THE INFLUENCE OF ORGANIZATIONAL STRUCTURE ON SOFTWARE QUALITY: AN EMPIRICAL CASE STUDY

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TO FOLLOW

‣ Context

‣ Experiment itself (details)

‣ Results

‣ Related work

‣ Conclusions and Future Work

‣ Questions
Software development context

Complex projects within organizations where many teams working together for a project

Product quality is strongly affected by organization structure (Brooks)

New metric schema (organizational)

Subject: Microsoft Windows Vista development
How does *organizational complexity* influence *quality*? Can we identify *measures* of the organizational structure? How well do they do at *predicting quality*, e.g., do they do a better job of identifying problems components than earlier used metrics [churn, coverage, bugs, etc.]?
EXPERIMENT

› A tree map of the organization structure

› Measures that quantify organizational complexity

› Version control system access
  - 3404 binaries (50 million lines of code)
  - each binary with metrics and post-release failures

› Correlation with the collected organizational metrics to provide empirical evidence
Level 0: organizations (AB, AC, AD)
Level 1: managers with their teams (ABA, ABB, ABC, etc.)
Level 2: lower managers (ABCA)
Level 3: developers (E1, E2, etc.)
EXPERIMENT - METRICS (1)

- Number of Engineers (NOE)
  how many did touch a particular binary

- Number of Ex-Engineers (NOEE)
  how many of them left the company (subset of NOE)

- Edit Frequency (EF)
  total number of times the binary code was edited

- Depth of Master Ownership (DMO)
  depth in hierarchy of the owner (75%) of the binary
EXPERIMENT - METRICS (2)

- Percentage of organization contributing to development (PO)
  number of people reporting to DMO level to the size of the whole org (not whole company)

- Level of Org Code Ownership (OCO)
  how much of the contributions belong to owner organization

- Overall Organization Ownership (OOW)
  ratio of contributing people at DMO to all contributing people (PO considering edits)

- Organization Intersection Factor (OIF)
  number of organizations touching the binary
RESULTS - COLLECTING

- Eight measures for each binary that quantify organizational structure
- Constructing prediction model using step-wise regression and principal component analysis
- Dependant variable: post-release failures
RESULTS - ASSESSING (1)

- Using precision and recall measures to measure the accuracy of the model; 50 random splits

Precision ≈ 87%
(50 random splits)
Recall ≈ 84%
(50 random splits)
RESULTS - ASSESSING (3)

Sensitivity
(Spearmen’s rank correlation)
(50 random splits)
## Results - Comparison

<table>
<thead>
<tr>
<th>Model</th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Structure</td>
<td>86.2%</td>
<td>84.0%</td>
</tr>
<tr>
<td>Code Churn</td>
<td>78.6%</td>
<td>79.9%</td>
</tr>
<tr>
<td>Code Complexity</td>
<td>79.3%</td>
<td>66.0%</td>
</tr>
<tr>
<td>Dependencies</td>
<td>74.4%</td>
<td>69.9%</td>
</tr>
<tr>
<td>Code Coverage</td>
<td>83.8%</td>
<td>54.4%</td>
</tr>
<tr>
<td>Pre-Release Bugs</td>
<td>73.8%</td>
<td>62.9%</td>
</tr>
</tbody>
</table>
RELATED WORK

- Two scopes:
  - organizational research from the software perspective
  - predicting faults/failures

- Geographically distributed organizations
  (Herbsleb & Grinter)

- SE decisions from the viewpoint of coordination
  (Herbsleb & Mockus)
CONCLUSIONS

- Introduced organizational measures
- Investigate the relation organization <-> quality
- Comparison against traditional measures
- Outcome: significant precision, recall and sensitivity with better prediction than traditional measures
- All the data is from one software system
- Cannot be generalized beyond the environment as of potentially large number of relevant context variables
FUTURE WORK

- Conduct the research within other companies
- Virtual organizations (open source projects)
- Social and cognitive aspects of the work
REFERENCES


QUESTIONS