

THE FORGOTTEN COSTS AND UNCERTAINTY ANALYSIS WITHIN THE DOD ACQUISITION ENVIRONMENT

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Introduction

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» Objective

- » Assist in developing reliable and relevant life-cycle cost estimates
- » Provide a holistic view of O&S cost estimating

» Scope

- » Overview of a high-level methodology and disciplined process to account for uncertainty within LCCEs
- » Improve decision making strategies by providing the studies, publications, and web sites that assist in the development of reliable LCCEs



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O&S COSTS



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Background on Forgotten Costs

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- » Acquisition Category (ACAT) Designation
 - » Provides a short-term perspective of supporting user requirements and system capabilities
 - » Overlooks the long-term perspective of the O&S costs of the system
- » Defense Acquisition Community
 - » Consistently trades down-stream supportability for required capability and program survival



ACAT Designation Focus

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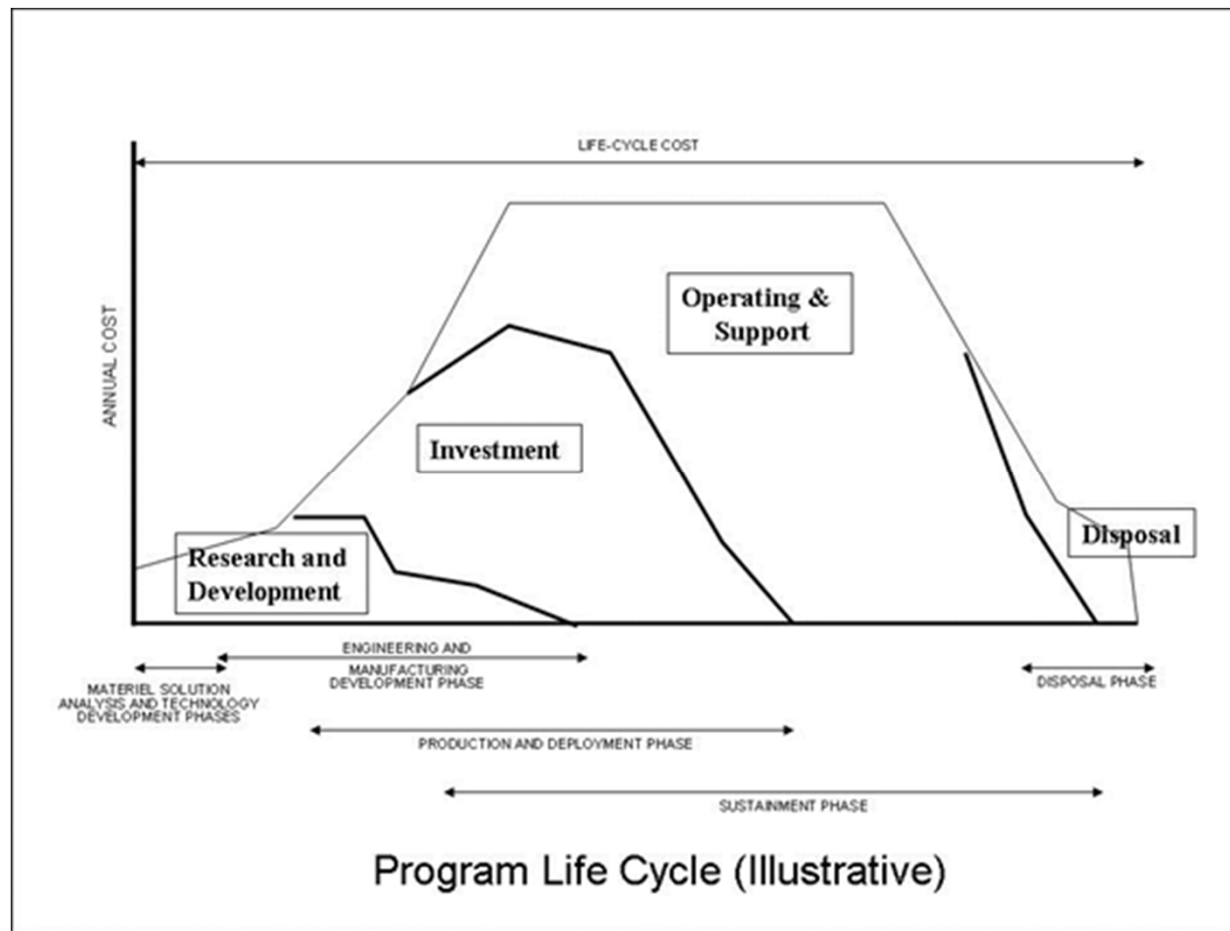
ACAT I	<ul style="list-style-type: none">• MDAPs (10 U.S.C. §2430)• RDT&E total expenditure > \$365 million in Fiscal Year (FY) 2000 constant dollars, or• Procurement total expenditure > \$2.190 billion in FY 2000 constant dollars, or• MDA designation as special interest
ACAT II	<ul style="list-style-type: none">• Does not meet the criteria for ACAT I• Major Systems (10 U.S.C. §2302(5))<ul style="list-style-type: none">• RDT&E total expenditure > \$140 million in FY 2000 constant dollars, or• Procurement total expenditure > \$660 million in FY 2000 constant dollars, or• ASN(RD&A) designation as special interest• Not applicable to IT system programs
ACAT III	<ul style="list-style-type: none">• Does not meet the criteria for ACAT II or above• Weapon system programs:<ul style="list-style-type: none">• RDT&E total expenditure ≤ \$140 million in FY 2000 constant dollars, or• Procurement total expenditure ≤ \$660 million in FY 2000 constant dollars, and• Affects mission characteristics of ships or aircraft or combat capability• IT system programs:<ul style="list-style-type: none">• Program costs/year ≥ \$15 million ≤ \$32 million in FY 2000 constant dollars, or• Total program costs ≥ \$30 million ≤ \$126 million in FY 2000 constant dollars, or• Total life-cycle costs ≤ \$378 million in FY 2000 constant dollars



