Lessons Learned From Industrial Validation of COSYSMO

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Outline

• Introduction & motivation
• Summary of lessons from model development (11)
• Industrial validation of COSYSMO (15)
• Application challenges
• The future
Introduction & Motivation

• Constructive Systems Engineering Cost Model (COSYSMO)
  – COCOMO II family
  – Development began in 2001
• Extensive practitioner support
  – ISPA, INCOSE, CSSE Corporate Affiliates, LAI Consortium
• Historical project data & industry calibration enables
  – understanding the model’s robustness
  – establishment of initial relationships between parameters and outcomes
  – validation of drivers
• Challenge is that SE measurement is not standardized
• Model development process yielded 11 lessons learned

Lessons Learned from Development

Lesson #1: Scope of the model
Lesson #2: Types of projects needed for data collection effort
Lesson #3: Size drivers
Lesson #4: Effort Multiplier
Lesson #5: Systems Engineering hours across life cycle stages
Lesson #6: Data collection form
Lesson #7: Definition
Lesson #8: Significance vs. data availability
Lesson #9: Influence of data on the drivers and statistical significance
Lesson #10: Data safeguarding procedure
Lesson #11: Buy-in from constituents
Lessons Learned from Validation

Lesson #1: Skills Needed to use COSYSMO
Provide a list of assumptions/prerequisites for model use as well as the appropriate training/resources for COSYSMO understanding

Lesson #2: Model Usability
Understanding usability will lead to more reliable inputs to the model especially at the early phases of the life cycle where there is little project information available

Lesson #3: Model Adoption
Providing organizations with a sequential process driven by implementation experience will facilitate the adoption of COSYSMO

Lesson #4: Accounting for Reuse
Providing a way to account for reuse in systems engineering is essential for improving the accuracy of the model
Lessons Learned from Validation

Lesson #5: Risk in Cost Estimates
Modeling the probability of the estimate provided by COSYSMO will help assess the risk associated with that estimate as part of the overall risk management strategy for the project.

Lesson #6: Counting Rules
Detailed counting rules can ensure that size drivers, specifically requirements, are counted consistently across the diverse set of systems engineering projects, hence improving the model’s application across organizations.

Lesson #7: Rating Complexity
Guidance on rating complexity via easy, nominal, difficult is necessary to ensure consistent use across organizations.

Lesson #8: Rating Drivers With Multiple Viewpoints
Clarification on how rating levels are averaged between multiple viewpoints is needed to reconcile possible conflicts in the driver interpretations.
Lessons Learned from Validation

Lesson #9: Driver Rating Scales and Polarization
Matching the ratings scales and polarization of drivers made their impact on systems engineering effort easier to understand.

Lesson #10: Overlap of Requirements, Operational Scenarios, Algorithms, Interfaces
Detailed examples need to be provided to prevent double dipping across multiple size drivers.

Lesson #11: Effect of Schedule on Effort
Systems engineering schedule is driven by project-level milestones and is therefore unlike the cube root law in software.

Lesson #12: Life Cycle Coverage
Focus the scope of COSYSMO only on life cycle phases that can be calibrated with historical data.
Lessons Learned from Validation

Lesson #13: Systems Engineering Effort Profile
The capability to model systems engineering effort distribution by phase is necessary since many projects estimate portions of the life cycle rather than the entire lifecycle.

Lesson #14: Local Calibration
Provide ways for individual organizations to self-calibrate COSYSMO.

Lesson #15: Prototypes
Defining prototypical system types will help communicate the application of the model.
Application Challenges of COSYSMO

• Requirements Change throughout system life cycle
  – Difficult to quantify impact of requirements volatility on SE effort

• Estimation needs are more complex than what the data provides
  – Standard WBS vs. detailed systems engineering tasks

• Local calibrations are time consuming
  – Data from multiple homogenous programs is needed to generate a useful calibration
The Future of COSYSMO

- Continued data collection with LMCO, BAE, Raytheon, SAIC, General Dynamics, Northrop Grumman, L-3 Communications
  - Boeing is next
- COSYSMO book (Wiley 2007)
  - “Systems Engineering Cost Estimation with COSYSMO”
- COSYSMO documentation available at: http://www.valerdi.com/cosysmo


