

Challenges to Integrated Cost and Performance/Effectiveness Analysis



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Preface

- This briefing focuses on the challenges of performing integrated analyses across the traditionally ‘stove-piped’ analytic environments of systems engineering/ engineering design, system performance modeling, and system cost estimation

Discussion Topics

- Background
- Historical Analytic Shortcomings
- Modeling Environment
 - Cross-domain mapping dilemma
 - Integrated Modeling Workflow
- Effects of Integrated Analyses
 - Performance and Capability-based Costing Challenges
 - Potential Approach
 - Why LCC / Hour?
 - Cost Estimation Data Flow
 - Calculating Cost of Capability
 - Other Challenges
- Lessons Learned / Insights
- Questions

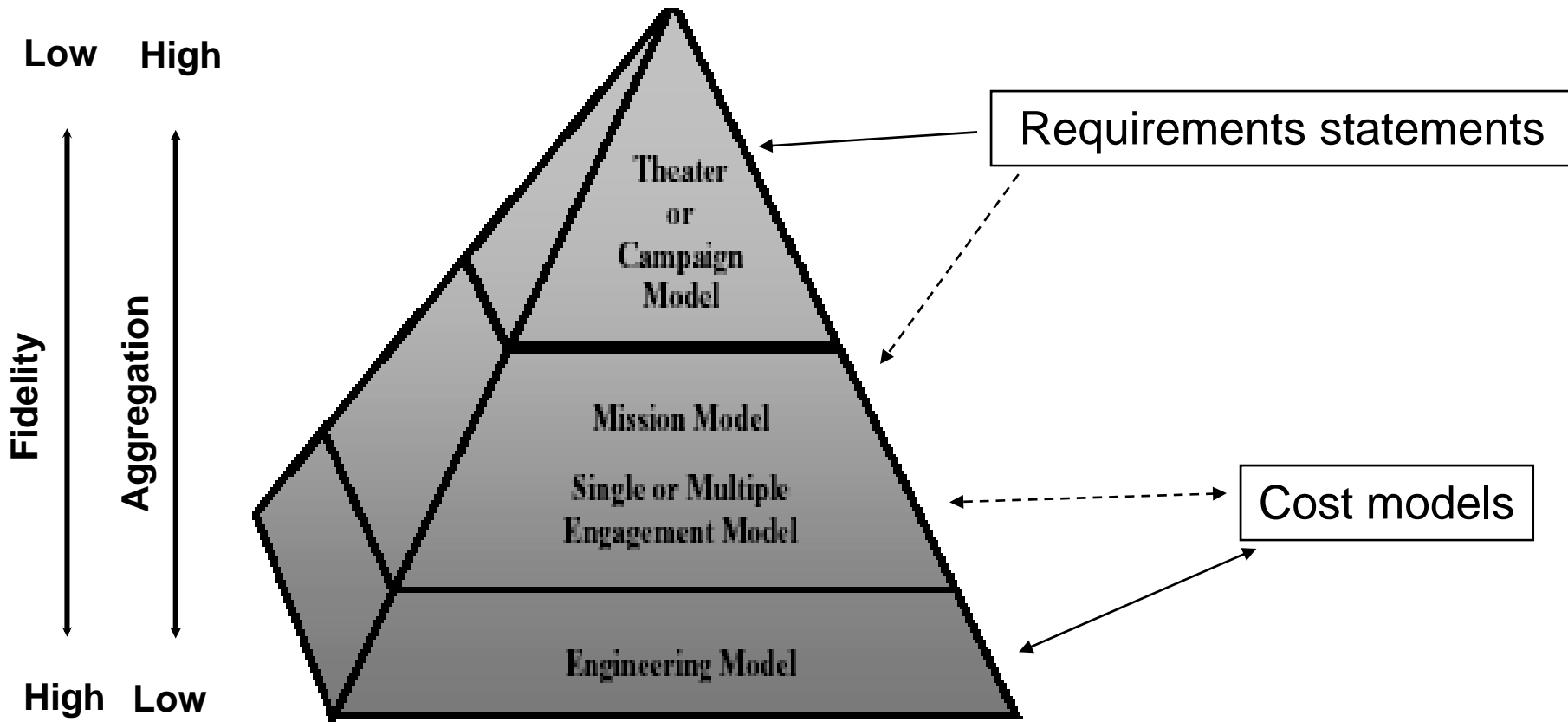
Background

- Recent Summit Engineering Group projects focused on creating integrated analytic frameworks that utilize applicable cost, performance, and engineering models
 - Office of the Deputy Assistant to the Secretary of the Army - Cost and Economic Analysis (ODASA-CE) Integrated Performance and Cost Model (IPCM) Program
 - Naval Air Systems Command (NAVAIR) Decision Support System (DSS)
- Significant challenges to this approach
 - Establishing communications between design engineers, performance modelers, and cost analysts throughout program life cycle
 - Conceptual/Theoretical differences between Performance-based and Capability-based costing
 - Often the classified performance data is housed in a different environment than the typically unclassified cost data
- Ultimate goal is to provide decision makers and stakeholders with better information, earlier in acquisition cycle

