Better Requirements Decomposition Guidelines Can Improve Cost Estimation of Systems Engineering and Human Systems Integration

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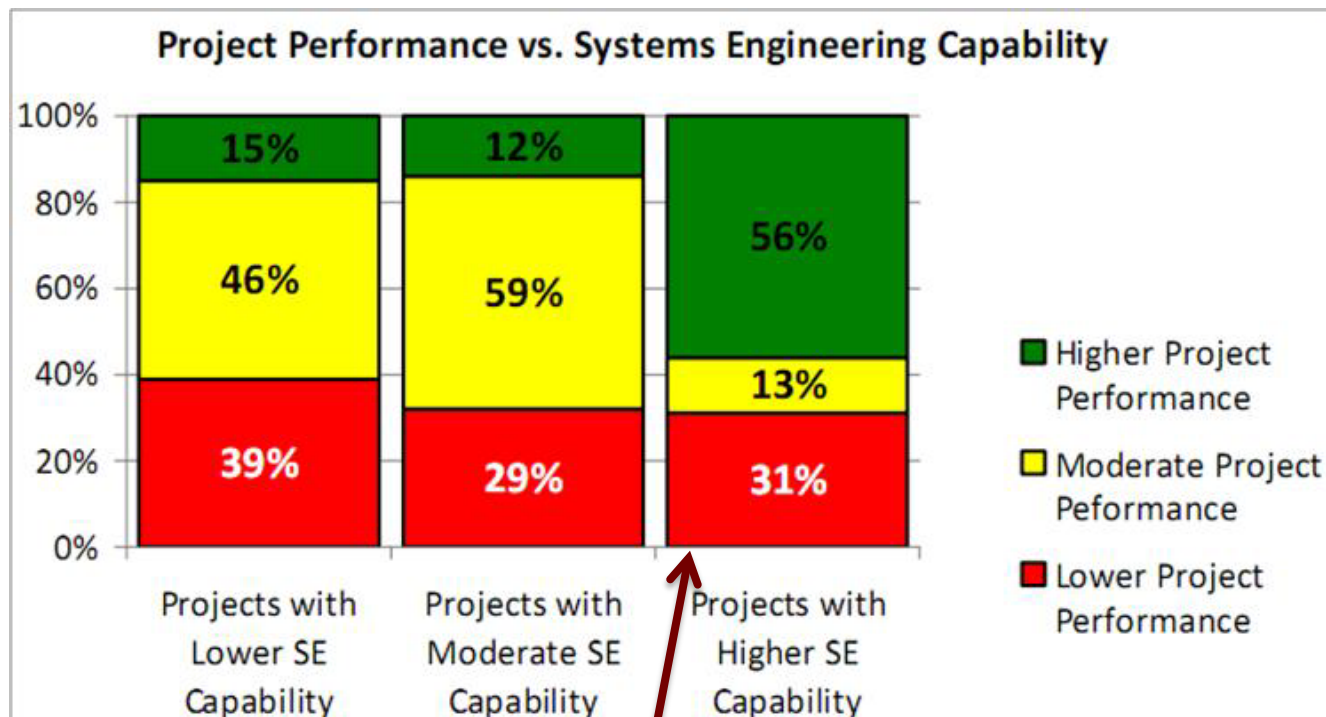Systems Engineering Advancement Research Initiative (SEAri)

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CSER 2010 — conference on systems engineering research

NDIA Survey of SE Effectiveness

Project Performance vs. Systems Engineering Capability

SE is not the answer alone

Motivation-Cost Model

Size Drivers

 # Requirements
 # Interfaces
 # Scenarios
 # Algorithms
+
3 Volatility Factors

Effort Multipliers

- **Application factors**
- **8 factors**
- **Team factors**
- **6 factors**
- **Schedule driver**

