Enhancing Cost Estimation Models with Task Assignment Information

Joanne Hale
Allen Parrish
Brandon Dixon
Randy Smith
Intensity

Number of time units devoted to $t$
Total duration of $t$

- High intensity: sharp focus and few or no hiatuses
- Low intensity: may have sat untouched for long periods of time.
- Development effort decreased as intensity increased
Concurrency

• Average number of developers working on task \( t \) during any given time unit

• Teams took less time to complete a module when members were able to work more independently
Fragmentation

• Degree to which a team’s time is fragmented over multiple tasks:

\[
\frac{\text{Total number of reported tasks for all developers}}{\text{Number of developers reporting work on } t}
\]

• Fragmentation increased development effort
Improving Cost Estimates

• COCOMO I model augmented with task assignment metrics
  – linear model
  – prediction accuracy improved from PRED(.30) of 31% to PRED(.30) of 49%

• Limited usability
  – More data
  – Ratio scales
Suggested Approach

- Compare to norms
- Adjust if factor in Upper or Lower Quartile
- Monitor and calibrate

<table>
<thead>
<tr>
<th>Metric</th>
<th>Very Low</th>
<th>Typical</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>1.3</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Concurrency</td>
<td>0.9</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Fragmentation</td>
<td>0.9</td>
<td>1</td>
<td>1.4</td>
</tr>
</tbody>
</table>
What Results Should You Expect?

• Data set divided in half
  – Half used to create the EAFs
    • Linear regression used to estimate factors.
    • 3, 4, 5 levels of each metric were evaluated.
    • 4, 5-level models rejected; added complexity, no significant improvement
  – Other half used for evaluation
## Improved Estimates

**criterion: PRED (30%)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate COCOMO I</td>
<td>29%</td>
</tr>
<tr>
<td>Augmented</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Improvement</strong></td>
<td><strong>6%</strong></td>
</tr>
<tr>
<td>COCOMO Post Arch.</td>
<td>37%</td>
</tr>
<tr>
<td>Augmented</td>
<td>43%</td>
</tr>
<tr>
<td><strong>Improvement</strong></td>
<td><strong>6%</strong></td>
</tr>
</tbody>
</table>