Program Life Cycle

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» O&S is about 60 – 70 percent of a program's life-cycle cost



Role of O&S Cost Estimate*

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<u>Stage</u>	<u>Focus</u>
MSA	<ul style="list-style-type: none">• Obtain enhanced visibility of O&S costs and key cost drivers<ul style="list-style-type: none">– Support to trade-off studies– Support to Analysis of Alternatives• Establish initial affordability target (average annual O&S cost per unit or system)
MSB	<ul style="list-style-type: none">• Ensure early influence on system design<ul style="list-style-type: none">– Adequate attention and investment in logistics engineering efforts• Assist the Product Support Business Case Analysis<ul style="list-style-type: none">– Organic versus CLS– Goals for Performance Based Logistics, Reliability/Maintainability/Availability• Update affordability O&S target and establish as formal requirement to be used for subsequent assessment of performance over the life cycle
MSC	<ul style="list-style-type: none">• Track and assess current O&S estimate relative to prior "affordability requirement"<ul style="list-style-type: none">– Early use of T&E data– Provide insights into sustainability shortfalls and help identify appropriate mitigation actions• Update Product Support Business Case Analysis• Provide foundation for budgetary requirements (manpower, major O&M elements)
FRP DR	<ul style="list-style-type: none">• Track and assess current O&S estimate relative to prior estimates and "affordability requirement"<ul style="list-style-type: none">– Early use of O&S cost actual experience• Refine Product Support Business Case Analysis• Update estimates of budgetary requirements
Post-IOC	<ul style="list-style-type: none">• Assess and manage O&S trends for legacy systems• Assess needs for continuing system improvements/modifications or recapitalization• Assess adequacy of programmed sustainment funding

Note: *As the DoD continues to be plagued by cost over runs, and inadequate attention to O&S costs, accurately estimating life-cycle costs for acquisition programs is becoming more vital in severely budget-constrained environments.