CO SYS MO
CONSTRUCTIVE SYSTEMS ENGINEERING COST MODEL

COSYSMO

SE Effort

Calibration

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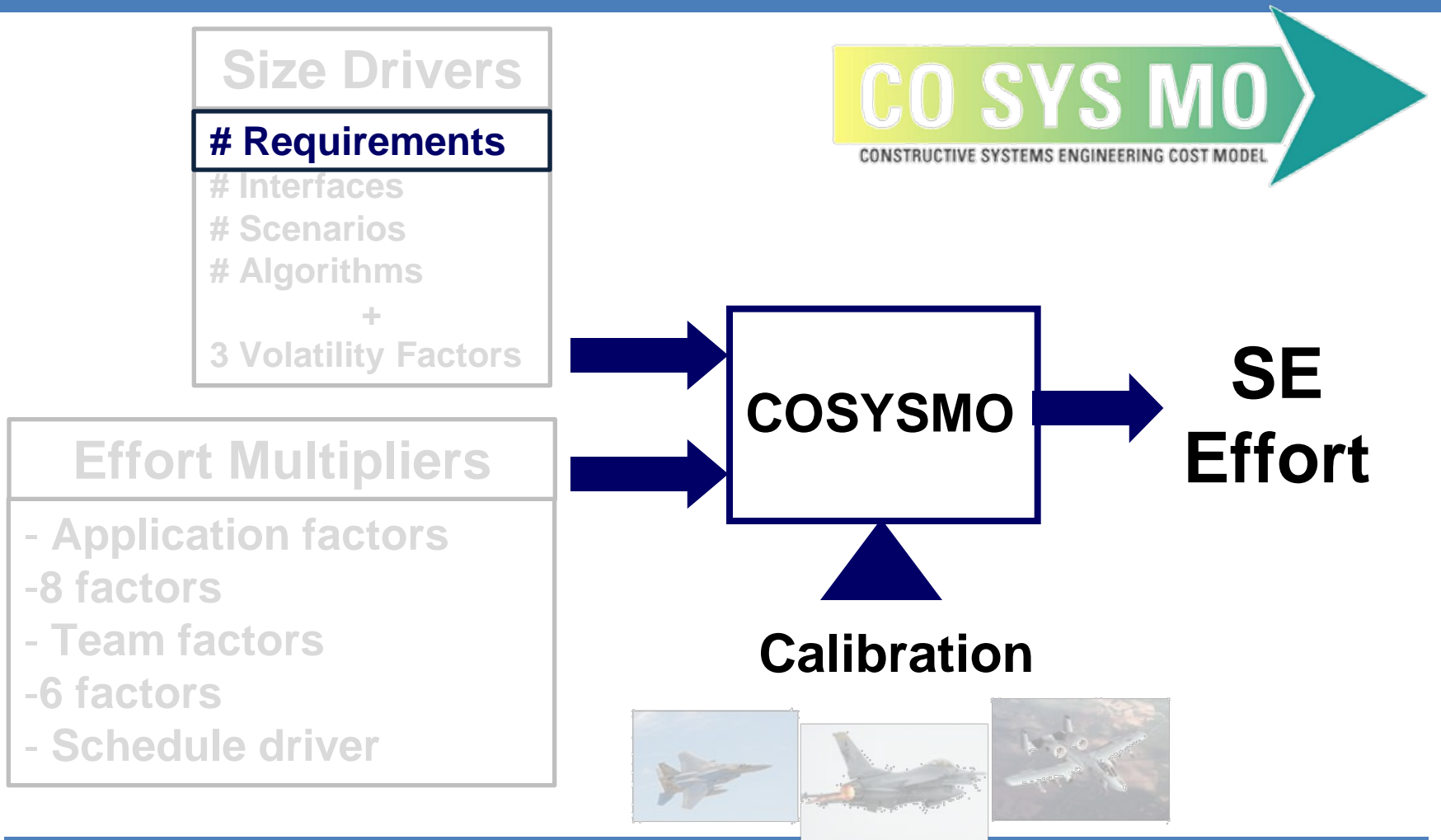
