COCOTS (ConSpective COTS) Integration Cost Model: An Overview

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Outline

- Model Development History and Support
- Problem Context
- COTS Integration Cost Sources
- COCOTS vs. COCOMO Cost Sources
- COTS Assessment
- COTS Tailoring
- COTS Glue Code Development and Test
- COTS Volatility Effects on Application Development Cost
- Total COTS Integration Cost Estimate
Model Development History and Support

USAF/ESC Effort
- March 1996 through June 1997
  - Initial Glue Code Model Definition, Experimental Calibration

FAA Effort
- Phase 1 (July to October, 1997)
  - Glue Code Model Redefinition, Experimental Calibration
- Phase 2 (October 1997 to April 1998)
  - Glue Code Model Refinement
  - Initial Volatility Models Defined
- Phase 3 (April 1998 to September 1998)
  - Further Data Collection & Model Refinement, Calibration
  - Goal: functional prototype fielded by end FY'98

ONR Effort
- January 1998 through 1999
  - Further Refinement of Models, Data Collection & Calibration
  - Determination of How Best to Associate COCOTS with COCOMO II

Coordination of FAA and ONR Data Collection Being Pursued with Help DoD

Problem Context
COTS and Custom Applications Components
New COCOTS Modeling Problem

COTS Infrastructure
COTS Tools
COCOMO II: PVOL, PEXP
LTEX, TOOL

Cost Modeling Currently Addressed
COTS Integration Cost Sources

1. COTS Assessment
   - Initial Filtering
   - Final Selection
2. COTS Tailoring
3. COTS Application Glue Code Development and (System) Test
4. COTS Volatility Effects on Application Development Cost

*Initial COCOTS Focus: Software Development; Operations & Maintenance to be addressed later

COCOMO Cost Sources
(No COTS in System)

Application Code Development Integration and Test Without The Use of COTS in System

STAFFING

TIME
COCOMO vs. COCOTS Cost Sources

(COTS in System)

Development and Test

Field Test

Increased Application Effort due to COTS Volatility

COTS Integration Cost Sources:

1) Assessment

Initial Filtering Effort

Total Effort = \# COTS Candidates

Average Filtering Effort Candidate

Final Selection Effort

Total Effort = \( \sum \text{\# COTS Candidates} \)

Average Assessment Effort for Attribute in Given Domain Candidate

- List of attributes still being refined (in collaboration with Dr. Elizabeth Bailey)
- Efforts/candidate is project-dependent, within domain guidelines

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COTS Integration Cost Sources:

2) Tailoring

\[
\text{Total Effort} = \sum_{i} \frac{\text{COTS Candidates Tailored at Complexity Level}}{\text{Tailoring Complexity Level in Domain}} \times \text{Average Effort at Tailoring Complexity Level in Domain}
\]

- Five tailoring effort complexity levels:
  - Very Low, Low, Nominal, High, Very High
  - Differentiated based on number tailored parameters, difficulty of needed scripts, API iterations, etc.

COTS Integration Cost Sources:

3) Glue Code Development and Test

\[
\text{Total Effort} = A \times [(\text{size})^1 + (\text{breakage})^{0.5}] \times (\text{effort multipliers})
\]

- A - a linear scaling constant
- Size - of the glue code in SLOC or FP
- Breakage - of the glue code due to change in requirements and/or COTS volatility
- Effort Multipliers - 13 parameters, each with settings ranging VL to VH
- B - an architectural scale factor with settings VL to VH
COTS Integration Cost Sources:
4) Increased Application Effort Due to COTS Volatility

Approximate Model:
\[
\text{Total Effort} = \text{(Application Effort)} \times \left[ \frac{\text{BRAK COTS}}{100} \right] \times \text{(EAF)}
\]

Detailed Model with COCOMO II Parameters:
\[
\text{Total Effort} = \text{(Application Effort)} \times \left( \left( \frac{\text{BRAK COTS}}{1-\text{BRAK}} \right)^{1.01+Z} \right) \times \text{(EAF)}
\]

- BRAK COTS: \% application code breakage due to COTS volatility
- BRAK: \% application code breakage otherwise
- Z: COCOMO II scale factor
- EAF: Effort Adjustment Factor (product of effort multipliers)

Total COTS Integration Cost Estimate

Total Integration Effort (in Person-Months) =
Assessment Effort + Tailoring Effort + Glue Code Effort + Volatility Effort

where
Assessment Effort = Filtering Effort + Final Selection Effort

Total integration Cost =
(Total Integration Effort) \times (\$\text{/Person-Month})
COTS Integration Cost Sources:

4) Increased Application Effort Due to COTS Volatility

Approximate Model:

Total Effort = (Application Effort) \times \left( \frac{BRAK \ COTS}{100} \right) \times (EAF) \ COTS

Detailed Model with COCOMO II Parameters:

Total Effort = (Application Effort) \times \left( \left( \frac{1 + BRAK \ COTS}{1 + BRAK} \right)^\Sigma \right) \times (EAF) \ COTS

BRAK \ COTS: \% application code breakage due to COTS volatility
BRAK: \% application code breakage otherwise
\Sigma: COCOMO II scale factor
EAF: Effort Adjustment Factor (product of effort multipliers)

Total COTS Integration Cost Estimate

Total Integration Effort (in Person-Months) = Assessment Effort + Tailoring Effort + Glue Code Effort + Volatility Effort

where

Assessment Effort = Filtering Effort + Final Selection Effort

Total integration Cost = (Total Integration Effort) \times ($/Person-Month)