Appropriations

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- » RDT&E
 - » Available for obligation for 2-years and is incrementally funded
 - » It is both an investment and expense type cost
- » Procurement
 - » Used to finance investments, available for obligation for 3-years
 - » Funded using full funded policy
- » O&M
 - » Used to finance O&S efforts, available for obligation for 1-year
 - » Funded using the annual funding policy (yearly business cycle)
- » Military Construction
 - » Used to support construction projects, available for obligation for 5-year

Applicable References

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- » DoDI 5000.2
 - » Operations and Support Phase Section
 - » Life-Cycle Sustainment
 - » Disposal
 - » Acquisition of Services (Enclosure 9)
 - » Acquisition Planning
 - » Data Collection
 - » System Engineering
 - » System Engineering Plan (SEP)
 - » Data Management and Technical Data Rights



Applicable References (cont'd)

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DoD 5000.4-M

Chapter 1: CARD Content

- » System Configuration
- » Government Furnished Equipment
- » System Technical & Physical Description
- » Software Description (factors that influence maintenance costs)
- » System Quality Factors (Reliability, Availability, and Maintainability)
- » Portability and Transportability
- » Predecessor and/or Reference System
- » Risk (O&S)
- » System Operational Concept
 - » Organizational Structure
 - » Basing and Deployment Description
 - » Logistics (support concept, supply, and training)
- » Quantity Requirements
- » System Manpower Requirements
- » System Activity Rates
- » Acquisition Plan and/or Strategy
- » Operational Support Facilities
- » Contractor Cost Data Reporting (CCDR) Plan

Applicable References (cont'd)

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DoD 5000.4-M

Chapter 2:

- » Operating and Support Life Cycle Cost Categories WBS

Chapter 3: Cost Terms

- » Operating and Support Cost Categories Definitions

Chapter 4: VAMOSC Program

- » Requirements
- » Use of VAMOSC Data



Applicable References (cont'd)

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MIL-STD-881C

- » Common Elements Appendix “L”
 - » Sustainment/Contractor Logistics Support “L.7”

O&S Support Guide

- » Role of O&S Cost Information
- » O&S Cost Data
- » O&S Cost Estimating Process
- » OSD Cost Element Structure

UFC-3-700 Series

- » UFC-3-701 DoD Facilities Pricing Guide
- » UFC-3-730 Programing Costs Estimates for Military Construction
- » UFC-3-740 Handbook Construction Cost Estimating

Web Sites

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- » The Navy Visibility and Management of Operating and Support Costs (VAMOSOC) at <https://www.vamosoc.navy.mil/>
- » Unified Facilities Criteria (UFC) site at http://www.wbdg.org/ccb/browse_cat.php?c=4
- » Defense Cost and Resource Center (DCARC) at <http://dcarc.cape.osd.mil/Default.aspx>
- » Army O&S Cost web site at <https://www.osmisweb.army.mil/>
- » Air Force Total Ownership Cost (AFTOC) site at <https://aftoc.hill.af.mil/Portalpage/index.asp>
- » The Naval Center for Cost Analysis (NCCA) site at <http://www.ncca.navy.mil/>

Studies

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- » Berteau, D., Hofbauer, J., Sanders, G., and Ben-Ari, G. (2010). Cost and Time Overruns in Major Defense Acquisition Programs. Ft. Belvoir: Defense Technical Information Center.
- » Cancian, M. (2010). Cost Growth: Perception and Reality. Defense Acquisition University.
- » Ryan, E. T., Jacques, D.R., Ritschel, J.D., and Schubert, C.M. (2012). Characterizing The Accuracy Of DoD Operating And Support Cost Estimates.
- » Ryan, E. T., Jacques, D.R., Ritschel, J.D., and Schubert, C.M. (2012). A Macro-Stochastic Model for improving the Accuracy of DoD Life Cycle Cost Estimating.
- » U.S. GAO (July 2010). DoD needs Better Information and Guidance to More Effectively Manage and Reduce Operating and Support Costs of Major Weapon Systems.



