The Rosetta Stone: Making Your COCOMO Estimates Work with COCOMO II

Sunita Chulani
Research Staff Member
IBM Research, Center for Software Engineering
sunita@us.ibm.com
Agenda

- What is the COCOMO Rosetta Stone?
- How is the Rosetta Stone used?
- Our experience with the Rosetta Stone
What’s the Rosetta Stone?

- A black basalt slab bearing an inscription that was the key to deciphering hieroglyphics
- Found by French troops in 1799 near the town of Rosetta, Egypt
- Contained a decree praising Egyptian King Ptolemy V in three scripts: Greek, demotic and hieroglyphics
What’s The COCOMO Rosetta Stone?

- Converts existing COCOMO 81 projects for use with the COCOMO II.2000 model
  - One can take advantage of the COCOMO II.2000 model’s many advanced features
  - One can create a calibration database which allows you to estimate effort/duration more accurately
  - Converted COCOMO 81 data is an approximation of what that data would look like if collected for COCOMO II

- Desire is to develop a standard process that can become part of your estimating practices
Agenda

• What is the COCOMO Rosetta Stone?
• How is the Rosetta Stone used?
• Our experience with the Rosetta Stone
Differences between COCOMO 81 and COCOMO II

- Three modes replaced by five Scale Factors (SF)
- Reuse of code is non-linear in COCOMO II
- Requirements Volatility replaced by Requirements Evolution and Volatility (REVL)
- Added DOCU, RUSE, PVOL, PLEX, LTEX, PCON, SITE
- Removed VIRT, TURN, VEXP, LEXP, MODP
Suggested Conversion Approach

1. Update Cost Estimate
   - Actuals
     - Size
     - Scope
     - Breakage
     - Etc.

2. Estimates from Software Cost Database
3. Normalized Data
4. Convert COCOMO Estimates using Rosetta Stone
5. Results
6. Make Other Adjustments Including Stratification
7. Results
8. Determine Accuracy of Estimates by Comparing with Actuals
9. Report
Converting DSI's To SLOC's

- **Programming languages conversions**
  - 2nd generation reduce DSI by 35%
  - 3rd generation reduce DSI by 25%
  - 4th generation reduce DSI by 40%
  - object-oriented reduce DSI by 30%

- **Function point conversions**
  - Use expansion factors developed by Capers Jones

- **Feature point conversions**
  - Use expansion factors developed by Capers Jones
# Scale Factor Settings

<table>
<thead>
<tr>
<th>MODE/SCALE FACTORS</th>
<th>ORGANIC</th>
<th>SEMIDETACHED</th>
<th>EMBEDDED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precededness (PREC)</td>
<td>XH</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Development flexibility (FLEX)</td>
<td>XH</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Architecture/risk resolution (RESL)</td>
<td>XH</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Team cohesion (TEAM)</td>
<td>XH</td>
<td>VH</td>
<td>N</td>
</tr>
<tr>
<td>Process maturity (PMAT)</td>
<td>( f(\text{MODP}) )</td>
<td>( f(\text{MODP}) )</td>
<td>( f(\text{MODP}) )</td>
</tr>
</tbody>
</table>
PMAT Computation

- Use COCOMO 81 MODP for COCOMO II PMAT
  - if MODP is rated VL or L then set PMAT to VL
  - if MODP is rated N then set PMAT to L
  - if MODP is rated H or VH then set PMAT to N
# Effort Multipliers - Product

<table>
<thead>
<tr>
<th>COCOMO 81 DRIVERS</th>
<th>COCOMO II DRIVERS</th>
<th>CONVERSION FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELY</td>
<td>RELY</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>DATA</td>
<td>DATA</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>CPLX</td>
<td>CPLX</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>RUSE</td>
<td></td>
<td>Set to N, or actual if available</td>
</tr>
<tr>
<td>DOCU</td>
<td></td>
<td>If Mode = Organic, set to L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= Semidetached, set to N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= Embedded, set to H</td>
</tr>
</tbody>
</table>
## Effort Multipliers - Personnel

