Systems Engineering Sizing Via Requirements

GSAW

Strategies for Successful Ground Systems

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Outline

- Model definition
- Sizing
- Current hypotheses
- Problem statement
- Proposed approaches

COSYSMO: Overview

- Parametric model to estimate system engineering costs
- Covers full system engineering lifecycle (per ISO/IEC 15288)
- Estimates standard Systems Engineering WBS tasks (per EIA/ANSI 632)
- Focused on use for
  - Effort estimation
  - Investment Analysis
  - Concept Definition phases estimation
  - Tradeoff analyses
  - Risk analyses

USC-CSE Affiliates (33)

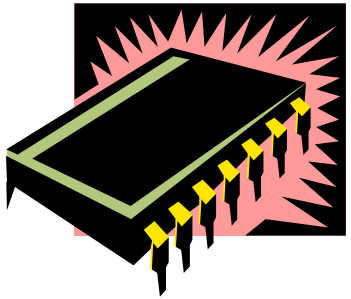
- **Commercial Industry (15)**
  - **Daimler Chrysler, Freshwater Partners, Galorath, Group Systems.Com, Hughes, IBM, Cost Xpert Group, Microsoft, Motorola, Price Systems, Rational, Reuters Consulting, Sun, Telcordia, Xerox**
- **Aerospace Industry (6)**
  - **BAE, Boeing, Lockheed Martin, Northrop Grumman, Raytheon, SAIC**
- **Government (8)**
  - **DARPA, DISA, FAA, NASA-Ames, NSF, OSD/ARA/SIS, US Army Research Labs, US Army TACOM**
- **FFRDC's and Consortia (4)**
  - **Aerospace, JPL, SEI, SPC**

COSYSMO Stakeholders

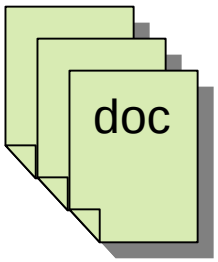
Organization	Expressed interest	Attended Working Group Meeting	Signed NDA	Filled Out Delphi	Contributed Data	Developed Local Calibration	Uses model as primary bid tool
Raytheon	✓	✓	✓	✓	✓	✓	
BAE	✓	✓	✓	✓	✓		
Aero	✓	✓	✓	✓	✓		
LMCO	✓	✓	✓	✓			
Gen Dyn	✓	✓					
Boeing	✓	✓					
L-3	✓	✓					