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COST UNCERTAINTY ANALYSIS



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Cost Overruns

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16

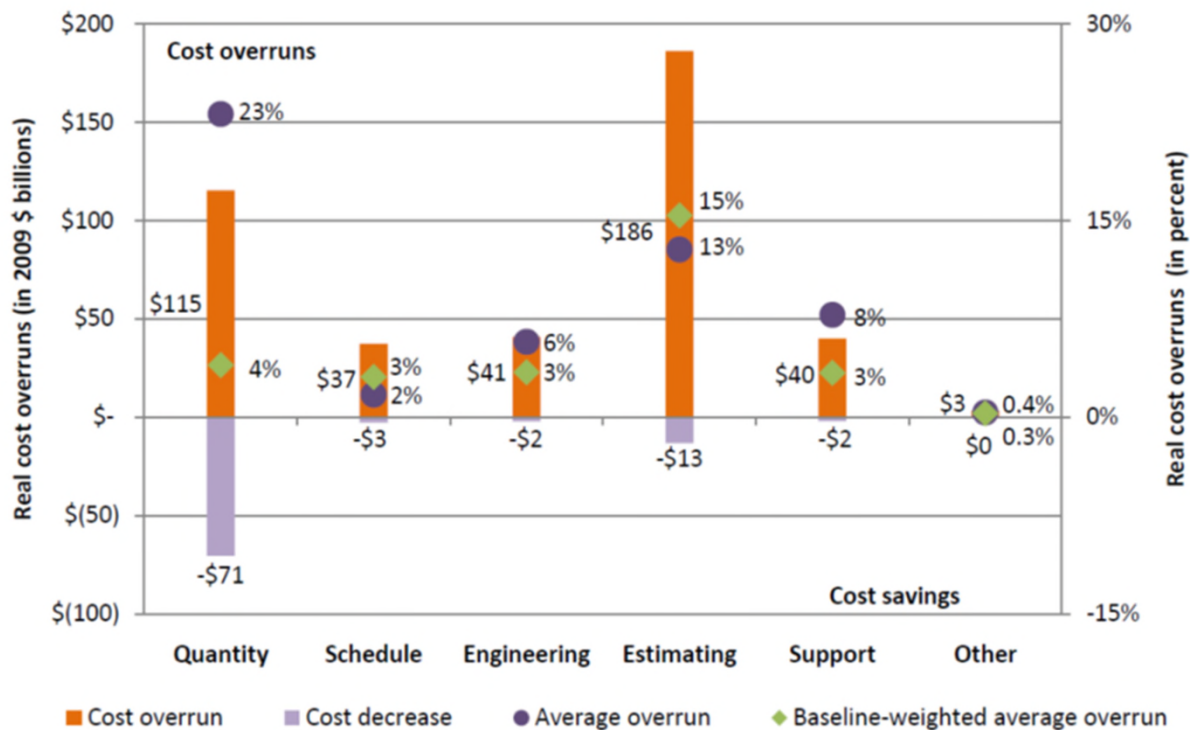
- » FY2010 MDAPs created a cumulative cost overrun totaling \$402 billion¹
- » “...inaccurate cost estimates are responsible for the strongest correlation with net cost growth changes and are associated with 40% of the accumulated cost overrun.”¹
- » Excessive cost overruns forces the Department of Defense to reallocate money from other programs

¹ Berteau, David, Joachim Hofbauer, Gregory Sanders, and Guy Ben-Ari. *Cost and Time Overruns in Major Defense Acquisition Programs*. Ft. Belvoir: Defense Technical Information Center, 2010. Print.

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17



Source: December 2009 SAR; analysis by CSIS Defense-Industrial Initiatives Group

¹Berteau, David, Joachim Hofbauer, Gregory Sanders, and Guy Ben-Ari. *Cost and Time Overruns in Major Defense Acquisition Programs*. Ft. Belvoir: Defense Technical Information Center, 2010. Print.

