

*Practical Software and Systems Measurement*

# ***Practical Software and Systems Measurement***

***A foundation for objective project management***



***COSYSMO 2.0 Reuse Out-Brief  
Friday, June 26 2009***

***Jared Fortune***

***PSM Users Group Conference  
22-26 June 2009  
Orlando, Florida***

## ***Workshop Participants***

***Mauricio Aguiar***

***Barry Boehm***

***Rick Cline***

***Jared Fortune***

***John Gaffney\****

***Akshat Mathur***

***MIT***

***Garry Roedler***

***Mike Ross***

***Lori Saleski***

***Alex Shernoff***

***Gan Wang***

***Kevin Woodward***

***Ricardo Valerdi\****

***TI Metrics***

***USC***

***Boeing***

***USC***

***Lockheed Martin***

***Lockheed Martin***

***Tecolote***

***BAE Systems***

***BAE Systems***

***BAE Systems***

***Lockheed Martin***

***MIT***

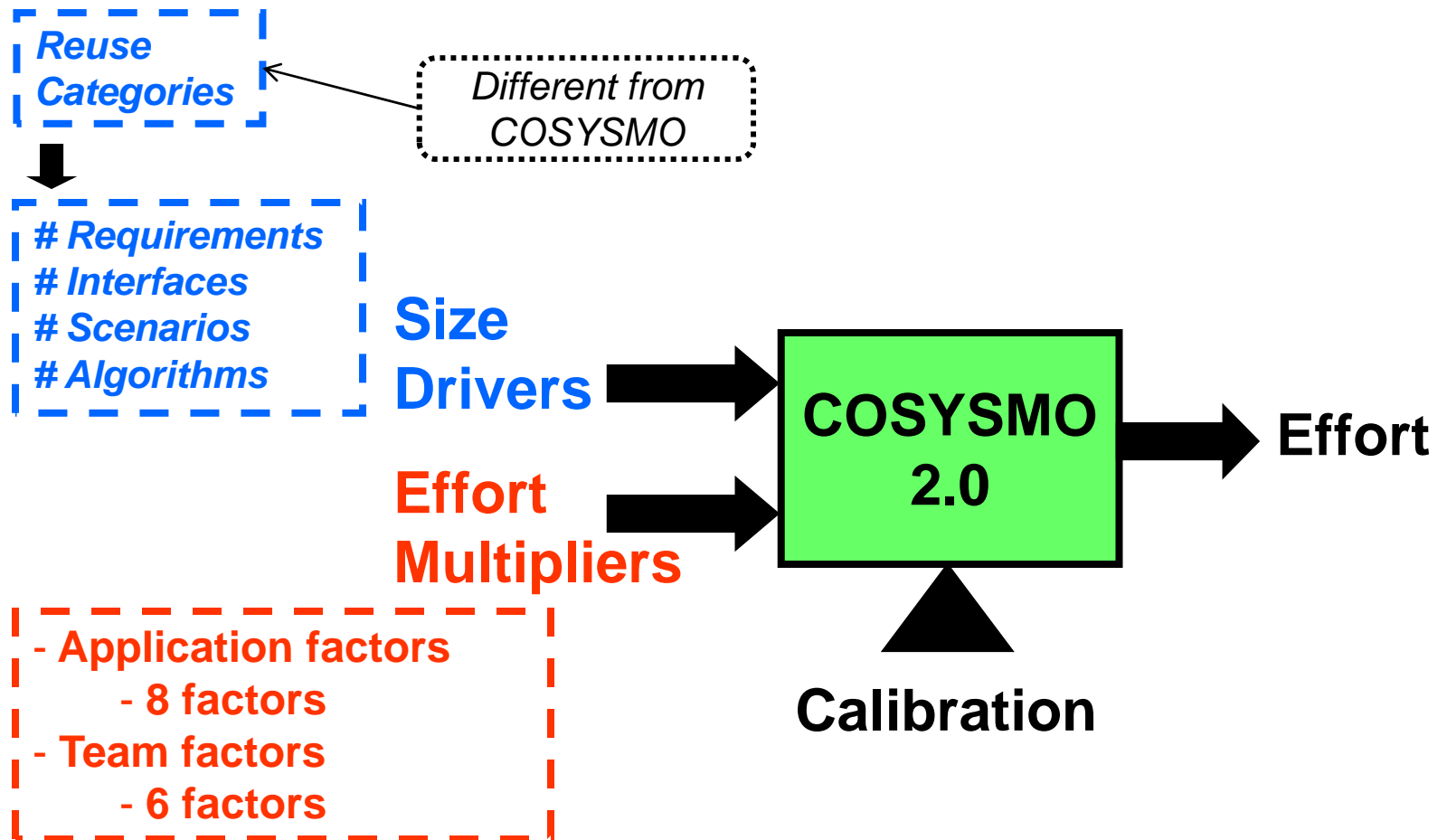
***\* Attended via phone***

***June 2009***

# ***Workshop Summary***

- ***Presented COSYSMO 2.0 model***
  - ***Estimate change in effective size of systems engineering activity with reuse***