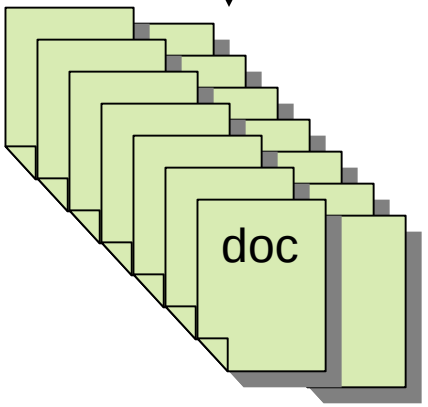
Sizing Views

Physical

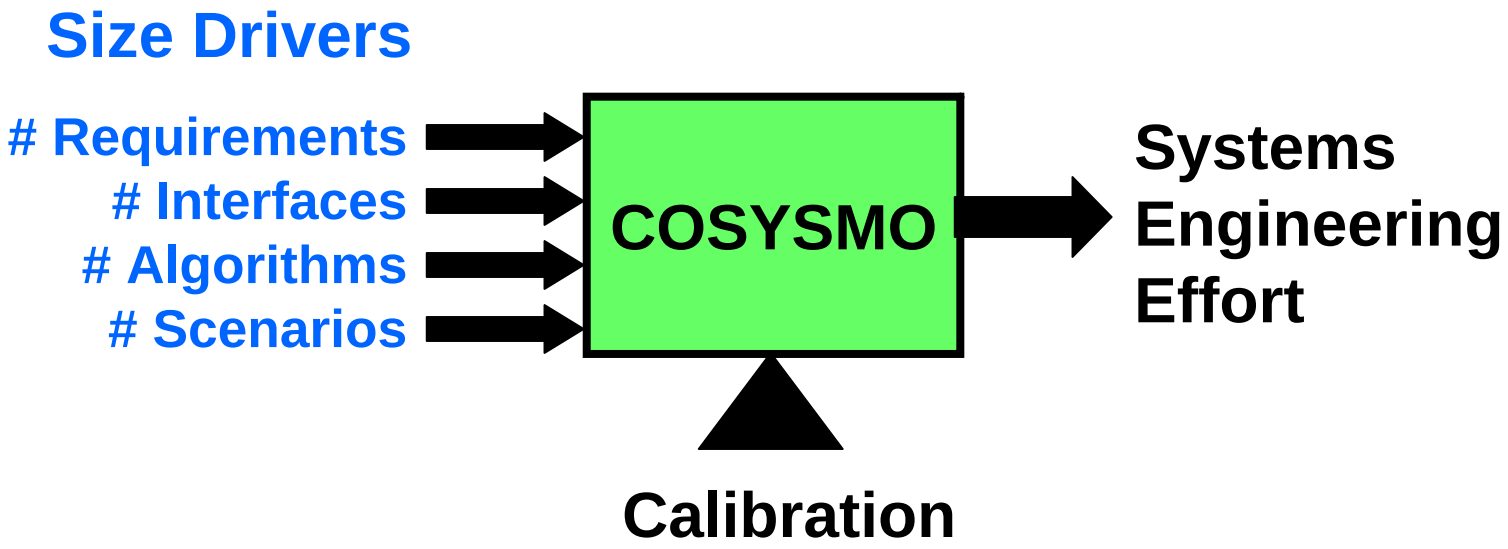


Technical





Hypothesis #1



COSYSMO includes 14 cost drivers

Hypothesis #2

Number of System Requirements

System requirements can typically be quantified by counting the number of applicable “shall’s” or “will’s” in the system or marketing specification.

Easy	Nominal	Difficult
- Well specified	- Loosely specified	- Poorly specified
- Traceable to source	- Can be traced to source with some effort	- Hard to trace to source
- Little requirements overlap	- Some overlap	- High degree of requirements overlap
From Delphi* **0.49**	**1.00**	**4.23**

*Wideband Delphi October 2003 (n=40)

Problem Statement

- We need to formulate specific counting rules for the *# of System Requirements* size driver in COSYSMO
- This involves:
  - Developing specific descriptions of the desired level for counting requirements (what level is too high? too low?)

Previous Approach

Proposed analogy to function point "files" concept

of System Requirements

System Level (too high): The system shall provide notification of out-of-tolerance inputs and outputs to authorized parties.

File Level (about right): Each system component has one or more files of parameters to monitor, report exceptions, and adjust tolerances in a familiar way.

Parameter Level (too low): The system shall determine that the temperature T at point P, is between T11 and T12, and report exceptions to the safety monitor.

