

Systems Engineering Sizing in the Age of Acquisition Reform



Ricardo Valerdi, USC

Michael Ernstoff, Consultant

Paul Mohlman, The Aerospace Corporation

Don Reifer, USC/RCI

Evin Stump, Galorath

Outline

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- **Models examined**
- **Areas of Analysis**
- **Life Cycle Stages**
- **Current SE Effort Sizing Approaches**
- **Discussion & Recommendations**
- **Conclusions & Future Research**

Goals

- **Discuss current estimating models that address System Engineering (SE) components**
- **Compare genesis, assumptions, and applicability of these models**
- **Suggest future research to foster matured estimation of SE size, resources and cost**

Models Examined

Model Name	Owner/Developer
Constructive Cost Model	USC
PRICE-Hardware	PRICE Systems
PRICE-Software	PRICE Systems
Raytheon SE Resource Forecasting Tool	Raytheon
SEER-Hardware	Galorath
SEER-Software Engineering Model	Galorath
Small Satellite Cost Model	The Aerospace Corp.
Unmanned Satellite Cost Model	Los Angeles Air Force Base

■ Hardware domain
 ■ Software domain

Areas of Analysis

- 1. Model inputs for software or hardware size**
- 2. Definition of Systems Engineering**
- 3. Model inputs for Systems Engineering**
- 4. Life Cycle stages used in the model**
- 5. Domain of applicability**

Life Cycle Stages Compared

<u>Model</u>	<u>Life Cycle Stages</u>									
COCOMO II	Inception			Elaboration			Construction		Transition	
PRICE-S	Concept	System Reqs	S/W Reqs	Pre Design	Detailed Design	Code/unit test	I&T	H/W & S/W Int	Field Test	
SEER-SEM	Sys Concpt	Reqs Design	S/W Req Analys	Pre Design	Detail Design	Code & Unit Test	I&T	Program Test	OT&E	Ops Support
PRICE-H	Initial concept		Design			Production		Operation	Disposal	
RSERFT	Mgmt Plan	System Design	System Analys	Specs & I/F	Status & Reviews	Test Plans	Test & Delivery	AI&T	V&V	Support
SEER-H	Development			Production			Operations		Support	
SSCM	Inception		Development			Launch		Orbital Ops Support		
USCM8	Inception		Development			Launch		Orbital Ops Support		

Current SE Effort Sizing Approaches

Software: Total size via SLOC, use cases, Function Points, Application Points, Predictive Object Points, etc.

Hardware: Total size via satellite weight, printed circuit board count, component sizes, # of communication channels, system complexity, etc.

- **SE effort obtained from total estimated effort, phase/activity distributions**
- **Calibrated from project data on SE Work Breakdown Structure Elements**

Discussion & Recommendations

- **Most current estimation tools:**
 - Use “rules of thumb” to estimate SE effort
 - Treat SE as a subset of a software or a hardware effort
 - Largely ignore the scope of SE
- **SE should be:**
 - Treated as an independent discipline
 - Forecasted based on the resource needs required by particular SE tasks

Conclusions & Future Research

- **Parameters must be established to quantitatively characterize SE resources**
- **Data is needed to calibrate SE parameters and develop Cost Estimating Relationships**
- **Better definition of SE in current models would help improve sizing methods**

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