COCOMO II Local Calibration Using Function Points

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Agenda - I

- Introduction
  - The COCOMO Model
  - Scope of the Study

- Model Calibration Framework
  - Study the Environment and Establish Project Categories
  - Select Target Category
  - Select Projects to Be Measured
  - Determine Actual Effort and Schedule
  - Measure Selected Projects in Function Points
  - Determine Scale Factors and Effort Multipliers
  - Calibrate Model
  - Assess Calibration and Analyze Results
Agenda - II

- Study Results
  - Organization A
  - Organization B
  - Organization C
  - Organization D
  - Organization E

- Conclusions and Future Work
  - Using COCOMO II Original Calibration as a Baseline
  - Calibration Difficulties, Lessons Learned, and Recommendations
Introduction
Introduction
The COCOMO Model

- COCOMO and COCOMO II are software engineering cost estimation models
- COCOMO was created by Barry Boehm in the 70’s and published in 1981
- COCOMO II updated COCOMO to modern software development practices
  - COCOMO II.1997
    - 83 data points, PRED(.30) = 52% – 64% (stratified)
  - COCOMO II.2000
    - 161 data points, PRED(.30) = 75% – 80% (stratified)
- Local calibration improves results
COCOMO II Local calibration – 5 Brazilian organizations
  – 3 government, 2 private
    ■ 2 financial institutions
    ■ 1 service organization
    ■ 1 IT organization
    ■ 1 manufacture
  – All use Function Points as a measure of size

Study Goals
  – Discuss challenges, difficulties, and lessons learned
  – Provide results on the use of Function Points as input to COCOMO II
Model Calibration Framework
Model Calibration Framework

- **Data Collection**
  - Study the environment and establish project categories
  - Select a target project category
  - Select projects to be measured
  - Determine actual effort and schedule
  - Measure projects in Function Points
  - Determine scale factors and effort multipliers

- **Model Calibration**
  - Calibrate a COCOMO II Model using CALICO¹

- **Analysis**
  - Assess calibration and analyze results

¹ CALICO can be downloaded free of charge from http://www.softstarsystems.com
Study Results
Study Results
Organization A

- **Goal**: to estimate effort and schedule for one project
- 6 completed projects selected out of 8 available
- Projects measured both in SLOC and FP
- Effort and schedule obtained in interviews

![Bar chart with EAF values]

- EAF – Mean .73
- Std Dev .16
- SF - nominal
Calibration Results for SLOC

MRE = 11.68% – PRED(.30) = 83%
Calibration Results for Function Points

MRE = 11.38% – PRED(.30) = 100%
Conclusions

- SLOC and FP gave similar results
- Good PRED(.30) values
- New project was estimated using FP estimated size and calibrated model
Study Results
Organization B

- **Goal**: to implement a COCOMO II estimation process
- 6 completed projects selected
- Small projects: < 300 FP, 2 to 4 months duration
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

![Bar Chart]

EAF – Mean .30
Std Dev .11
SF - nominal
Study Results
Organization B

Calibration Results

MRE = 18.50% – PRED(.30) = 83%
Study Results
Organization B

- Results considered OK as a first step
  - \( \text{PRED}(0.30) = 83\% \)

- Next step to collect more projects and recalibrate model
**Study Results**

**Organization C**

- **Goal**: to implement a COCOMO II estimation process
- 16 completed projects selected
- All projects from the same category
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

![Chart showing EAF, Mean .30, Std Dev .08, SF - nominal]
Study Results
Organization C

Calibration Results

MRE = 29.52% – PRED(.30) = 56%
Study Results
Organization C

- Large variation in effort for the same size
  - Around 300 FP – 3 to 12 PM effort
  - Same situation around 450-500 FP

- More analysis needed
  - Stabilize development process
Study Results
Organization D

- **Goal:** to implement a COCOMO II estimation process
- 8 completed projects selected
- All from the same platform
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

![Chart with data points and labels](chart.png)

EAF – Mean .61
Std Dev .17
SF - nominal
Study Results
Organization D

Calibration Results

MRE = 68.24% – PRED(.30) = 25%
Study Results
Organization D

- Graphs used to look for causes of low PRED

Example:

Blue bar: driver rating – Red bar: percent error
Study Results
Organization D

Potential reasons for low PRED:

- Some projects interrupted and then resumed
- Some were 1-person projects
- Inconsistent rating of DATA effort multiplier
- In some cases construction was done by a different organization
- In some cases different software processes were used

Resolve problems, add more projects, and recalibrate
Study Results
Organization E

- **Goal**: to upgrade the organization’s estimating process to COCOMO II
- 7 completed projects selected
- Project selection based on availability
- Project size estimated in FP (NESMA technique)
- Effort and schedule obtained in interviews

![Graph showing EAF - Mean .70, Std Dev .51, SF - nominal]
Study Results
Organization E

Calibration Results

MRE = 27.42% – PRED(.30) = 57%
A large project may have strongly influenced the model
Largest EAF variation observed
(Re)define project categories, add projects, and recalibrate
Conclusions and Future Work
Conclusions and Future Work
Using Original CII Calibration as a Baseline

Original COCOMO II calibrations provide a baseline for assessing local calibrations
Conclusions and Future Work
Difficulties, Lessons Learned and Recommendations

Topics

- Obtaining a set of completed projects
- Measuring or estimating size
  - NESMA approach
- Obtaining values for effort and schedule
- Dealing with subjectivity in cost driver rating
  - The importance of local standards
  - Monte Carlo may help deal with uncertainty
Conclusions and Future Work

Future Work

Help organizations to:

- Add more projects & recalibrate models
- Calibrate new models for other categories
- Create local standards for cost driver rating
- Group projects into categories for model building
- Implement COCOMO II estimation processes
Thank You!

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