A Survey into the Rigor of UML Use and its Perceived Impact on Quality and Productivity

Software Engineering Seminar 2010
A Survey into the Rigor of UML Use and its Perceived Impact on Quality and Productivity

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Hi, I'm a person. And I'll show you my world!

This is my house. And those are my cars!

And that's everyone!

Guys?

Anyone?

Damn... Being a singleton really sucks.

Source: umlcomics.com
Intent of Paper

- UML
  - „de facto“ standard
  - Model Driven Architecture

- UML characteristics
  - Completeness
  - Level of detail

- Hypothesis: modeling style has impact on productivity and quality of software projects
Survey Design

- 20 questions (13 main research, 7 background)
- Parts
  - Rigor and styles
  - Model – Code correspondence
  - Productivity and quality benefits
- Case Control design
- Likert scale and nominal scale
- Participants: Developers with UML experience
  - IT companies, SW developer communities
Responses

- 80 valid responses (out of 365)
- 56% responses from two IT companies
- 80% respondents >5 years experience
- 80% respondents from the Netherlands
- Respondents background:
UML Model Completeness in Projects

- Developers' perception on model completeness in projects

> Low completeness

72%
UML Model Completeness in Projects

- Occurrence of imperfections in UML models that lead to implementation problems

35%
Level of Detail Used in UML Models

Diagram:

- A
  - do
    - do(par)
      - do(par: STRING)
        - res: STRING

- B
  - Foo
- Foo
  - +do(): string
- Foo
  - -bar: int
    - +do(): string
Level of Detail Used in UML Models

- Usage of detail in models
Model – Code Correspondence

- Importance of correspondence

![Bar chart showing the importance levels of model-code correspondence. The chart indicates that 45% find it very important, 10% find it important, and 0% find it not important.]

- Individual Perceptions
- Project-collective Perceptions
Model – Code Correspondence

- Strictness in implementing different constructs

<table>
<thead>
<tr>
<th>Package structure</th>
<th>Dependency relations</th>
<th>Inheritance relations</th>
<th>Class and method names</th>
<th>Order of method calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loosely</td>
<td>Somewhat loosely</td>
<td>Neutral</td>
<td>Somewhat strict</td>
<td>Strictly</td>
</tr>
</tbody>
</table>

Montag, 19. April 2010
Model – Code Correspondence

- Methods used in maintaining correspondence

63%
Use of UML and Productivity

- The use of UML and productivity

![Bar chart showing the percentage of respondents who find UML very hinderers, hinders, somewhat hinders, neutral, somewhat helpful, helpful, and very helpful in different phases of software development.](chart-image)

- Analysis: 67%
- Design: 80%
- Implementation: 39%
- Testing: 26%

Montag, 19. April 2010
Use of UML and Software Quality

- Use of UML and its impact on software quality properties

UML in testing
Threats to Validity

- **Internal validity threats**
  - No probabilistic sampling for subject selection
  - Self reporting to collect data on attitude and behaviour

- **External validity threats**
  - Results may be limited to organizations which use UML extensively

- **My opinion**
  - Small data pool
  - Netherland and organization specific
  - Online communities unknown
Conclusion: Targeting Completeness & Level of Detail

- Incomplete UML models lead to implementation problems and deviations

- Completeness and level of detail of models depend on the complexity and criticality of the component

- UML model – implementation correspondence is important
  - Lack of support in maintaining correspondence
Conclusion: Targeting Completeness & Level of Detail

- Use of UML increases productivity
  - Analysis, Design and Implementation

- UML is not used in the maintenance or testing phase

- Use of UML increases quality
  - Understandability and Modularity
Appendix
UML Model Completeness in Projects

- Responses when encountering inconsistency
Model – Code Correspondence

- Factors driving deviation in an implementation

- Lack of model quality
Model – Code Correspondence

- Model completeness – Strictness in implementing modeling constructs correlation

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</tr>
</thead>
<tbody>
<tr>
<td>Model Completeness</td>
<td>.102</td>
<td>.299**</td>
<td>.306**</td>
<td>.322**</td>
<td>.347**</td>
</tr>
<tr>
<td>R-square</td>
<td>.010</td>
<td>.089</td>
<td>.093</td>
<td>.103</td>
<td>.120</td>
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</tbody>
</table>

** indicates significance at 0.01 level (2-tailed)

1% 12%
## Use of UML and Productivity

### Implementing modeling constructs – Development phase productivity correlation

<table>
<thead>
<tr>
<th></th>
<th>Analysis</th>
<th>Design</th>
<th>Implementation</th>
<th>Testing</th>
<th>Maintenance</th>
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</thead>
<tbody>
<tr>
<td>Package structure</td>
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<td>.088</td>
<td>.333**</td>
<td>.126</td>
<td>.117</td>
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<tr>
<td>Dependency relations</td>
<td>.347**</td>
<td>.278*</td>
<td>.380**</td>
<td>.252*</td>
<td>.294**</td>
</tr>
<tr>
<td>Inheritance relations</td>
<td>.126</td>
<td>.179</td>
<td>.304**</td>
<td>.141</td>
<td>.204</td>
</tr>
<tr>
<td>Class &amp; method names</td>
<td>.094</td>
<td>.323**</td>
<td>.375**</td>
<td>.227*</td>
<td>.066</td>
</tr>
<tr>
<td>Order of method calls</td>
<td>.141</td>
<td>.321**</td>
<td>.337**</td>
<td>.360**</td>
<td>.090</td>
</tr>
</tbody>
</table>

** Identicates significance at 0.05 level (2-tailed)
* Identicates significance at 0.01 level (2-tailed)
Related Work

- How UML is used
  - B. Dobing, J. Parsons

- How and why software developers used drawings
  - M. Cherubini, G. Venolia, R Deline, A. J. Ko

- The impact of UML documentation on software maintainance
  - E. Arisholm, L. C. Briand, S. E. Hove, Y. Labiche

- Contribution: Productivity increase in various software development phases
Future work

- Usage of UML for testing
- Impact of different UML styles
  - Quality and Productivity
- Which modeling constructs improve productivity
Spearman correlation

- Non-parametric test to measure statistical dependence between variables
- R-Square: Coefficient of determination