Cost Estimating Uncertainty Analysis

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18

- » WSARA 2009 requires MDAPs and MAISs LCCEs be presented at an 80% confidence level
- » No policy that dictates how cost uncertainty be modeled
- » Resources and tools to aid in modeling cost uncertainty:
 - » Air Force CRUH
 - » GAO Guide for Cost Estimating
 - » CEBok Modules
 - » “Probability Methods of Cost Uncertainty Analysis” by Paul Garvey

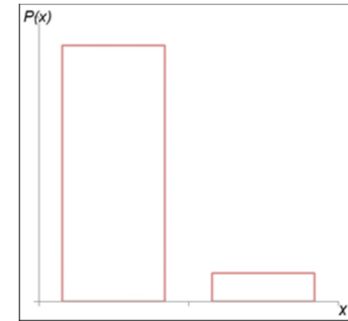
Probability Distributions

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19

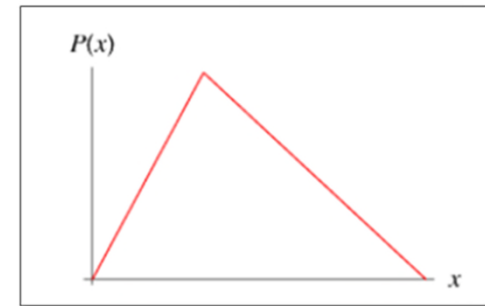
» Discrete

- » Values and probability of occurrence
- » What-If or logical statement



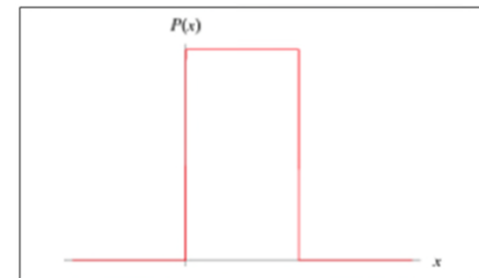
» Triangular

- » High, low and most likely
- » Easy to understand



» Uniform

- » High and low
- » All other values likely to occur



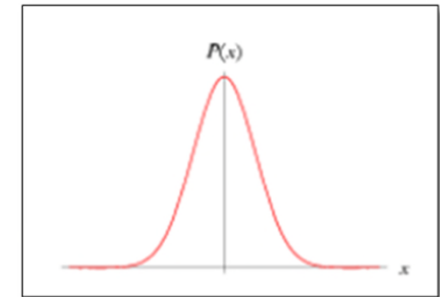
Probability Distributions

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20

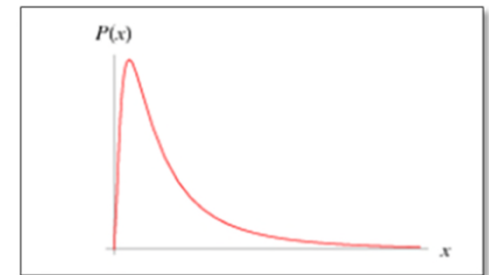
» Normal

- » Most likely and standard deviation
- » Equal possibility of cost overrun and cost underrun
- » Likely to represent the summation of inputs, or outputs, rather than placed on individual cost elements



» Lognormal

- » Most likely and standard deviation
- » Truncated at zero
- » Use as default when lack of other data