### COCOMO 81 Drivers | COCOMO II Drivers | Conversion Factors
--- | --- | ---
ACAP | ACAP | None, rate the same or the actual
PCAP | PCAP | None, rate the same or the actual
AEXP | APEX | Use next-highest rating. 1-year AEXP was rated L; for COCOMO II APEX 1 year is rated N. VH stays VH.
VEXP | PLEX | None, rate the same or the actual
LEXP | LTEX | None, rate the same or the actual
PCON | Set to N, or actual if available
## Effort Multipliers - Platform

<table>
<thead>
<tr>
<th>COCOMO 81 DRIVERS</th>
<th>COCOMO II DRIVERS</th>
<th>CONVERSION FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME</td>
<td>TIME</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>STOR</td>
<td>STOR</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>VIRT</td>
<td>PVOL</td>
<td>None, rate the same or the actual</td>
</tr>
<tr>
<td>TURN</td>
<td></td>
<td>Use values in Table 4.3.5</td>
</tr>
</tbody>
</table>
**Effort Multipliers - Project**

<table>
<thead>
<tr>
<th>COCOMO 81 DRIVERS</th>
<th>COCOMO II DRIVERS</th>
<th>CONVERSION FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOOL</td>
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<td>Use values in Table 4.3.5</td>
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<tr>
<td>SCED</td>
<td>SCED</td>
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</tr>
<tr>
<td>SITE</td>
<td>SITE</td>
<td>Set to H, or actual if available</td>
</tr>
</tbody>
</table>
More Work May Be Needed

- Use the actual size including requirements evolution and volatility instead of the estimated size if it is available
- Adjust both the multipliers and scaling factors to reflect your actuals
- When in doubt with ratings, use N to reflect the nominal case
Issues to be Sensitive to

- COCOMO II includes many additional enhancements
  - REVL used to account for requirements volatility
  - Reuse size model (design with reuse) adjustments
    - Must rate SU, UNFM and Level of AA
  - RUSE multiplier (design for reuse) adjustments
    - Must push RELY up one notch as a standard adjustment
  - TOOL ratings must be adjusted downward as current ratings reflect added maturity of industry
Agenda

• What is the COCOMO Rosetta Stone?
• How is the Rosetta Stone used?
◆ Our experience with the Rosetta Stone
Experimental Calibrations

- USC COCOMO software package has an auto-calibration feature
  - Permits you to compute effort and schedule constants based upon your cost histories
  - COCOMO II.2000 parameters calibrated using Bayesian Approach
    - See http://sunset.usc.edu/TechRpts/Dissertations/SChulani.pdf
  - We used the package to create an 89 project database for use in calibrating the model
  - Used Rosetta stone to do this and then adjusted results based upon knowledge of projects
Results of Experimentation

• Using Rosetta stone (no adjustments, selected projects)
  – Effort coefficient: 4.11 versus 2.45
  – Schedule coefficient: 3.67 versus 2.66
  – Accuracy: within 25% of actuals, 49% of time

• Using Rosetta stone and knowledge base adjustments (all 89 projects in database)
  – Effort coefficient: 3.96
  – Schedule coefficient: 3.43
  – Accuracy: within 25% of actuals, 56% of time
More Accuracy Analysis

• Using Rosetta stone, adjustments and domains

<table>
<thead>
<tr>
<th></th>
<th>Effort</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace A</td>
<td>4.46</td>
<td>5.14</td>
</tr>
<tr>
<td>Aerospace B</td>
<td>5.45</td>
<td>4.68</td>
</tr>
<tr>
<td>Aerospace C</td>
<td>4.76</td>
<td>4.68</td>
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<tr>
<td>Management Info Systems</td>
<td>2.65</td>
<td>2.76</td>
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<tr>
<td>Software Packages</td>
<td>2.88</td>
<td>2.89</td>
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<tr>
<td>Switching Systems</td>
<td>3.45</td>
<td>3.74</td>
</tr>
</tbody>
</table>

• Accuracy: improved to within 20% of actuals, 63% of time (across all domains)
Conclusions & Recommendations

- The Rosetta stone provides a standard process for converting between versions of the COCOMO model
- The Rosetta stone provides a great deal of value when used as a starting point
- Statistical accuracy improves as a function of stratification by organization, domain, size, etc.
  - Reinforces importance of developing your own calibration
  - Package’s auto-calibration feature is very useful