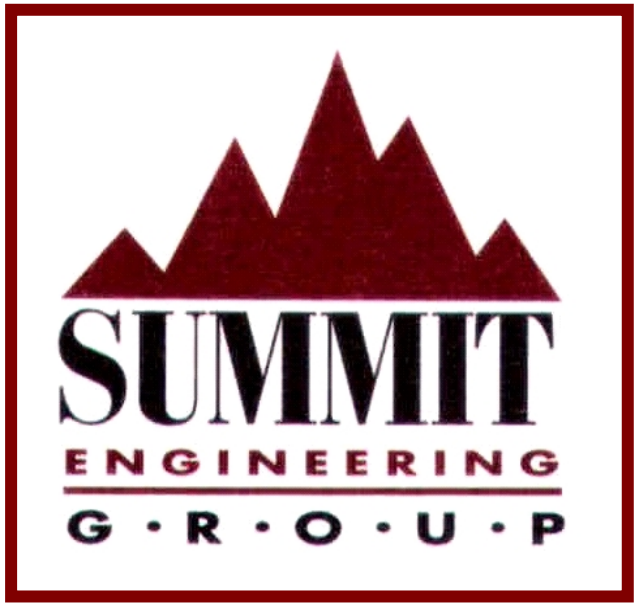
Challenges to Integrated Cost and Performance Analysis



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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

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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

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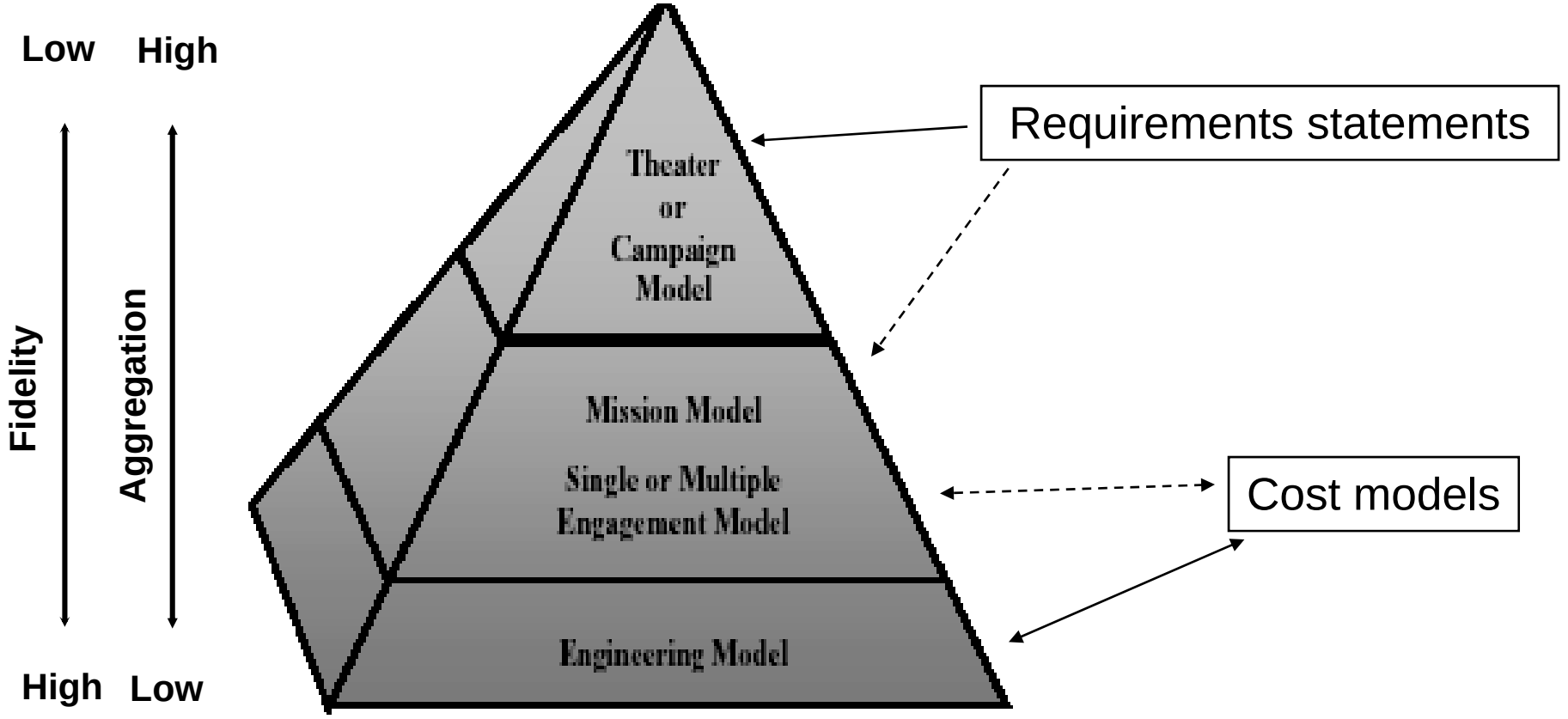
Background

