Exploring the Relation Between Effort and Duration in Software Engineering Projects

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Agenda...

- Context
- Description of the data sample
- Building project duration models
- Models analysis
- Conclusion
In spite of the work done on this topic in the past, existing duration models are often based on small empirical samples.

This confirmatory study is characterized by:

- The use of a large and internationally recognized data sample,
- The perspective of a “first order” estimation of duration,
- A consideration for the project development platform,
Description of the data sample...

- **Data source:** International Software Benchmarking Standard Group (ISBSG),
- **Representing 396 software projects,**
- **Out of which 312 for which project effort, duration and development platform are known,**

<table>
<thead>
<tr>
<th></th>
<th>Project duration (months)</th>
<th>Project effort (person-hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of obs. (N)</td>
<td>312</td>
<td>312</td>
</tr>
<tr>
<td>Minimum value</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Maximum value</td>
<td>78</td>
<td>106 480</td>
</tr>
<tr>
<td>Mean value</td>
<td>10,5</td>
<td>5 933</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>9,0</td>
<td>12 169</td>
</tr>
<tr>
<td>Median</td>
<td>8,0</td>
<td>2 228</td>
</tr>
</tbody>
</table>
Description of the data sample...

- A first look at duration and effort:

![Graph showing relationship between project duration (months) and project effort (person-hour).](image)

- Logarithmic scale for both duration and effort.

![Logarithmic graph showing project duration and effort.](image)

- Sample size: N = 312
Building duration models...

- Separate models built for:
  - Mainframe development platform (MF),
  - Mid-range development platform (MR),
  - Personal computer development platform (PC),

- Linear regression models:
  - Independent variable: project effort,
  - Dependent variable: project duration,
Building duration models...

- Modeling results:

<table>
<thead>
<tr>
<th></th>
<th>MR platform</th>
<th>PC platform</th>
<th>MF platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>65</td>
<td>39</td>
<td>208</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.434</td>
<td>0.140</td>
<td>0.522</td>
</tr>
<tr>
<td>$F (1, (N-1))$</td>
<td>48,324</td>
<td>5,970</td>
<td>224,865</td>
</tr>
<tr>
<td>Prob. &gt; F</td>
<td>0.0001</td>
<td>0.0194</td>
<td>0.0001</td>
</tr>
<tr>
<td>Log (effort) coefficient</td>
<td>0.360</td>
<td>0.201</td>
<td>0.366</td>
</tr>
<tr>
<td>Std. Error of Log (effort)</td>
<td>0.052</td>
<td>0.082</td>
<td>0.024</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.261</td>
<td>0.287</td>
<td>-0.339</td>
</tr>
</tbody>
</table>
Building duration models...

- Modeling results:

![Graph showing log (Project duration) vs log (Project effort) with three labeled regions: PC, MR, and MF.](image)
Models equations (multiplicative form):

For MF projects: $D = 0,458 \times E^{0.366}$

For MR projects: $D = 0,548 \times E^{0.360}$

For PC projects: $D = 1,936 \times E^{0.201}$

Where “$D$” is the project duration, in months, and “$E$” is the project effort, in person-hours.
Is there a significant difference between these models?

A Student’s “t-test” was performed under the hypotheses that there was no differences between the three models.

Results show that, at the 95% level, MF and MR models do not differ significantly while the PC model display a significant difference from both the MF and MR models.
Conclusion...

- This study confirm the usefulness, in conjunction with other planning tools, of modeling project duration using project effort as an independent variable.

- The relationship between effort and duration is:
  - exponential rather than linear,
  - the exponential term is (0.3 to 0.4 range) is comparable to previous work on this topic,

- The relationship between effort and duration can differ depending on the development platform.
Acknowledgments

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