Historical Analytic Shortcomings

- Cost and performance analyses are ‘stove-piped’ and often disjointed
- System-level cost-performance trades sometime happen too late to implement (if they happen at all)
- Collaborative studies are time-consuming and usually only bilateral (involve only two modeling perspectives)
 - Cost/Engineering trades
 - Engineering/Performance trades
 - Engineering is link for cost/performance trade studies
- Cost analyses (POEs, ICEs, CAIG estimates) are often not 100% correlated with system configuration(s)

Modeling Environment



Cross-Domain Mapping Dilemma

- Engineering data feeds engineering models and generates Outputs
- Outputs serve as inputs to Performance model(s)
- Cost model utilizes engineering data/system configuration to generate costs

Engine Data
Boost
Boost/Sustain I
Boost/Sustain II
Pintle
Pulse-gel

Example of
Cost
community
focus

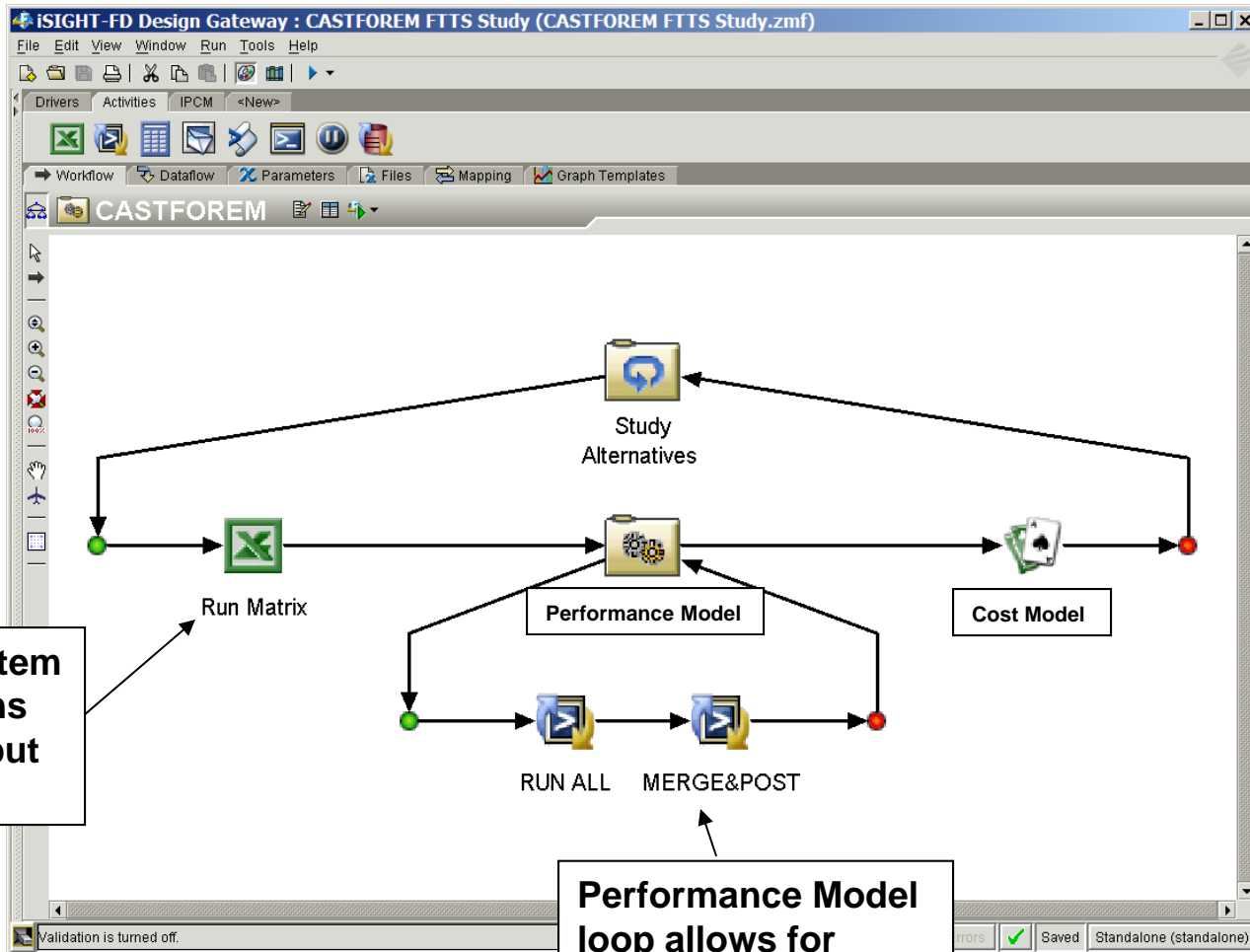


Outputs
Max Range
Average velocity

Example of
Performance
community
focus



Integrated Modeling Workflow



Effects of Integrated Analyses