- 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

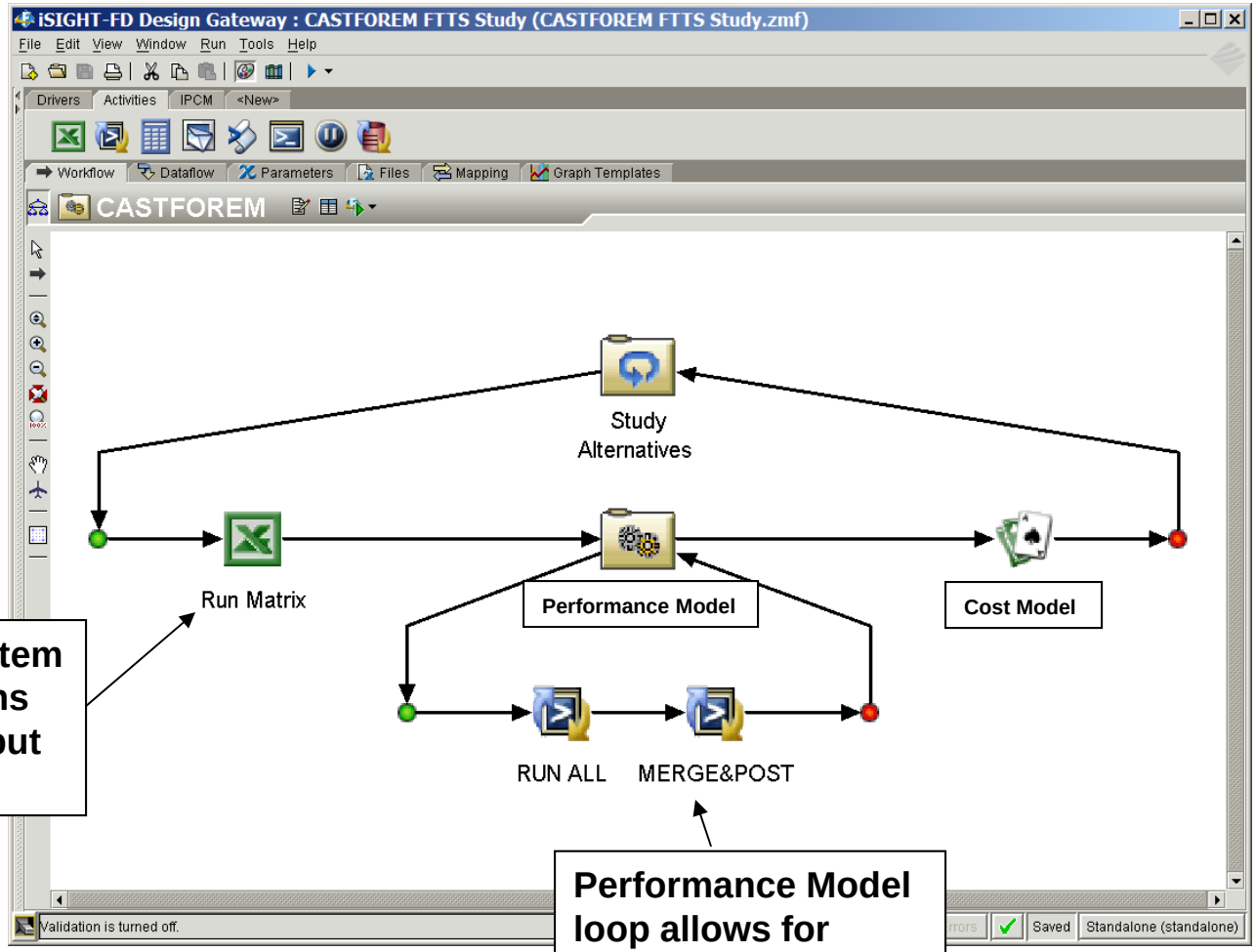
Example of Cost community focus

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

Outputs
Max Range
Average velocity

Example of Performance community focus

Integrated Modeling Workflow



Matrix of system configurations serves as input to models

Performance Model loop allows for multiple iterations

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

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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

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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

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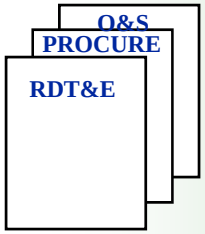
Cost Estimation Data Flow

LCC Data Sources



System N - Capability X

RDT&E: $ Total

Procurement: T_1 & Slope (Baseline)

T_1 & Slope (P^3I)

O&S: $/FH, FH/YR

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 • Comms Upgrade	10	$ 122	$ 389	$ 960	$ 1,471
5	• Current Baseline	15	$ 118	$ 526	$ 1,400	$ 2,044
6	• Same as package #4 • CARS Interface capability	26	$ 124	$ 968	$ 2,384	$ 3,477
7	• More CDL bandwidth • Current Baseline	26	$ 118	$ 896	$ 2,384	$ 3,398
8	• Same as package #6 • Heavy fuel engine • SIGINT, MTI Sensors • HSS/FPRS 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

Component N

	Cap 1	Cap 2	....
System 1	x		
System 2	x		
Total			

Architecture N

	Cap 1	Cap 2	Cap 3	....
Component 1	x			
Component 2			x	
Component 3		x		
..				

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)

LCC/hr = LCC / (# units * annual operating hrs * assumed lifetime)

Cost of Capability = $\sum$ LCC/hr_{entity} * $hrs\ employed_{entity}$

Other Challenges

Analytic Issue	Example Decisions	Cost Characteristics
New System(s)	• New/Niche capability • Redundant capability @ lower cost • Introduce Automation	• Ill-defined technical baseline • High uncertainty
Mods to Existing System(s)	• Add new capability • Improve capability	• Focused impacts • Lower uncertainty
Eliminate System(s)	• Phasing out capability provider • Exchange cost stream with new system(s)	• 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

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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