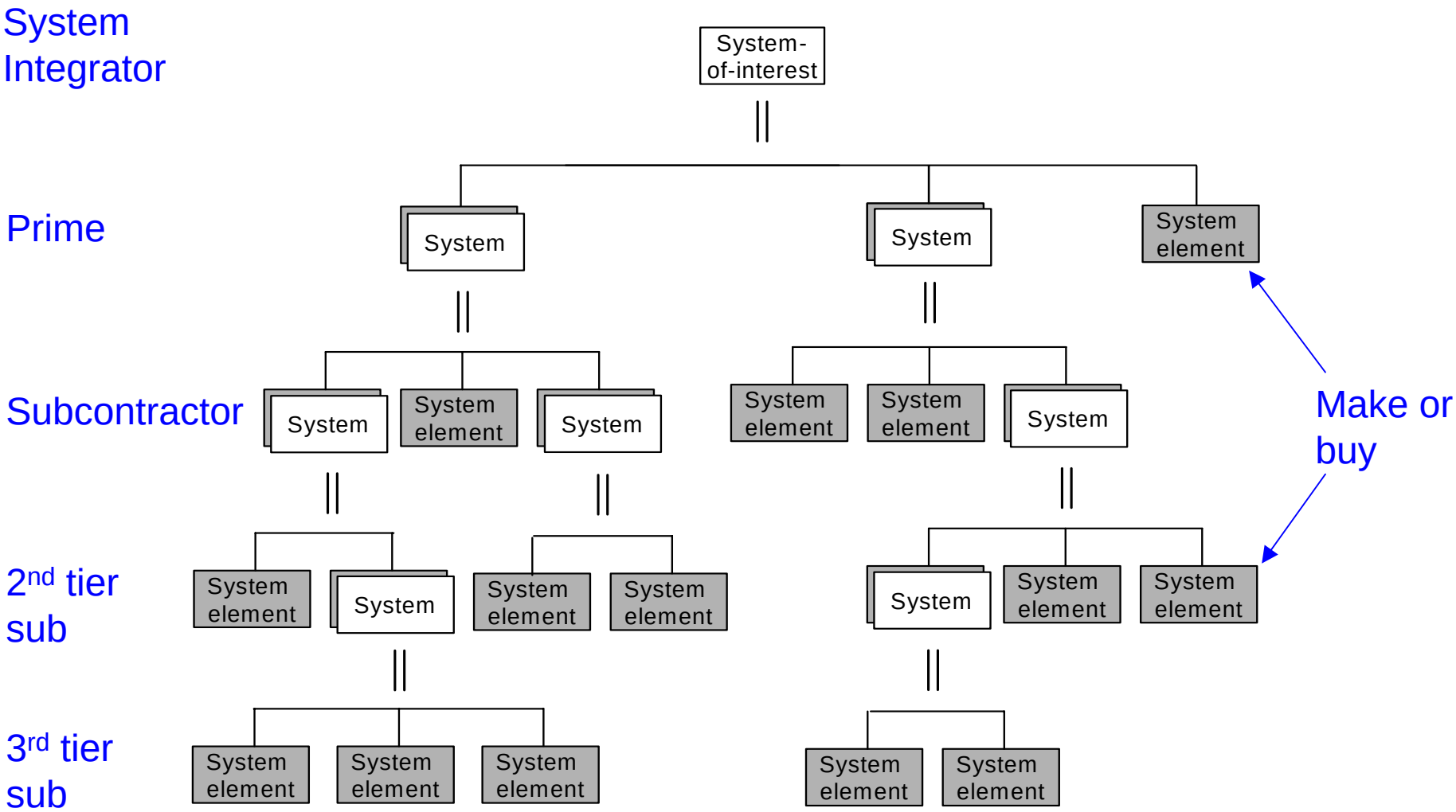
Proposed Approach

1. Determine the system of interest.
2. Decompose system objectives, capabilities, or measures of effectiveness into requirements that can be verified or designed.
3. Provide a graphical or narrative representation of the system of interest and how it relates to the rest of the system (if applicable).
4. Count the number of requirements in the system or marketing specification for the highest level of design in the desired system of interest. Make sure that all counted requirements are at the same design or bid level. Do not count the lower level requirements.