- ***Obtained agreement on model methodology***
  - ***Apply six reuse categories to COSYSMO size drivers***
  - ***Adjust COSYSMO size estimate by weights of reuse categories***
- ***Established framework for reuse process in organizations***
- ***Completed two model development exercises***
  - ***Reuse category weighting Delphi***
  - ***Reuse framework convergence***

# **COSYSMO 2.0 Operational Concept**



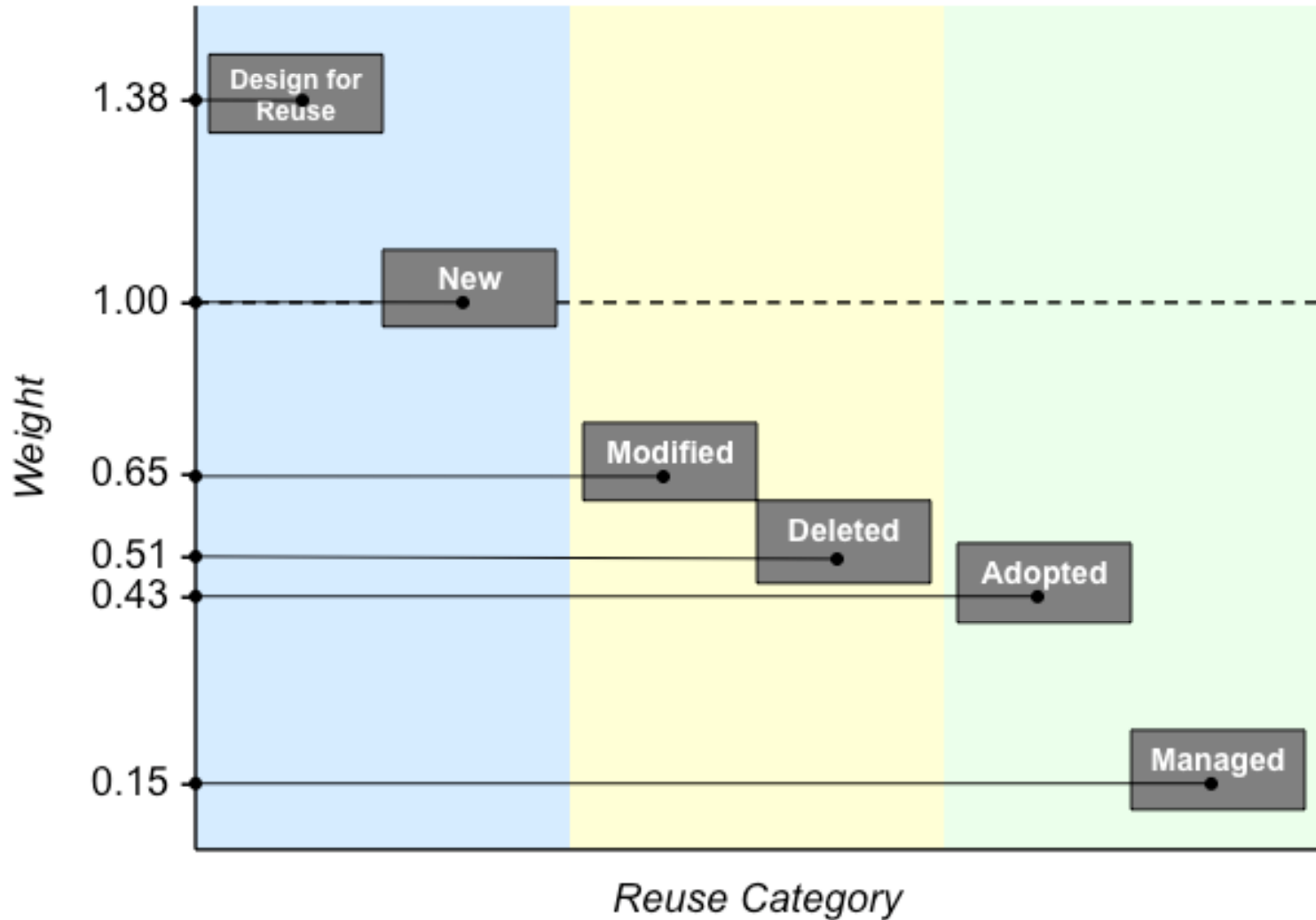
## **COSYSMO 2.0 Reuse Categories**

- 1) **New: artifacts that are completely new**
  - i) **Design for Reuse: artifacts that require an additional upfront investment to improve the potential reusability**
- 2) **Modified: artifacts that are inherited, but are tailored**
  - ii) **Deleted: artifacts that are removed from the system**
- 3) **Adopted: artifacts that are incorporated unmodified (also known as “black box reuse”)**
  - iii) **Managed: artifacts that are incorporated unmodified and with minimal testing**