- Focus discussion on feasibility and merits of Performance-based and Capability-based Costing versus current Engineering/Design-based Costing
- Rigidity of legacy cost and campaign models may not support Performance and Capability-based Costing paradigm
 - Need to invest in intellectual capital to leverage models currently in use
 - Need to invest in new data and new models
- Facilitates transition of analyst perspective from single-theater, single-conflict to global force structure

Performance and Capability-based Costing Challenges

- Different than the traditional idea of “system cost”
- Creates a need for new CERs that are more aligned with mission/campaign model inputs
 - Kills/hr, area coverage, etc.
- Reasonableness and traceability of cost data becomes a real requirement

Potential Approach

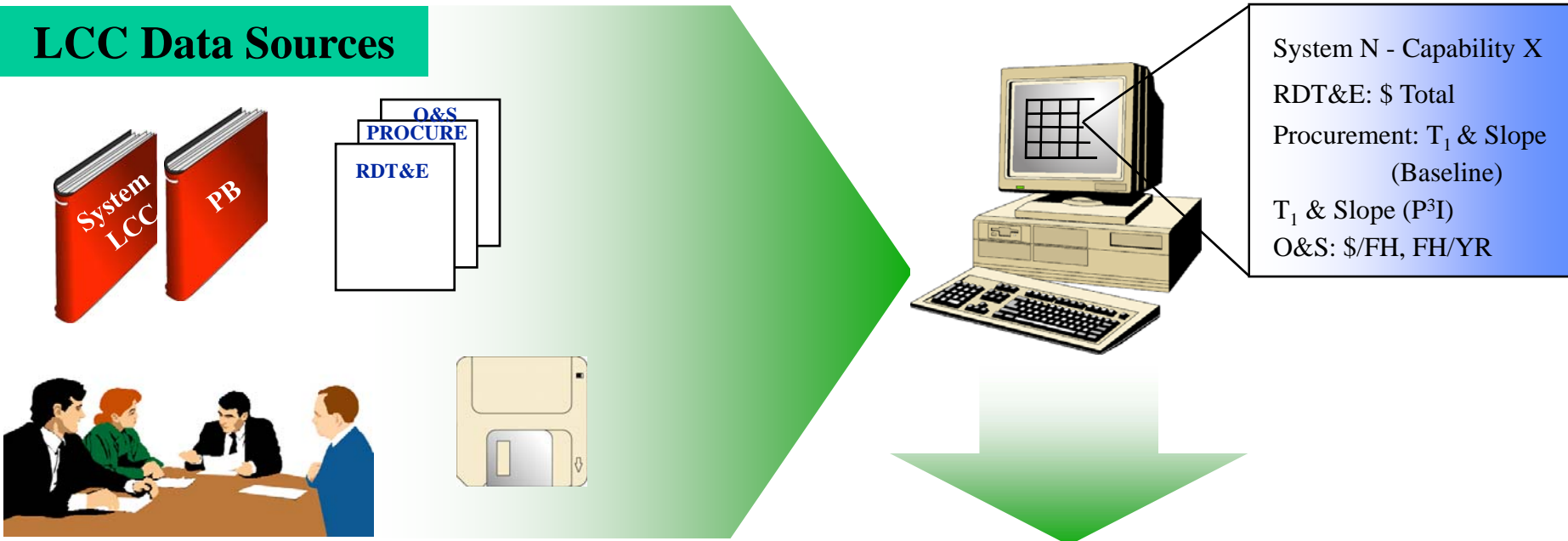
- Given “ground truth”, can calculate level of effectiveness
 - For example, percent of targets detected
- Given specified fixed-level of effectiveness (goal), time to achieve a common level will vary by alternative
- Use ***time*** to quantify both cost and effectiveness
 - LCC per hour x hours to achieve desired level of effectiveness

Why LCC / Hour?

