td>
<td>Comp. A</td>
<td>MIS</td>
<td>5</td>
<td>3 year experienced</td>
<td>Effect of industrial MIS projects</td>
</tr>
<tr>
<td>G4</td>
<td>17, Project [8-24]</td>
<td>Key8-Key24</td>
<td>Comp. B</td>
<td>Real-Time and Embedded</td>
<td>17</td>
<td>5 year experienced</td>
<td>Effect of different application domains</td>
</tr>
</tbody>
</table>
Case Study-Expert Review

- Key preparation: Project 1 – Project 24 is discussed and measured by the authors.
- We started the review process with G1
- Each measurement document is evaluated based on its key
- After completing the process for G1, we continued with G2, G3 and G4
Case Study-Expert Review

- Expert Review is conducted based on error categories and whenever a defect is identified, it is recorded in the defect marking template.
- Effort spent for expert review is recorded.
## Expert Review - Defect Marking Template

<table>
<thead>
<tr>
<th>Table Column Head</th>
<th>Type of Control</th>
<th>Total</th>
<th>M1</th>
<th>M2</th>
<th>...</th>
<th>M10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
<td><strong>Name</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FP duplication</td>
<td>Review</td>
<td>60</td>
<td>4</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tool</td>
<td>62</td>
<td>0</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Lack of List before update FP</td>
<td>Review</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tool</td>
<td>27</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>OOI names consist of verbs</td>
<td>Review</td>
<td>66</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tool</td>
<td>64</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Case Study-Tool Utilization

- FP type (Create, Delete, Update, List, Retrieve) of each functional process identified for each functional size measurement document in G1, G2 and G3 respectively.

- FP types of G4’s measurements cannot be identified since G4 is composed of real-time and embedded software projects.

- Data attributes of each measurement document are identified.

- For measurement documents of G1, G2 and G3, identified FP types and data attributes are updated in the CUBIT database.
Case Study-Tool Utilization

- Tool is facilitated for each measurement document respectively.
- Effort spent for the tool utilization is recorded.
## Results

<table>
<thead>
<tr>
<th>EC</th>
<th>Detecting same defects</th>
<th>Missing Defects</th>
<th>Redundant Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G1</td>
<td>G2</td>
<td>G3</td>
</tr>
<tr>
<td>1</td>
<td>88%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>76%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>96%</td>
<td>100%</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>70%</td>
<td>100%</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>73%</td>
<td>100%</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>100%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>84%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>8</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>9</td>
<td>100%</td>
<td>100%</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>11</td>
<td>14%</td>
<td>40%</td>
<td>N/A</td>
</tr>
<tr>
<td>12</td>
<td>67%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>13</td>
<td>100%</td>
<td>100%</td>
<td>N/A</td>
</tr>
<tr>
<td>14</td>
<td>98%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>15</td>
<td>97%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>
## Effort Spent for Expert Review & Tool Utilization

<table>
<thead>
<tr>
<th>Item</th>
<th>Effort (mins)</th>
<th>Effort (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Preparation</td>
<td>860</td>
<td>14</td>
</tr>
<tr>
<td>For expert review, preparation of defect detection sheet</td>
<td>510</td>
<td>8,5</td>
</tr>
<tr>
<td>Evaluation and error categories identification</td>
<td>2440</td>
<td>41</td>
</tr>
<tr>
<td>Defect detection based on error categories</td>
<td>2910</td>
<td>48,5</td>
</tr>
<tr>
<td>Statistical calculations</td>
<td>240</td>
<td>4</td>
</tr>
<tr>
<td><strong>Expert Review (Total)</strong></td>
<td><strong>6960</strong></td>
<td><strong>116</strong></td>
</tr>
<tr>
<td>FP Type identification and modification of measurements in CUBIT</td>
<td>180</td>
<td>3</td>
</tr>
<tr>
<td>DA identification and modification of measurements in CUBIT</td>
<td>315</td>
<td>5,25</td>
</tr>
<tr>
<td>The Tool utilization (for 10 measurement case)</td>
<td>30</td>
<td>0,5</td>
</tr>
<tr>
<td><strong>The Tool (Total)</strong></td>
<td><strong>525</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>
Validity Threats

- Expert review process is conducted by the author - A certified COSMIC FSM expert with 3 years experience helped at critical points.
- Error categories and FP types are identified based on the COSMIC FSMs of MIS software projects.
Future Work

- Different FP-Types are required to facilitate the tool on different type of application domains.
- R-COVER approach and tool are developed based on COSMIC FSMs, the tool cannot detect defects of measurements which are measured by using different FSM methods, such as IFPUG, UniFSm, etc.
Thanks for your attention

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