Tool Ratings and Effects on Software Development Effort

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Presentation Outline

- Motivation
- Technical Approach
- CASE Tool Rating Scale
- ROI Analysis for CASE Tool Adoption
- Future Work
Motivation

- Very Simple Tool Rating Scale in COCOMOII Model
- Strong Statistical Significance of TOOL Effect on Effort & Schedule
- No Consideration of Correlations and Overlaps with Other Parameters

COCOMOII TOOL Rating Scale

<table>
<thead>
<tr>
<th>Rating</th>
<th>CASE Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>Edit, code, debug</td>
</tr>
<tr>
<td>Low</td>
<td>Simple, front-end CASE, back-end CASE</td>
</tr>
<tr>
<td>Nominal</td>
<td>Basic life cycle tools, Little integration</td>
</tr>
<tr>
<td>High</td>
<td>Strong, mature life cycle tools, Moderately integrated</td>
</tr>
<tr>
<td>Very High</td>
<td>Strong, mature, proactive life cycle tools</td>
</tr>
</tbody>
</table>

- No Comparison of the Same Kind of Tools
- No Clear Definition of Tools
- No Considerations of Interactions with Other Factors
COCOMOII.1998 Productivity Range

Distribution of TOOL Ratings

TOOL Rating Distribution of COCOMOII.1998 161 Data
COCOMOII.1998 Bayesian TOOL Analysis

161 Projects
1 = 2,408

Bayesian
A-posteriori

1.50

Expert Delphi
A-priori

Correlations of TOOL with Others

- TOOL Ratings Largely Orthogonal to Other Ratings
  - PMAT only correlation higher than 0.4 for 161 COCOMO II projects
  - May be Complex Size interactions (e.g. GUI-builder tools)
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Technical Approach

- Establish a tool rating framework that more effectively correlates COCOMO II TOOL ratings with relative effort
- Perform more In-depth analysis of tool interactions with other factors and effects on software development effort
- ROI Analysis that relates CASE tool costs to savings
### New Tool Rating Scale:

**Activity Coverage**

<table>
<thead>
<tr>
<th>Tool</th>
<th>CASE Tool</th>
<th>Activity Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

- **Basis of Tool Rating Scale**
  - Breadth of Activity Coverage
    - Specification, Analysis, Design, Programming, Test, CM, QA, Collaboration, Management, etc.
  - Degree of Tool Integration
    - CMM Tool/Process Integration Support
  - Tool Maturity and User Support

### Software Tools Coverage by Activity

<table>
<thead>
<tr>
<th>Plan</th>
<th>A Background</th>
<th>Product Design</th>
<th>Programming</th>
<th>Tool</th>
<th>Implementation &amp; Multi-Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</table>

- For example, a specific tool may cover activities such as "Design" or "Testing."
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CASE Tool Rating Scale

- 3 Individual Rating Scales
  - Completeness of Activity Coverage
  - Degree of Tool Integration
  - Tool Maturity and User Support

- Weighted-Sum or Subjective Combination of Individual Ratings
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ROI Analysis for CASE Adoption

CASE Expenditures

1. Initial Investment:
   1.1 Technical Assessments
   1.2 CASE Software
   1.3 Tool Tailoring and Integration
   1.4 Workstations
   1.5 Skill Development Training
   1.6 Tool Consultants

2. Ongoing Operations: 4 Years
   2.1 Tool Support Group
   2.2 Workstation Maintenance
   2.3 Software Upgrades/Maintenance
   2.4 Ongoing Training

CASE\_Expenditure(0) = \sum_{i=1}^{m} I_i x \sum_{j=1}^{n} O_j

CASE Expenditure\_Total = \sum_{i=1}^{m} I_i x \sum_{j=1}^{n} O_j

COCOMO Benefit Parameters

TOOL(t) = f(Coverage, Integration, Maturity(t))

LTEX(t) = f(LTEX\_Total, TOOL(t), Training(t))

Benefit(t) = (COCOMO\_Total - COCOMO(t)) - CASE\_Expenditure(t)

ROI(t) = \frac{Benefit(t)}{CASE\_Expenditure(t)}

- can be adjusted for present value

Adapted from Clifford C. Huff, ACM Communications, April 1992
CASE Tool Expenditures

<table>
<thead>
<tr>
<th>Initial Investment</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Assessments</td>
<td></td>
</tr>
<tr>
<td>CASE Software</td>
<td></td>
</tr>
<tr>
<td>Tool Tailoring and Integration</td>
<td></td>
</tr>
<tr>
<td>Workstations</td>
<td></td>
</tr>
<tr>
<td>Skill Development/Training</td>
<td></td>
</tr>
<tr>
<td>Tool Consultants</td>
<td></td>
</tr>
<tr>
<td><strong>Total Initial Investment</strong></td>
<td></td>
</tr>
<tr>
<td>Ongoing Operations</td>
<td></td>
</tr>
<tr>
<td>Tool Support Group</td>
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<td>Software Upgrades/Maintenance</td>
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</tr>
<tr>
<td>Ongoing Training</td>
<td></td>
</tr>
<tr>
<td>Conference/Team Group Meetings</td>
<td></td>
</tr>
<tr>
<td><strong>Total Ongoing Costs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total CASE Expenditure</strong></td>
<td></td>
</tr>
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</table>

TOOL ROI Analyzer

Current TOOL Rating

COCOMO II

Time-Phased TOOL Expenditures

PV(Benefit = ROI)

Time-Phased TOOL Savings

Present Value

PV(Benefit = IF)
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Future Work

- Refine behavioral analysis of TOOL effects
  - Investigate TOOL/Size Interactions
- Data Collection for interaction among TOOL rating scales
- Determine weights of individual CASE TOOL rating-scale effects on S/W development effort
- Tool Support for ROI Analysis of CASE tool adoption
- Integration of ROI Analyzer with USC-COCOMOII