- LCC / Hour captures not only O&S, but also all related R&D/Acquisition/Construction investments required to realize the capability of interest
- Some applicable LCC / Hour adjustments
 - Vignette attrition
 - Weapon expenditures
 - Multi-mission platforms
 - Global services
- Evens “playing field” between legacy and new systems

Cost Estimation Data Flow

LCC Data Sources



Architecture N				
	Cap 1	Cap 2	Cap 3
Component 1	x			
Component 2			x	
Component 3		x		
..				

Component N			
	Cap 1	Cap 2
System 1	x		
System 2	x		
Total			

System N

Package #	Configuration	Qty	RDT&E \$	Procurement \$	O&S \$	Total LCC \$
1		0	\$ 0	\$ 0	\$ 0	\$ 0
2	• Current Baseline	10	\$ 118	\$ 361	\$ 960	\$ 1,439
3	• Current Baseline	10	\$ 118	\$ 361	\$ 960	\$ 1,439
4	• TS II Replacement • IR Upgrade • Comm. Upgrade	10	\$ 122	\$ 389	\$ 960	\$ 1,471
5	• Current Baseline	15	\$ 118	\$ 526	\$ 1,400	\$ 2,044
6	• Same as package #4 • O&S Interface capability	26	\$ 124	\$ 968	\$ 2,384	\$ 3,477
7	• More CDE bandwidth • Current Baseline	26	\$ 118	\$ 896	\$ 2,384	\$ 3,398
8	• Same as package #6 • Heavy fuel engine • SIGINT, MFI Sensors • HSI/PPMS Sensors	64	\$ 174	\$ 2,880	\$ 6,048	\$ 9,102
9	• Same as package #8	64	\$ 174	\$ 2,880	\$ 6,048	\$ 9,102
10	• Same as Package #8	64	\$ 174	\$ 2,880	\$ 6,048	\$ 9,102

Calculating Cost of Capability

- Develop System LCC estimate
 - R&D (Actuals for legacy systems and some new systems)
 - Acquisition/Construction (Actuals for legacy systems)
 - O&S (Historical for legacy systems)
- Convert all LCC estimates to common \$ basis
- Calculate LCC/hr for each platform/system as configured
- Apply LCC/hr for length of time each platform/system plays (multiplier)

$$\text{LCC/hr} = \text{LCC} / (\# \text{ units} * \text{annual operating hrs} * \text{assumed lifetime})$$

$$\text{Cost of Capability} = \sum \text{LCC/hr}_{\text{entity}} * \text{hrs employed}_{\text{entity}}$$

Other Challenges

Analytic Issue	Example Decisions	Cost Characteristics
New System(s)	<ul style="list-style-type: none"> • New/Niche capability • Redundant capability @ lower cost • Introduce Automation 	<ul style="list-style-type: none"> • Ill-defined technical baseline • High uncertainty
Mods to Existing System(s)	<ul style="list-style-type: none"> • Add new capability • Improve capability 	<ul style="list-style-type: none"> • Focused impacts • Lower uncertainty
Eliminate System(s)	<ul style="list-style-type: none"> • Phasing out capability provider • Exchange cost stream with new system(s) 	<ul style="list-style-type: none"> • Focused impacts (vs. entire estimate) • Political Issues

Lessons Learned / Insights

- Engineering Models
 - Not built for collaboration
 - May require significant simplifying assumptions
- Models are currently designed to be used within current stove-piped analytic process
 - Adapting models for integration may require *invasive changes* to model
 - Proliferation of integration environments may lead to culture changes resulting in models that are less closed and stove-piped
- Integrated modeling is more about analysis than about integration
- Cultural roadblocks threaten collaboration
 - Too much reliance on SMEs
 - Data sharing issues
 - Lack of early communication
- Classification issues must be addressed ASAP
- Benefits of integrated modeling environments
 - Can help break stove-pipes
 - Get engineers involved early in decision process
 - Help provide requirements traceability
 - Enable analysts to “see” the whole trade space
 - Encourage development of CERs

Questions?

Presenter Biographies

- Mr. Kurt Willstatter
 - Sr. Principal at Summit Engineering Group
 - Certified Cost Estimator/Cost Analyst (SCEA)
 - BA Biology (Texas A&M)
 - MS Operations Research (Naval Post Graduate School)
 - 15+ years of systems engineering, modeling & simulation, cost estimation experience
 - 20 years of Navy operations and systems engineering
- Mr. Richard “Andy” Campbell
 - Associate at Summit Engineering Group
 - Certified Cost Estimator/Cost Analyst (SCEA)
 - BS Mathematics, BA Economics (Rhodes College)
 - 4+ years of cost estimation, program analysis/management, and effectiveness modeling experience