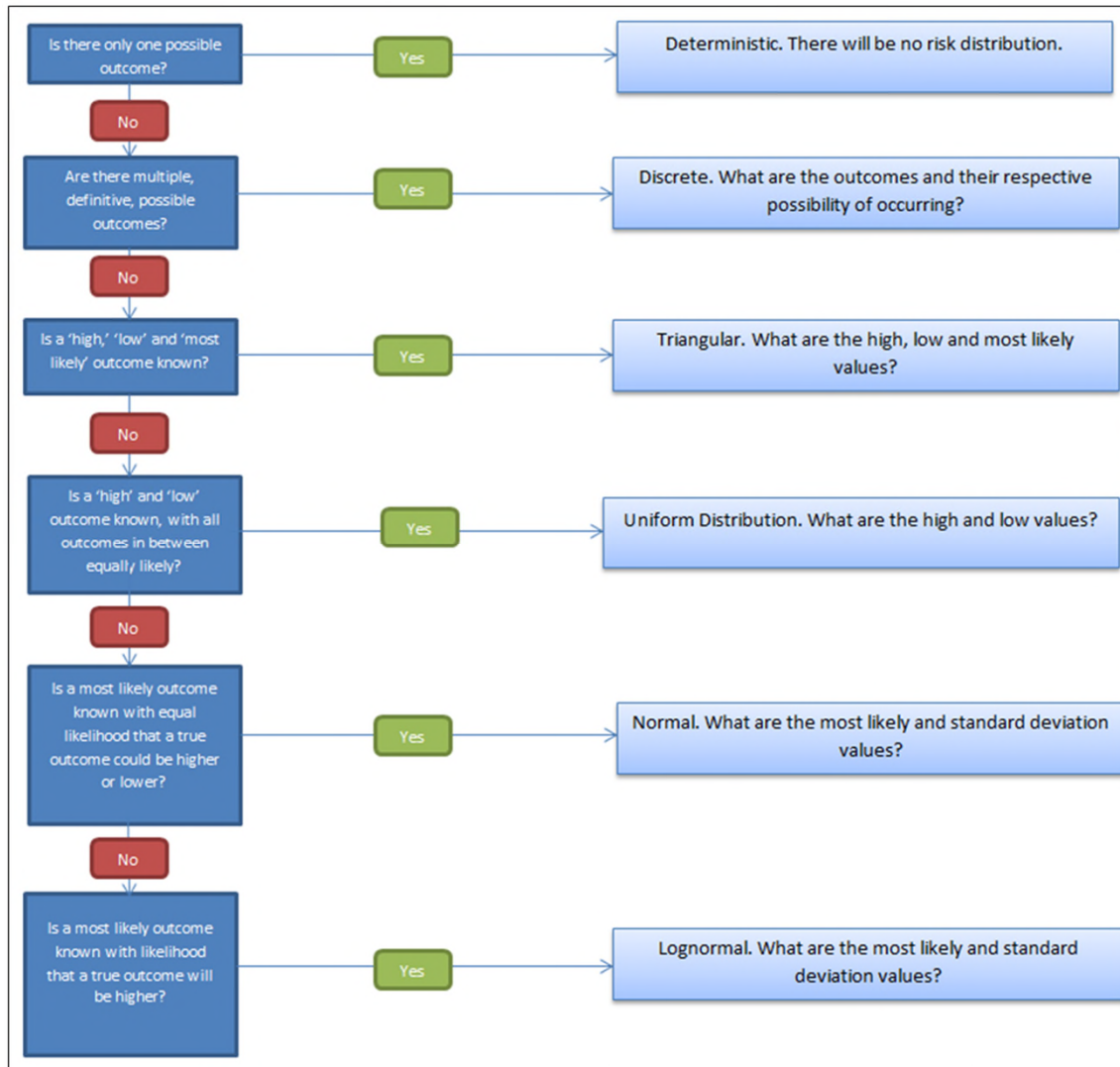


Probability Distributions

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21

Important to be aware of uncertainty during the data collection process!



Data Documentation

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» Document during data collection to ensure defensible estimate

Date	Data Source	Input Variable	Distribution	Parameters			Notes
					Value	Units	
27-Feb-13	SME-John Doe	Fiber optic cabling	Triangular Distribution	High	1000	ft	
				Low	300	ft	
				Most Likely	700	ft	