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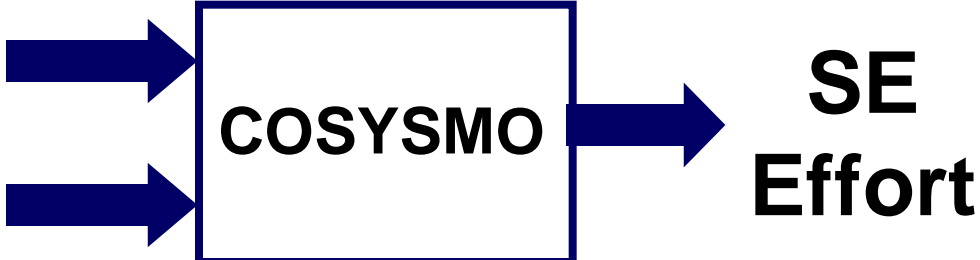
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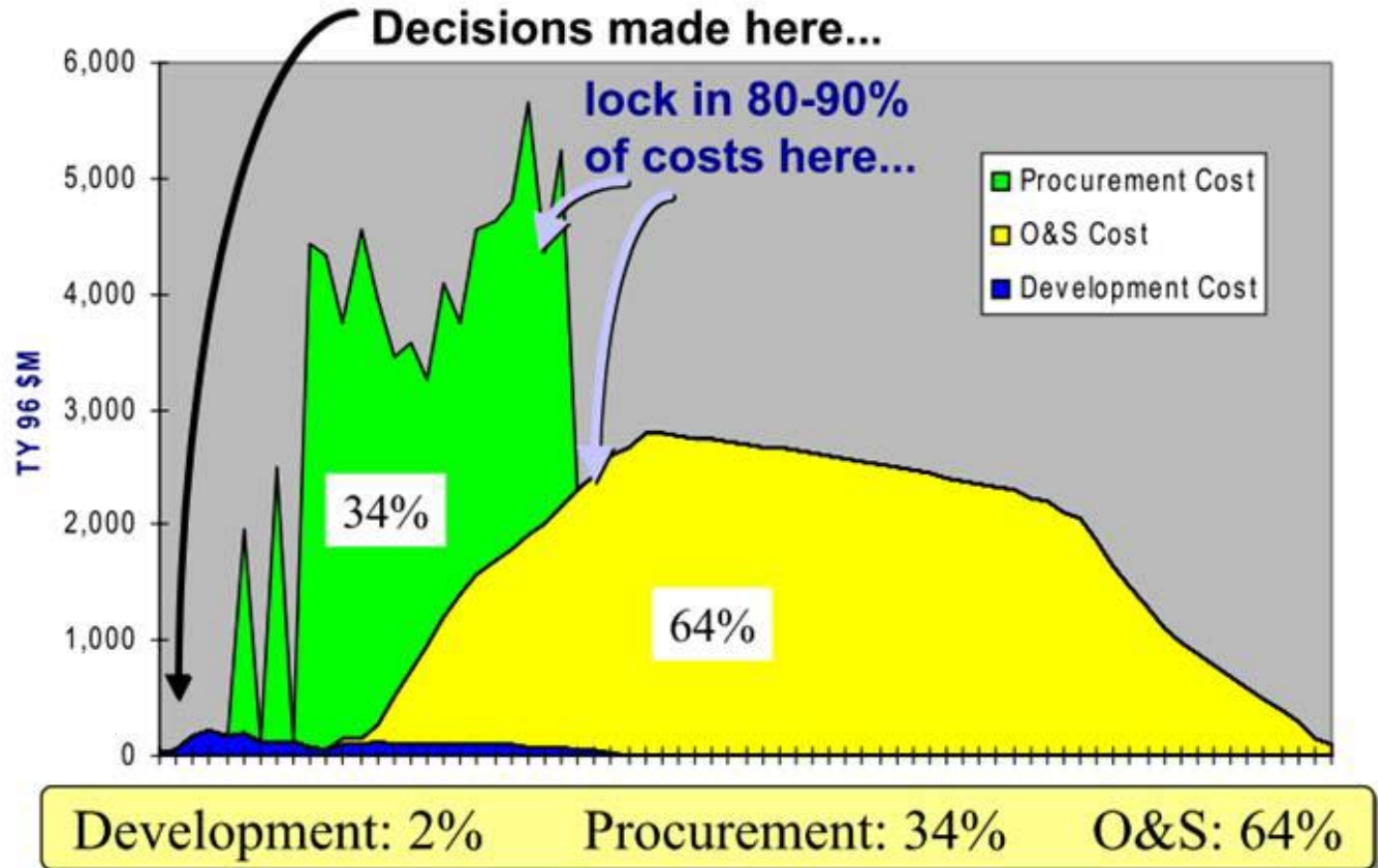-8 factors
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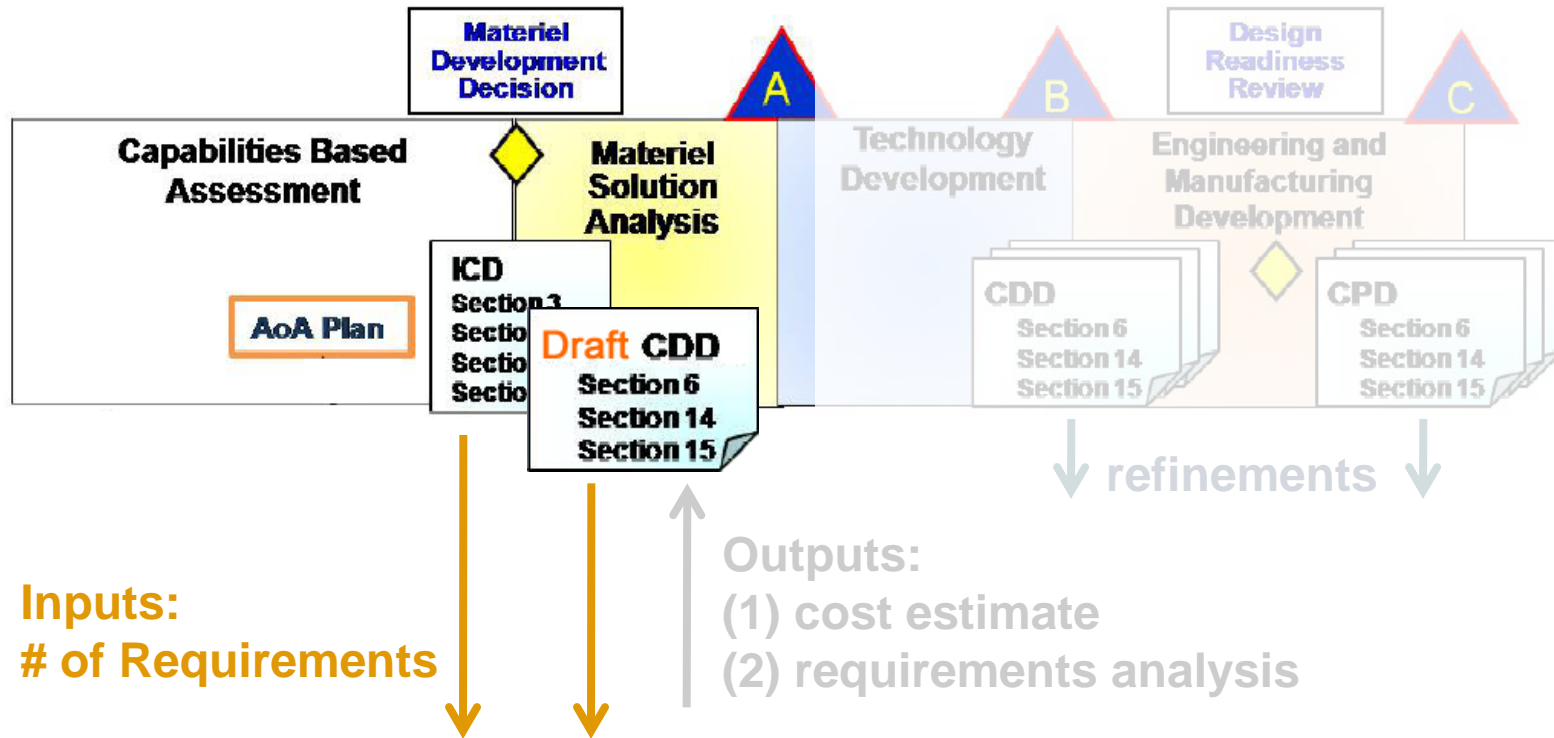- Schedule driver

