

System Trade Studies and Design Optimization

Model Based Systems Engineering Track

Bryce Martin Lockheed Martin – Space Systems Company

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Agenda

- 4
- System Design Optimization Project Summary
- Notional Scenario Case Study Overview
- System Trades & Optimization Approach & Process
- Demonstration Videos
- Legacy vs Integrated Analysis Process Comparison
- Summary
- Q&A

System Design Optimization Project Summary

Project Objectives

- Demonstrate effectiveness of integrating the System Architecture Model (SAM) with system performance analysis tools for better system design trades.
- Improve our ability to evaluate the system trade space in more depth, with less effort and a faster cycle-time.

Key activities:

- Define set of system scenarios to evaluate proposed system designs
- Integrate the SAM with system performance simulations
- Run parametric driven system analysis
- Validate results and evaluate process change

Notional Scenario Case Study Overview

Notional Scenario

- Freedonia launches a tactical strike on Sylvania
- Sylvania must be able to defend its capital and the surrounding area
- The current missile defense system is not capable of defending against potential future threats





Requirements

- The new interceptor shall have a minimum defended area coverage...
 - The defended area is defined as the area outlined in blue in the graphic.
- The interceptor mass shall not exceed...

System Architecture Model (SAM) Overview

- ✓ Established modeling toolset
- ✓ Setup SAM structure
- ✓ Defined approach for product variants
- ✓ Captured partial project specs and IF data
- Identified partial element structure, req's, & behaviors
 Captured Parametric data set
- ✓ Generated docs from SAM



- Capture complete mission requirements set, including relevant external interface data
- Define complete set of system and subsystem requirements and con-ops
- Establish traceability across all model elements
- Integrate SAM with MCAD and Integration & Test models
- Generate specifications and related docs on demand



- RAMT Integrate Specialty Engineering Reliability-Availability-Maintainability-Testability (RAMT) requirements and analysis capabilities into SAM to improve accuracy and update cycletime
- System Design Optimization Integrate SAM with system performance simulations for improved system trades
- Power Management- Create lifecycle power mgnt approach using SAM; complementary approach with mass and reliability mgnt



New Business

- Capture new business stakeholder needs and mission requirements
- Model key new concept system con-ops
- Capture families of concept system and subsystem requirements as product variants

Extending System Model Content and Extracting Value to Reduce Startup Risks at Contract ATP

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System Trades & Optimization Approach

Analyses and System Architecture are Tied Together via Phoenix Integration's ModelCenter



Architecture Changes Can Be Identified and Analyzed Quickly – Improves Understanding of Performance Impacts and Validating Critical Parameters

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System Trade Study & Optimization Process



Multi-Variable Parametric Trade Studies and Closed Loop System Concept Design Optimization Enabled via Data and Analysis Process Integration

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Trade Space Exploration Demo



Design Optimization Demo



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Legacy versus Integrated Analysis Process

Legacy Defended Area Analysis Process



Performance Parameter Update Released Update Scenario Parameters in SAM Execute ModelCenter Defended Area Analysis Run

Review Defended Area Results

Less Time Setting Up Analyses -> More Time Understanding & Improving the Design

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Summary

- Integration of system architecture model and system analysis tools enables requirement driven design optimization
 - Program will no longer need to 'guess' what the answer is and 'hope' the requirement is met
- Eliminating manual data translation steps and establishing an integrated common record of authority will improve analysis cycle time

Expect a Productivity Improvement of 50-75% With System Arch. Integrated Analysis



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