What Makes A Task Difficult?

An Empirical Study of Perceptions of Task Difficulty

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Task Difficulty

Software Engineering

Managers

Project

Developer

Task
Task Difficulty

Software Engineering

Managers

Project

Developer

Task

Time ?
Effort ?
“... software engineers are in great need for techniques for accurate effort estimation, and they are not necessarily knowledgeable about techniques they can use to meet their needs.” [Ivanov et al., FSE2017]
Goal

When and why do developers estimate task difficulty, AND if they use metrics (and which).

RQs:

1. Why do developers perform task estimation?
2. How comfortable are developers when performing estimations?
3. What project metrics do developers find useful when estimating task difficulty?
Methodology

Survey  →  Interview  →  Card Sorting Analysis

33 responses  15 participants  557 cards
2 companies   34 minute (avg.)  23 categories
### Exploratory Survey

Participants thought of:
- One difficult task
- One easy task

Rate the metrics:

<table>
<thead>
<tr>
<th>Category</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CODE</strong></td>
<td>LOC - Lines of Code</td>
</tr>
<tr>
<td></td>
<td>CCOM - Cyclomatic complexity</td>
</tr>
<tr>
<td></td>
<td>CTCR - Comment To Code Ratio</td>
</tr>
<tr>
<td><strong>TASK</strong></td>
<td>CMTT - Task Comments</td>
</tr>
<tr>
<td></td>
<td>FILT - Task Files</td>
</tr>
<tr>
<td></td>
<td>REOP - Reopens</td>
</tr>
<tr>
<td></td>
<td>DEVT - Developers associated with task</td>
</tr>
<tr>
<td><strong>PROCESS</strong></td>
<td>FCOM – # commits of the file</td>
</tr>
<tr>
<td></td>
<td>CENT - Centrality</td>
</tr>
<tr>
<td></td>
<td>DEVF - Developers associated with file</td>
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</table>
Follow-up Interview

- Task Assignment
- Task Management
- Metric Ratings (survey)
- Identifying difficult tasks
RQ1: Why do developers perform task estimation?

Prioritizing tasks
7 out of 15

Ensuring optimal task assignments
11 out of 15
RQ1: Why do developers perform task estimation?

Prioritizing tasks

7 out of 15

"I choose the difficult task first, …” [P14]

"... I follow the one which are easier to solve first.” [P7]

Ensuring optimal task assignments

11 out of 15

"... [if] I am given a task which is relatively simple to me, then the team is losing out on my experience.” [P12]

Every developer finds it essential to perform task estimation.

Some do it without acknowledging it as a separate task.
RQ2: How comfortable are developers when performing estimations?

- Comfortable: 6 out of 15
- Unsure or Unable: 9 out of 15
- Informal “guesstimation”: 6 out of 9
- Unsure: 3 out of 9
RQ2: How comfortable are developers when performing estimations?

“Usually by the time you get [the task] you have a good idea of how difficult it is going to be …” [P3]

6 out of 15
Comfortable

9 out of 15
Unsure or Unable

Informal “guesstimation”
6 out of 9

Unsure
3 out of 9

“there is no rule ... to say that if [this happens] ... then [the task] is difficult”. [P5]

Developers are either unaware of various metrics.

Or performing estimation with those metrics is difficult.
RQ3: What metrics do developers find useful when estimating task difficulty?

P11 says prioritizing work “... requires looking at the code.”

Useful Metrics (Survey)

Developers claim that some of the existing metrics are useful.

Additional Metrics (Interview)

There are additional, non-traditional metrics that developers find important.
## Useful Metrics

<table>
<thead>
<tr>
<th>Rank</th>
<th>Metric</th>
<th>E</th>
<th>W</th>
<th>UI</th>
<th>UW</th>
<th>W+%</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>DEVT (T)</td>
<td>9</td>
<td>17</td>
<td>2</td>
<td>5</td>
<td>78.8</td>
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<td>CMTT (T)</td>
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<td>CTCR (C)</td>
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<td>7</td>
<td>10</td>
<td>48.5</td>
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Useful Metrics

1. DEVT (Task)
2. FILT (Task)

Reflect the amount of work required to complete the task.

3. DEVF (Process)
3. FCOM (Process)

These reflect the evolution (history) of the file.

Traditionally, Code metrics used in models. Developers find Task and Process metrics more useful.
# Additional Metrics

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<th>Category</th>
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<tr>
<td>Collaboration</td>
<td>Communication, Coordination, Clients, Access</td>
</tr>
<tr>
<td>Project History</td>
<td>Task Lifetime, Defects</td>
</tr>
<tr>
<td>Task Character</td>
<td>Priority, Dependencies</td>
</tr>
<tr>
<td>Task Type</td>
<td>Bug Reproduction, Framework, Testing</td>
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IMPLICATIONS

Formal Models for Task Estimation

Develop formal models that developers can use themselves.

Task Metrics

Including task-related metrics in formal task estimation models.

Measuring Additional Metrics

Find ways to measure additional metrics that developers find useful.
Thank you for listening!

Have more questions?
Please email it to Rafael Leano: leanor@oregonstate.edu
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