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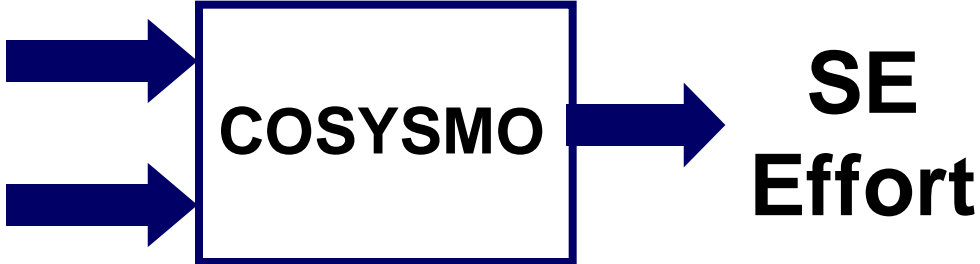
Calibration

Motivation-Early Cost Estimation

"Life Cycle Cost of Surface Combatants." Graph from Mr. Joe Louden NAVSEA TOC Deputy May 24, 2000.

Decisions made here...

lock in 80-90% of costs here...

Procurement Cost
O&S Cost
Development Cost

34%

64%

Development: 2%   Procurement: 34%   O&S: 64%
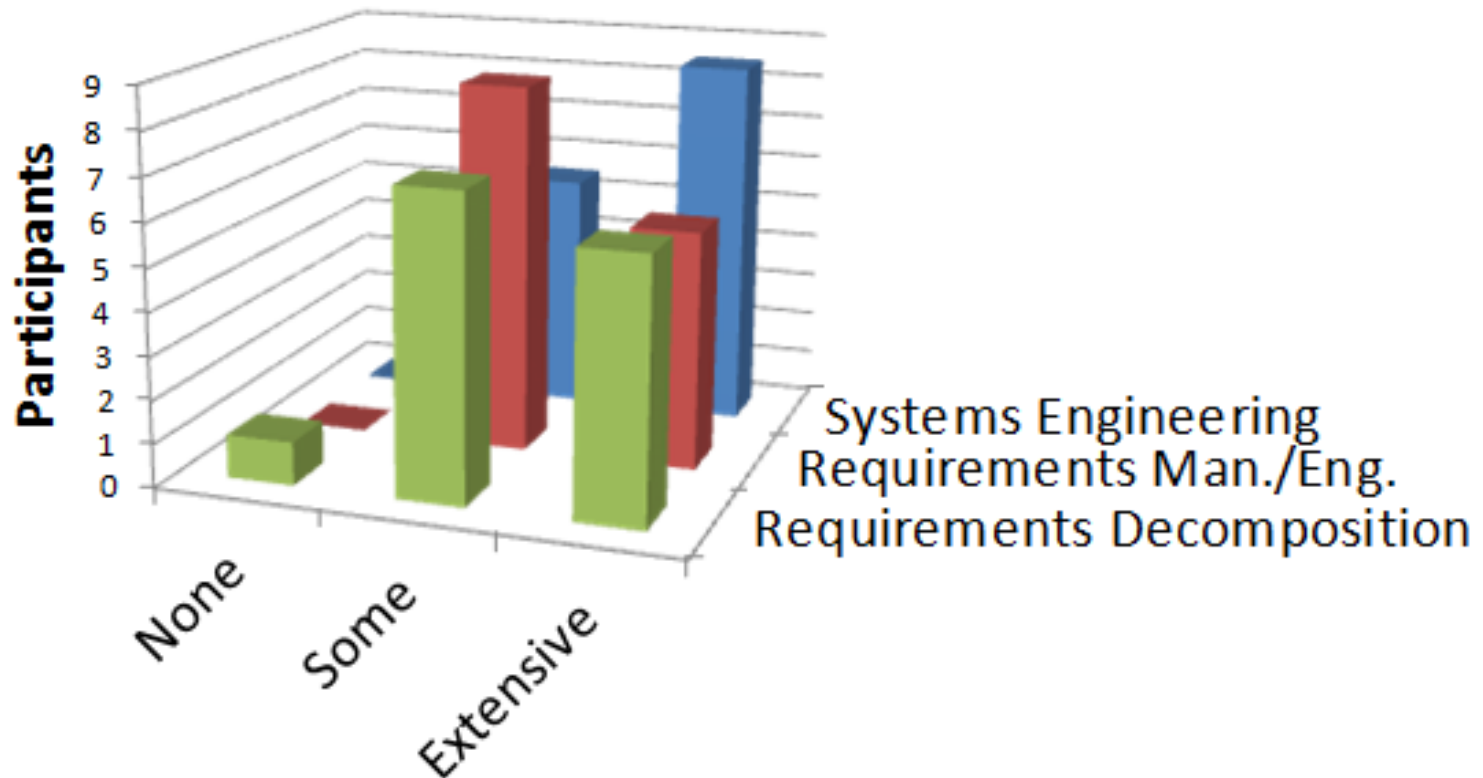
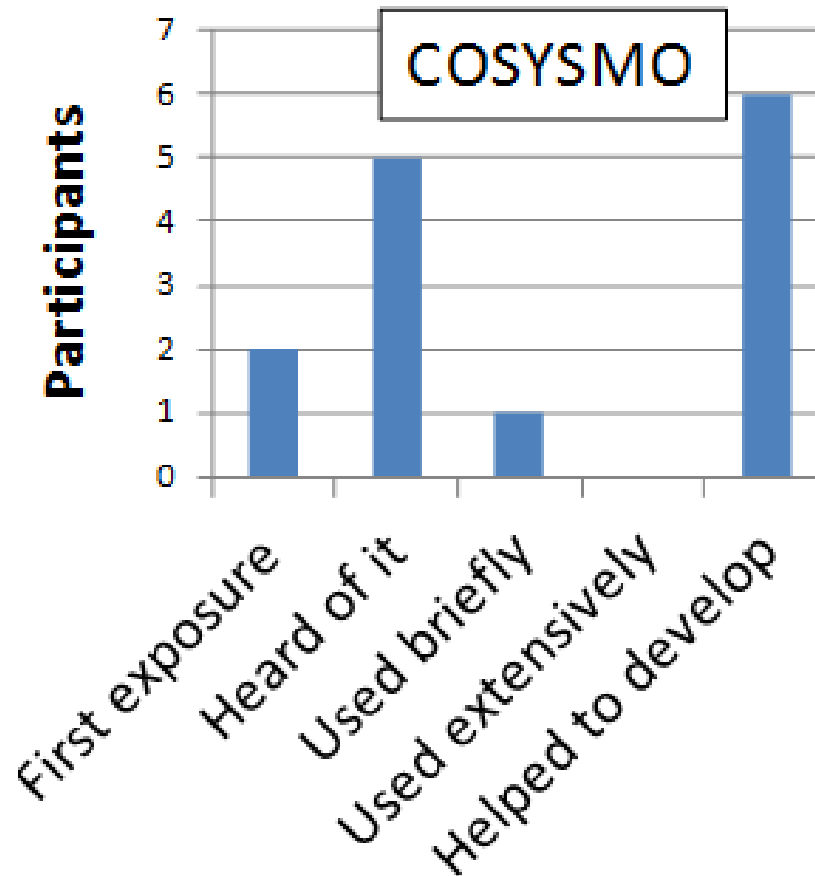# Motivation-Early Cost Estimation