OR

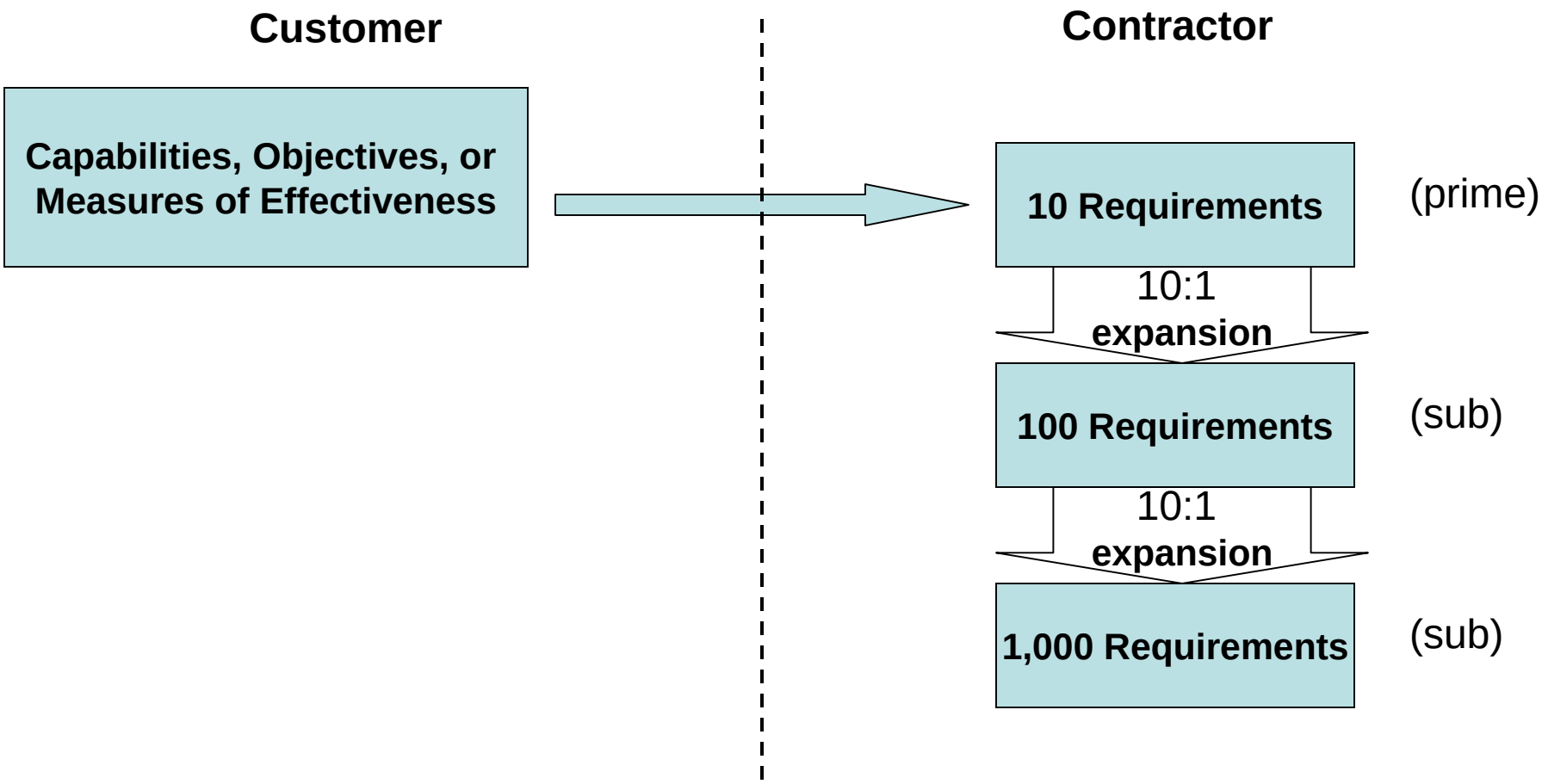
4. Count the number of requirements in your verification trade matrix for the highest level of design in the desired system of interest. Make sure that all counted requirements are at the same design or bid level. Do not count the lower level requirements.
5. Determine how many requirements are easy, nominal, or difficult.

Point #1: ISO/IEC 15288 System of Interest Structure



Source: ISO/IEC 15288.

Point #2: Decompose customer inputs into requirements



Next Steps

- Refine definition
- Apply the same ideas to # of Interfaces and # of Operations Scenarios
- Develop example from satellite exemplar system

Questions or Comments?

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