Status of the COSYSMO 3.0 Model

Jim Alstad, USC-CSSE
USC Center for Systems and Software Engineering
2015 Annual Research Review
April 14, 2015
Introduction

• Dr Boehm and I, working with the Affiliates, have been developing the next-generation system engineering cost estimation model, COSYSMO 3.0.
  – Multiple directions have been tried.
  – Based on feedback from Affiliates, we think we are close to an acceptable model

• It has been suggested that our process in developing COSYSMO 3.0 should be more rigorous, so the following slides summarize the current approach; unresolved topics will be discussed at the Workshop (Wednesday 1-5):
  – Mission
  – Objectives
  – Feature list
Mission of COSYSMO 3.0

• The mission is to advance the state of the art and the state of the practice in system engineering cost estimation (and, where feasible, in other types of cost estimation) by developing COSYSMO 3.0, a system engineering cost model that incorporates features from published models and from available expertise.
Objectives of COSYSMO 3.0 (1/3)

1. Calibrate the model, with statistical soundness, based on actual project data from a diverse set of divisions of companies and from a diverse set of project types.

2. Get Jim his thesis in a reasonable amount of time.
Objectives of COSYSMO 3.0 (2/3)

3. Develop a model that supports these types of usage:
   a. A tool developer, developing an estimating tool using the model.
   b. An estimator estimating system engineering cost for a project or for a series of projects
   c. Estimating within a system-of-systems context
   d. A division of a company desiring to calibrate the model to its type of project
   e. A division of a company having an existing database of project data that desires to use that data in support of estimation using the model
   f. A developer of a related cost estimating model who desires that the models coordinate
      • E.g., Cole’s total development cost model [7]; COCOMO III; a model using parameter values based on probability distribution
Objectives of COSYSMO 3.0 (3/3)

4. Use a selection of model features (see next section) that support the Mission and the other Objectives.
These features have been proposed (Boehm, “Suggested Data-Driven Reorganization”), and are believed to be non-controversial:

1. Use COSYSMO 1.0 as a starting point
   - Don’t change anything except as noted below
   - Its effort multipliers are grouped into:
     - Understanding Factors
     - Complexity Factors
     - Operations Factors
     - People Factors
     - Environment Factors

2. Drop the Documentation Match to Life Cycle Needs effort multiplier (EM) from Complexity Factors

3. Regroup the Personnel Experience/Continuity EM under People Factors
Non-controversial (con’t):
4. Handle partial development in some fashion
   – I.e., developing artifacts through only part of the life cycle
   – This is the key part of SEWR and can be part of SEFR
     • From the Generalized Reuse Framework [1]
5. Address interoperability per [6]
   – I.e., model two approaches, then drop one
6. Add CONOPS Understanding as an EM (under Operations Factors)
7. Add Requirements Volatility as a scale factor (per [9])
8. Move Process Capability to be a scale factor
9. Add Architecture and Risk Resolution as a scale factor
10. Add Schedule Compression as part of Architecture and Risk Resolution
Possible Model Features (3/4)

Non-controversial (con’t):

11. Multi-subsystem development

These features have been proposed, and need discussion:

1. Can EMRs and EM values from previous models be used without further calibration?

2. How is the “partial” aspect of partial development to be included:
   – As a modification to size?
   – As an EM?

3. How is the extra cost due to SEFR to be included:
   – As a modification to size, perhaps bundled with the partial development approach?
   – As an EM?
Possible Model Features (4/4)

Need discussion (con’t):
4. How to handle the impact-of-a-step-is-too-large problem (stated in [11])
   – Through a geometric mean approach, per [11]?
   – Through enhanced calibration approaches?
Bibliography (1/2)


Bibliography (2/2)


9. "Quantifying the Impact of Requirements Volatility on Systems Engineering Effort” (presentation), Mauricio Peña, Ricardo Valerdi, October 18, 2012 (COCOMO Forum)


Backup Charts
The Problem

- How much will the total system cost?
- Is one phase being optimized while increasing total cost?
- Is the system affordable?
- Does the acquisition comply with the Better Buying Power initiatives (DoD)?
COSATMO Objective

• Context:
  – Current and future trends create challenges for full-system cost estimation
    • Emergent requirements, rapid change, net-centric systems of systems, COTS, clouds, apps, widgets, high assurance with agility, multi-mission systems
  – Current development practices can minimize cost of one phase, such as development, while raising full-system cost

• The COSATMO project is developing a modern full-system cost model (first space systems, then other DoD domains)
  – “Constructive SATellite cost MOdel”
  – Current estimating models focus on one aspect, such as system engineering
  – COSATMO will enable:
    • System-level trades to be handled within a single model
    • Easy customer evaluation of full-system cost
    • Modern technologies to be covered
COSATMO as a Research Umbrella

- General direction:
  - Develop a full-coverage satellite system cost estimating model
  - Generalize that to additional applications

Specific current research initiatives:
- COSYSMO 3.0
- COCOMO III

Research vehicles:
- My thesis
- Other theses
- Other research
Harmonized COSYSMO 3.0 Multi-Subproject Model

• Sometimes a project consists of multiple subprojects
  – Where the subprojects use significantly different effort multipliers.
  – However, scale factors should apply to the project as a whole.

• Example:
  – Part of a project is SEFR; the rest is not

• The equation below is adapted from Equation 2 of [10] and is based on the Multiple Modules model of COCOMO II
  – When applicable, it supersedes the Top-Level Model

\[
PM_{C3M} = A_{C3} \cdot (Total\ Size_{C3})^E_{C3} \cdot \sum_{s \in \text{Subprojects}} \left( \frac{\text{Subproject}_s \cdot \text{Size}_{C3}}{Total\ Size_{C3}} \cdot \prod_{j=1}^{14+} EM_{C3:s,j} \right)
\]