A Comparison of the COCOMO and SLIM Cost Estimation Models in Commercial Product Development Environments

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Background

- Clients Develop High Volume Commercial Products
- Typically Low to Mid SEI Level 1 Organizations Using "Intuitive Guessing"
- Environment Is Often Very Basic
  - No Formal Data Collection Systems
  - No Code Sizing Practice In Place
  - No Life Cycle Model Data Used
The Use of Two Models

- COCOMO Because:
  - Open Model With Many Low Cost Implementations
  - COCOMO Calibration Process Gives Insight Into Client Process

- SLIM Because:
  - Open Model With Broad Published Database
  - Key Parameters (MBP and PP) Allow Quick Characterization of Client Process From Historical Data

Basic Effort and Schedule Equations

\[ \text{Effort} = K_1 \times (\text{Size})^{\exp 1} \]

\[ \text{Schedule} = K_2 \times (\text{Effort})^{\exp 2} \]
**Effort Equations**

**SLIM:**
\[ E_{\text{proj}}(x_{-m}) = 50,420 \times \left( \frac{F_c \times MBP^1}{PP^1} \right) \times KLOC^1 \]

**COCOMO:**
\[ \text{Effort}_{(x_{-m})} = 2.45 \times E.A.F. \times (KLOC)^{1/6} \]

Where: \( S.F. = 1.01 + 0.01 \sum_{i} SF_i \)

**Schedule Equations**

**SLIM:**
\[ t_{\text{proj}}(\text{min}) = 9.5555 \times \left( \frac{1}{F_{E.F.D} \times MBP} \right)^1 \times \left( E_{\text{proj}}(x_{-m}) \right)^1 \]

\[ t_{\text{proj}}(\text{min}) = \left[ 353.4 \times \left( \frac{B}{MBP} \right)^1 \times \left( \frac{1}{PP} \right)^1 \times (KLOC)^1 \right] \]

**COCOMO:**
\[ \text{Sched.}_{\text{min}} = 2.66 \times (\text{Effort}_{(x_{-m})})^{0.313} \times (S.F. - 1.01) \]

\[ \text{Sched.}_{\text{min}} = \left[ 2.66 \times (2.45 \times E.A.F.)^{0.313} \times (KLOC)^{0.313} \times (S.F. - 1.01) \right] \]
Observations on Master Equations

- SLIM is a fixed Exponent Model With Values of 1.286 (9/7) for Effort; 0.333 (1/3) and 0.429 (3/7) for Schedule
- SLIM Makes Heuristic Adjustments for Small Program Size (<70 KLOC)
- COCOMO Schedule Equation Complicated by S.F. Term In Linear Coefficient
- COCOMO Variable Exponent Provides Additional Flexibility

Range of Calibration Agreement of Models

<table>
<thead>
<tr>
<th>E.A.F. and S.F. Values Corresponding to Full Range of MBP and PP Values for Program Size&lt;240 KLOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBP</td>
</tr>
<tr>
<td>15.44</td>
</tr>
<tr>
<td>21.89</td>
</tr>
<tr>
<td>15.73</td>
</tr>
<tr>
<td>3.362</td>
</tr>
<tr>
<td>5.186</td>
</tr>
<tr>
<td>1.974</td>
</tr>
<tr>
<td>1.129</td>
</tr>
</tbody>
</table>

Key: (E.A.F., S.F.)
### Range of Estimate Agreement of Models

**E.A.F. and S.F. Ranges Which Generate Estimates Meeting Error Criteria for Program Sizes 30 KLOC to 200 KLOC**

<table>
<thead>
<tr>
<th>PP</th>
<th>MRP&lt;7.7</th>
<th>MRP&lt;7.9</th>
<th>MRP&lt;28.8</th>
<th>MRP&lt;35.0</th>
<th>MRP&lt;49.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.657</td>
<td>None</td>
<td>(1.04±2.20)</td>
<td>(1.07±4.20)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>8.362</td>
<td>None</td>
<td>(1.18±4.20)</td>
<td>(1.22±4.20)</td>
<td>(1.30±4.20)</td>
<td>None</td>
</tr>
<tr>
<td>1.997</td>
<td>None</td>
<td>(1.23±4.20)</td>
<td>(1.25±4.20)</td>
<td>(1.23±4.20)</td>
<td>None</td>
</tr>
</tbody>
</table>

For S.F. Range:

20.37 Range

### Example Estimate Curves for SLIM:(MBP=26.9, PP=8,362);
COCOMO:(E.A.F.=2.02, S.F.=1.12)

Calibration Point=80 KLOC
Summary

- COCOMO Is Variable Exponent Model, SLIM Fixed
- In Standard Form, SLIM Has Larger Range of Application
- Models Give Similar Estimates When Calibrated to Common Base Data
- Use of Both Models Often Improves Insight Into Client Process