# Reuse Category Weight Exercise

ISO/IEC 15288-Based Life Cycle Phases		<div> <div>Conceptualize</div> <div>Develop</div> <div>Operate Test &amp; Eval</div> <div>Transition to Operation</div> <div>Conceptualize</div> <div>Develop</div> </div>						
EIA 632-Reuse Activity Cross Walk		SE Activities For DESIGN FOR REUSE				SE Activities For NEW		
Product Realization	20. Implementation	X	X	X	X	X	X	X
	21. Transition to Use	X	X	X	X	X	X	X
Technical Evaluation	22. Effectiveness Analysis	XX	XX	X	X	X	X	X
	23. Tradeoff Analysis	XX	XX	X	X	X	X	X
	24. Risk Analysis	XX	XX	XX	X	X	X	X
	25. Requirements Statements Validation	XX	XX	X	X	X	X	X
	26. Acquirer Requirements Validation	X	X	X	X	X	X	X
	27. Other Stakeholder Requirements Validation	XX	XX	X	X	X	X	X
	28. System Technical Requirements Validation	XX	XX	X	X	X	X	X
	29. Logical Solution Representations Validation	XX	XX	X	X	X	X	X
	30. Design Solution Verification	XX	XX	XX	X	X	X	X
	31. End Product Verification	X	X	X	X	X	X	X
	32. Enabling Product Readiness	X	X	X	X	X	X	X
	33. End Products Validation	X	X	X	X	X	X	X

