Revisiting the COCOMO II SCED Cost-Schedule Driver

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Outline

• Background

• Approaches
  – Ideal Effort Multiplier Analysis on SCED driver
  – SCED Rating Quality Analysis

• Conclusions
Background

- COCOMO II calibrated to end-of-project actuals
  - Size, personnel ratings, complexity
- SCED ratings come from subjective judgments
  - Actual compression computable but not done
  - Judgments often different from actuals
- Analysis shows actuals are somewhat better predictors
  - But not determinable in advance
COCOMO II SCED Multipliers

Required Development Schedule (SCED) has the following effort multipliers in COCOMO II:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Very low</th>
<th>Low</th>
<th>Nominal</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplier</td>
<td>1.43</td>
<td>1.14</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Descriptor</td>
<td>75% of nominal</td>
<td>85% of nominal</td>
<td>100% of nominal</td>
<td>130% of nominal</td>
<td>160% of nominal</td>
</tr>
</tbody>
</table>

- Based on calibration to judgmental ratings
CII SCED Rating Distribution

- VL: 12
- VL-L: 1
- L: 17
- L-N: 2
- N: 109
- N-H: 3
- H: 15
- VH: 2

# of projects
Study Approaches

1. Perform the Ideal Effort Multiplier (IEM) analysis on SCED driver
2. Propose new SCED effort multipliers
3. Examine on SCED rating quality
Ideal Effort Multiplier (IEM) Analysis on SCED

• IEM
  – a way to normalize out contaminating effects of other cost driver attributes as much as possible in order to get a clear picture of the contribution of a single cost driver

• Equation
  – $IEM(P, \text{SCED}) = \frac{PM(P, \text{actual})}{PM(P, \text{SCED})}$
    • $IEM(P, \text{SCED})$: the ideal effort multiplier for project P
    • $PM(P, \text{actual})$: project P’s actual development effort
    • $PM(P, \text{SCED})$: CII estimate excluding the SCED driver
Steps

1. Compute PM(P, SCED) for each project in the repository
2. Compute IEM(P, SCED) using equation:
   \[ IEM(P, SCED) = \frac{PM(P, \text{actual})}{PM(P, SCED)} \]
3. Group IEM(P, SCED) by the same SCED ratings
4. Compute median value for each rating
IEM-SCED Values vs. Ratings

IEM Value vs. Rated SCED

1: VL
2: VL-L
3: L
4: L-N
5: N
6: N-H
7: H
8: VH
IEM-SCED Values on CII DB

The graph shows the relationship between SCED ratings and values with different datasets:

- **C81**:
  - VL: 1.23
  - L: 1.08
  - N: 1
  - H: 1.04
  - VH: 1.11

- **CII 2000**:
  - VL: 1.43
  - L: 1.14
  - N: 1
  - H: 1
  - VH: 1

- **CII-IEM**:
  - VL: 1.44
  - L: 1.11
  - N: 1
  - H: 1.1
  - VH: 0.87

Questions:

- **High: under estimation?**
- **Very High: overestimation?**
# Model Accuracy Improvements

<table>
<thead>
<tr>
<th></th>
<th>CII</th>
<th>CII with IEM-SCED</th>
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</thead>
<tbody>
<tr>
<td>Pred(.20)</td>
<td>63%</td>
<td>63%</td>
</tr>
<tr>
<td>Pred(.25)</td>
<td>68%</td>
<td>71%</td>
</tr>
<tr>
<td>Pred(.30)</td>
<td>75%</td>
<td>76%</td>
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</table>
SCED Rating Quality

- **“Rated” SCED**
  - Reported in data collection form

- **“Derived” SCED**
  - Analyzed from the actual schedule compression ratio, which is actual schedule/estimated schedule

- SCED Rating Quality
  - Compatibility between SCED\textsubscript{rated} and SCED\textsubscript{derived}
Steps

1. CII Data → PM\textsubscript{est} = A \times \text{SIZE}\(B+\Sigma\) \times \Pi(EM) → Estimated Efforts

2. SCED Rating Quality Matrix: TDEV\textsubscript{est} = C \times \text{PM}\textsubscript{est}^{(D+\Sigma)} → Estimated Schedules

3. CR = \frac{TDEV\textsubscript{actual}}{TDEV\textsubscript{est}}

4. Check SCED definition

5. SCED rating quality analysis: “Derived” SCED → Rated SCED
SCED Rating Quality Matrix

- Preliminary analysis result:
  - Compatibility: 21% (32 out of 155 data points)

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<table>
<thead>
<tr>
<th>CR</th>
<th>&lt;77%</th>
<th>78%-82%</th>
<th>83%-90%</th>
<th>90%-95%</th>
<th>95%-110%</th>
<th>110%-122%</th>
<th>123%-137%</th>
<th>138%-152%</th>
<th>&gt;153%</th>
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<td>7</td>
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<tr>
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<td>1</td>
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<tr>
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<td>1</td>
<td>5</td>
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<tr>
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<td>13</td>
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<td>22</td>
<td>11</td>
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</table>
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"Derived" SCED
Conclusion

• Subjective SCED ratings often differ greatly from actuals
  – Acceleration reasons: smooth integration, well-jelled teams
  – Deceleration: requirements volatility, funding gaps, critical-path delays
• Actual SCED compression ratings give somewhat better results
  – But not determinable in advance
• Worth exploring in detailed rating scale workshop