Workshop-Task

Cautions and Warnings. Method for displaying system warnings, cautions, and alarms must be appropriate given the importance of the situation (**Threshold**).
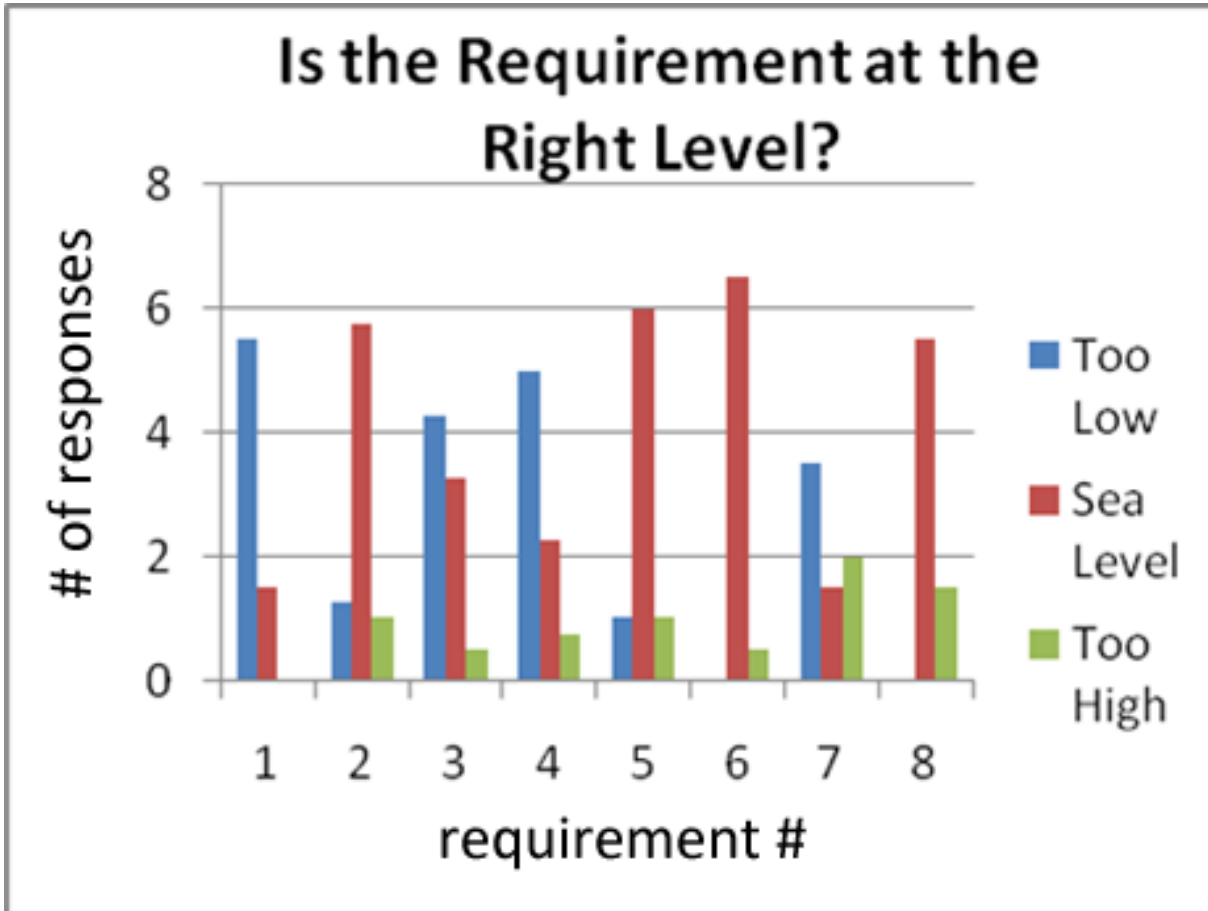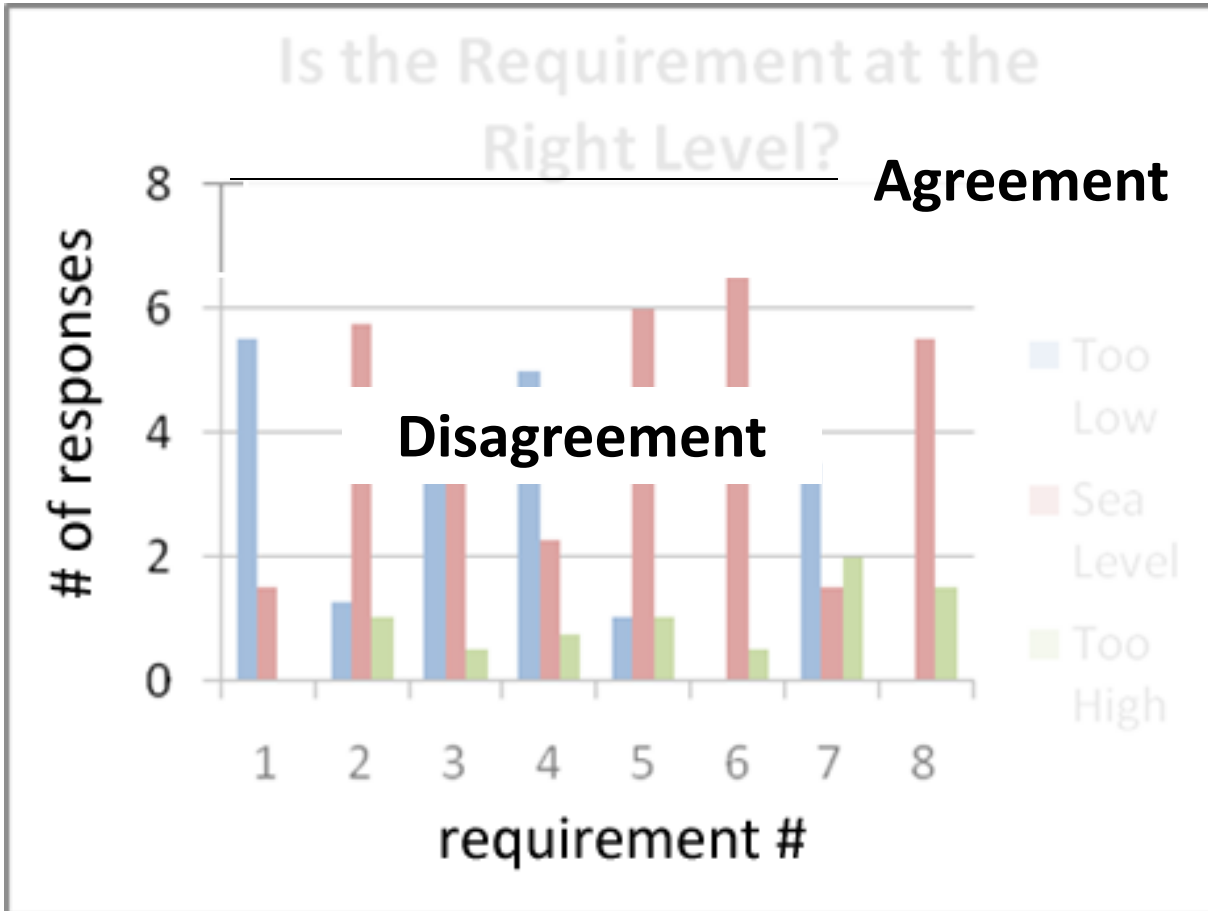
Workshop-Background