## ***Reuse Category Weights***

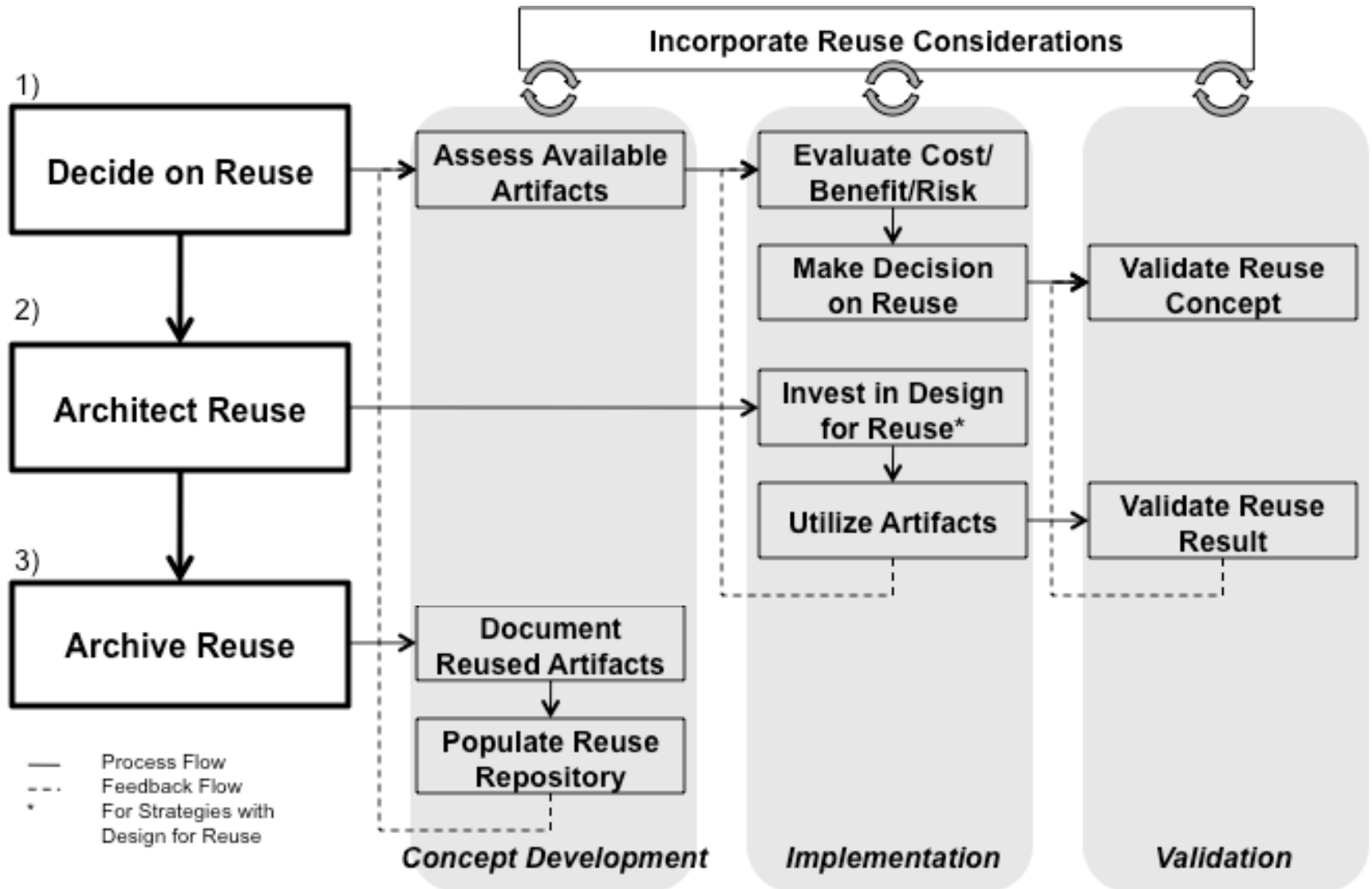


# ***Reuse Framework Exercise***

- ***What should be the process for how systems engineering organizations handle reuse?***
  - ***Where does the quantification of reuse (COSYSMO 2.0) fit?***
- ***General Comments***
  - ***All systems engineering products are fully/partially reusable***
  - ***Evaluation of business case for reuse occurs upfront***
  - ***Risks are high initially, decrease over time with usage***
  - ***Need to have proper assumptions/technical alignment***
- ***Results***
  - ***Major steps with sub-processes and feedback loops***



# ***Reuse Framework***



# **Conclusions**

- ***Finalized COSYSMO 2.0 methodology***
  - *Application of six reuse categories across size drivers*
  - *Adjustment of effective size of systems engineering project*
  - *Maintain compatibility with COSYSMO 1.0 estimates*
- ***Completed derivation of reuse category weights***
  - *Exercise determined weight of “Design for Reuse” category*
- ***Converged on a framework for handling reuse***
  - *Exercise provided “big picture” perspective on reuse and identified where COSYSMO 2.0 fits in to the process*

## **Next Steps**

- **Complete COSYSMO 2.0 development**
  - *Distribute survey to identify range of category weights for opportunistic vs. product-line reuse strategy*
  - *Collect reuse data, calibrate model, validate results*
  - *Conduct case study to validate reuse framework*
  - *Provide update/conclusion at COSYSMO Workshop at COCOMO Forum in November*
- **Continue to explore areas for future COSYSMO research**
  - *Systems engineering project size: improve estimation and enable more consistent estimation*

# Practical Software and Systems Measurement



## Call for Participation

### Background

The USC Center for Systems and Software Engineering (CSSE) and Lean Advancement Initiative (LAI) at MIT in collaboration with the INCOSE Measurement Working Group have initiated the next phase of development of a Systems Engineering Cost Model called COSYSMO. Since the first version of the model was completed in 2005, COSYSMO has been widely accepted and adopted by over a dozen industrial and government organizations. To continually address the needs of the user community, an incremental update to the model is currently underway. This update, called COSYSMO 2.0, will improve the estimation power of the model by accounting for systems engineering reuse. To perform an industry calibration, we are seeking industry data in the form of labor actuals on various types of systems engineering projects that involved a significant amount of reuse.

### Benefits

By providing data for this model your organization will:

- ensure that your particular application domain is addressed by COSYSMO 2.0
- learn to tailor and calibrate the **updated model** for their specific application domain
- enable the **quantification of varying degrees of systems engineering reuse** on project estimates
- be able to claim in **CMMI reviews** that your systems engineering cost estimates are based on calibrated industry models

### Proven Methodology

COSYSMO (Constructive Systems Engineering Cost Model) employs a proven methodology developed for the COCOMO (Constructive Cost Model), the most widely used software cost model in the world.

### Proven Process

USC-CSSE and LAI at MIT have proven processes in place to ensure the confidentiality of the data with its Corporate Affiliates and Consortium Members. Successful data protection has enabled it to attract the participation of several organizations in this effort including Boeing, Raytheon, Northrop Grumman, Lockheed Martin, General Dynamics, SAIC, L-3 Communications, BAE Systems, and the US Air Force Space & Missile Systems Center.

### Contact

Jared Fortune [fortune@usc.edu]  
Ricardo Valerdi [rvalerdi@mit.edu]