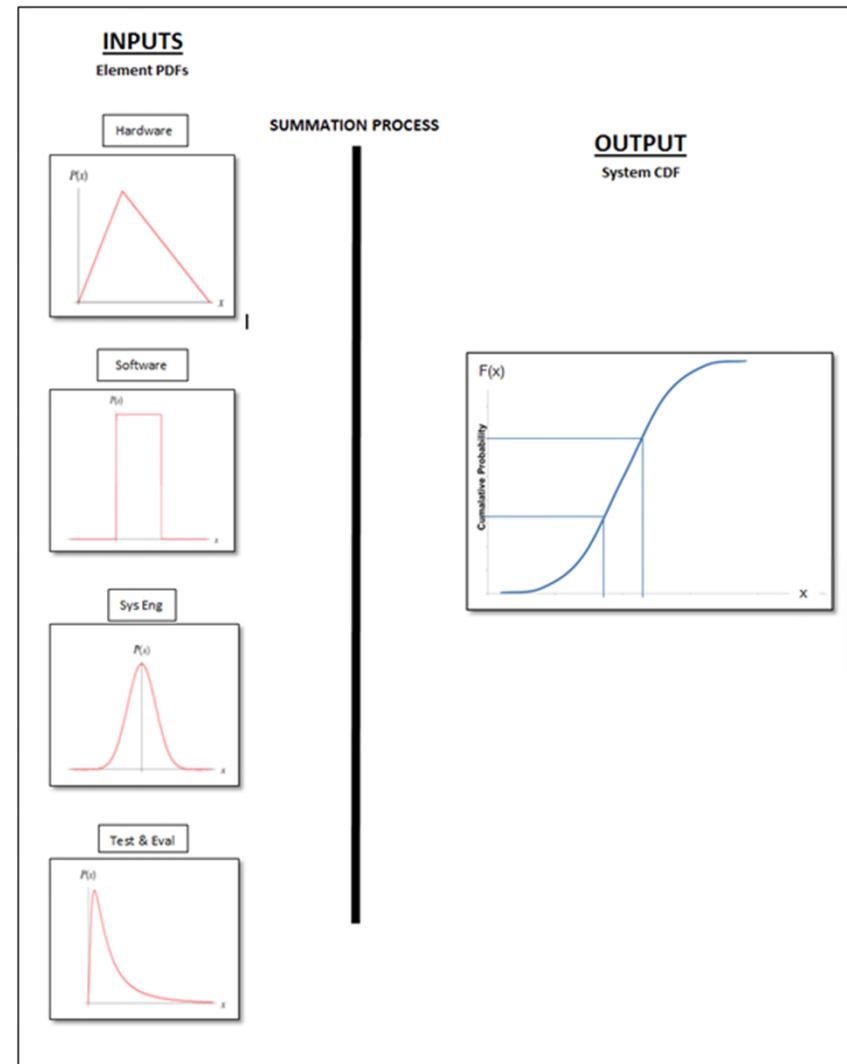
CES	Description	Appropriation	Color of Money	Program Office Cost (Y/N)	Other LCCE Cost (Y/N)	Methodology /Formula	Unique Ground Rule: & Assumptions	Data Source / Rationale	Phasing / Profiling Method	Uncertainty Range	Uncertainty Rationale/Source	Rates, Factors, CERs	Rates, Factors, CER: Sources	Crosschecks
1.0	Research & Development													
2.0	Investment													
3.0	Operating & Support													
4.0	Disposal													

S-Curve

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23

- » Always present the probability along with the cost estimate
- » Present cost estimate range using two confidence levels
- » What does it cost? Well, it depends!



Data Validity

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24

- » Question all assumptions
- » Assume average performance/productivity
- » Use multiple SMEs
- » Avoid leading questions

Bias	Remedy
Overly Confident	Assume SME input covers 70% of true data range; obtain most likely value near end of interview
Availability	Be aware and direct conversation
Aversion	Assume SME input covers 70% of true data range
Anchoring	Avoid leading questions; obtain most likely value near end of interview

Conclusion

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25

- » By making decision makers aware of O&S costs and applying more rigorous uncertainty analysis to LCCEs, cost estimates will become more accurate and more reliable, which will lead to less cost overruns due to cost estimating errors
 - » Estimate early. Estimate often.
 - » Gather information and metadata that will inform cost uncertainty while conducting the initial data gathering.
 - » Be aware of expert judgment biases during SME interviews.
 - » Document all cost uncertainty modeling methodologies.
 - » Always present a cost estimate as a range within the context of a cumulative distribution function (S-curve).