Workshop-Background

Is the Requirement at the Right Level?

which one?

Is the Requirement at the Right Level?

Agreement

Disagreement

# of responses — requirement #

Too Low

Sea Level

Too High

which one?

Workshop-Phase 2

Can the Requirement be Tested, Designed, or Verified?

Workshop-Phase 3

How many requirements does this decompose to?
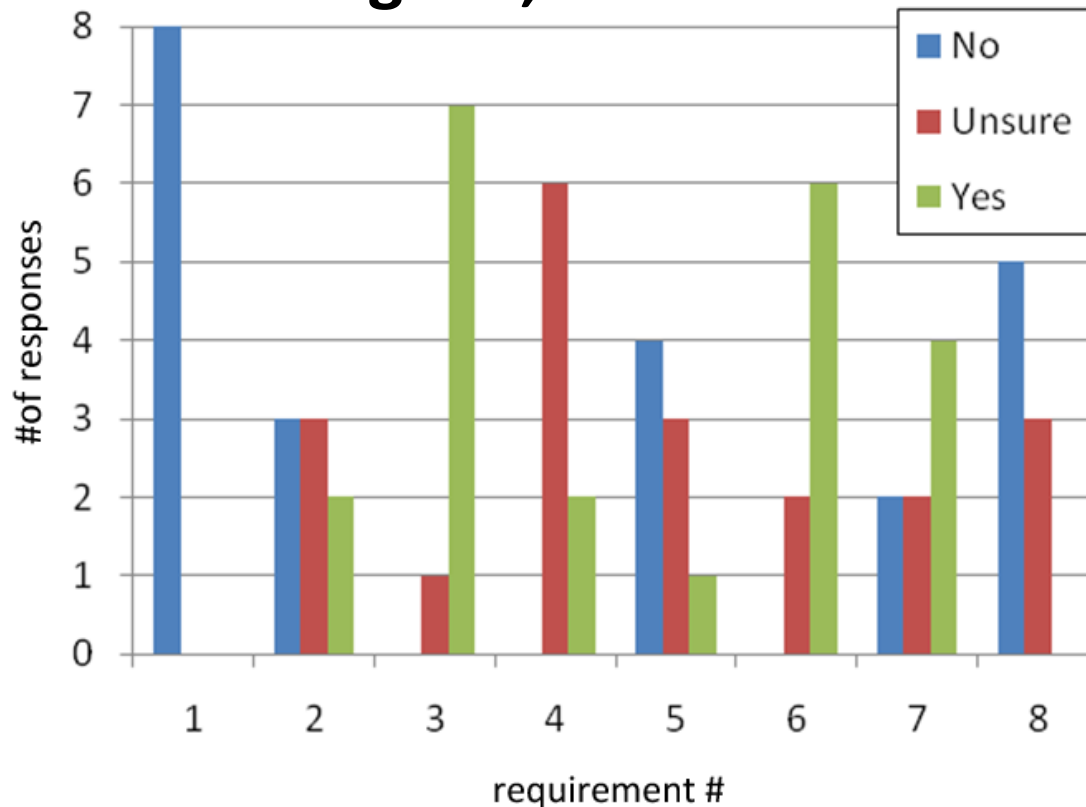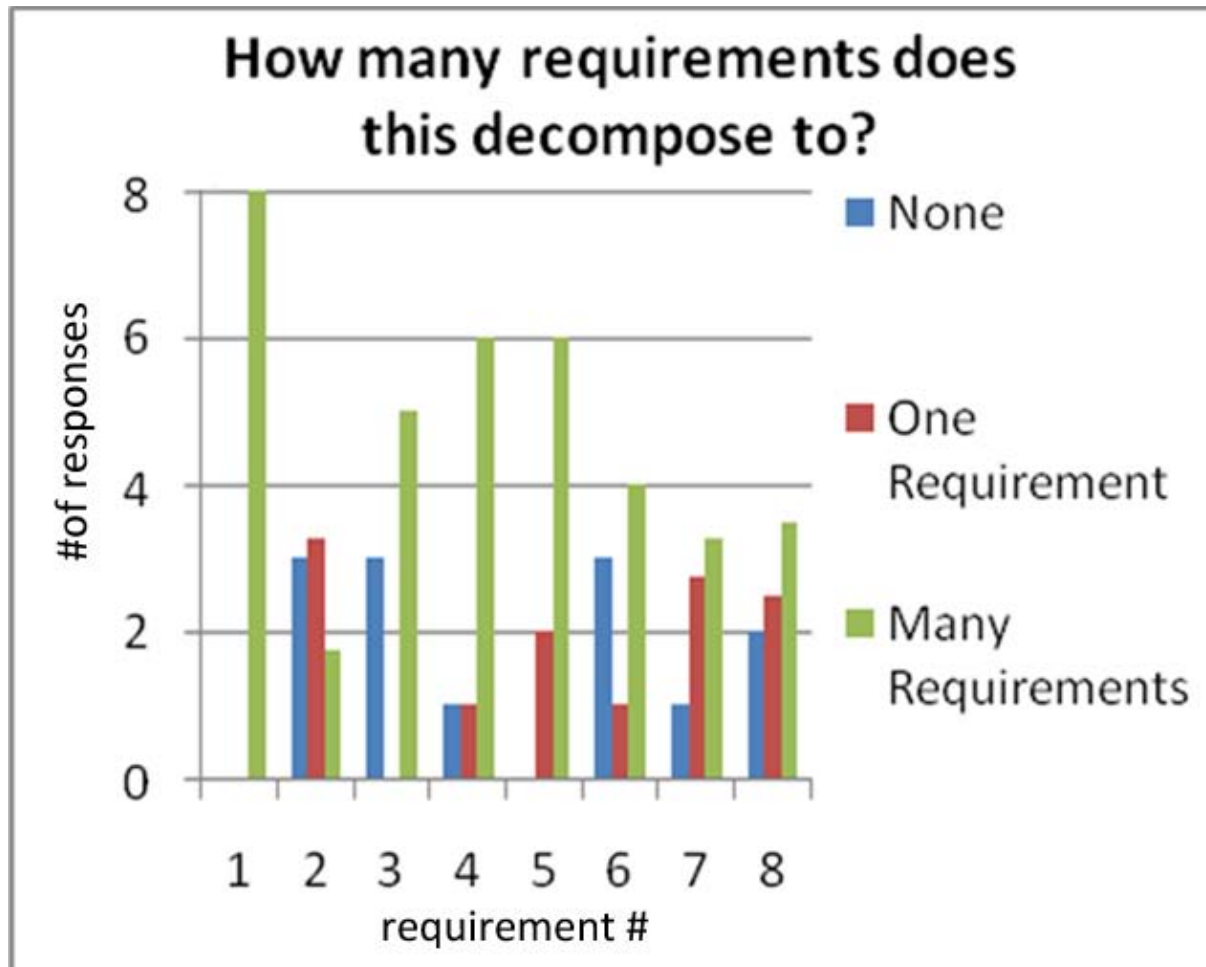
Workshop-Impact

Determine the system-of-interest	**1**	Is the requirement at the correct level?
Can it be tested, **verified** or designed?	**2**	Can it be tested or designed?
Assess System of Interest Relationship with Rest of the System	**3**	How do nonfunctional requirements affect the System-of-interest?
Count Requirements	**4**	Count Requirements
Assess Complexity (Difficulty)	**5**	Assess Complexity (Difficulty)

Takeaways

Bad requirements frustrate experienced and inexperienced alike.

Decomposition guidelines are important - for everyone

Takeaways

Bad requirements **are easy to identify**

Decomposition guidelines highlight what needs to be improved

Takeaways

Nonfunctional requirements cost money.

"**Human factors.** Human factors engineering principles such as specified in MIL-STD-1472 shall be employed in each GCS system solution (**Threshold = Objective**)."

Next Steps

Determine the system-of-interest	1	Is the requirement at the correct level?	
Can it be tested, **verified** or designed?	2	Can it be tested or designed?	
Assess System of Interest Relationship with Rest of the System	3	How do nonfunctional requirements affect the System-of-interest?	
Count Requirements	4	Count Requirements	
Assess Complexity (Difficulty)	5	Assess Complexity (Difficulty)	