Object-Oriented Systems Engineering Method (OOSEM)

Optimize and Evaluate Alternatives

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OOSEM Topics

- OOSEM Overview
- Method
  - Setup Model
  - Analyze Stakeholder Needs
  - Analyze System Requirements
  - Define Logical Architecture
  - Synthesize Candidate Physical Architectures
  - Optimize and Evaluate Alternatives
  - Manage Requirements Traceability
  - Integrate and Verify System
- Summary

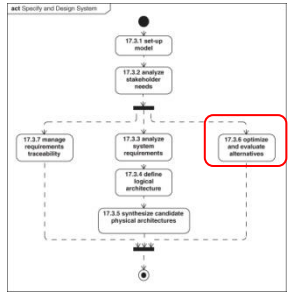
Module Objectives

- After completion of this module, student should understand
  - The primary modeling artifacts from Optimize and Evaluate Alternatives
  - How an analysis context is used to identify the analysis
  - How the top level moe's are captured in parametrics
  - How the moe's are flowed down through parametrics
  - How the parametrics are used to support tradeoff among alternative architectures

Motivation

- Analysis and Design must be integrated to support:
  - Identification, evaluation, and management of key parameters
  - Traceability and impact assessment
  - Synchronization of critical analysis models with design model

Optimize and Evaluate Alternatives



- Invoked throughout the process
  - Perform engineering analysis that supports system design trade studies and design optimization
- Parametric diagrams used to specify each critical analysis of the system

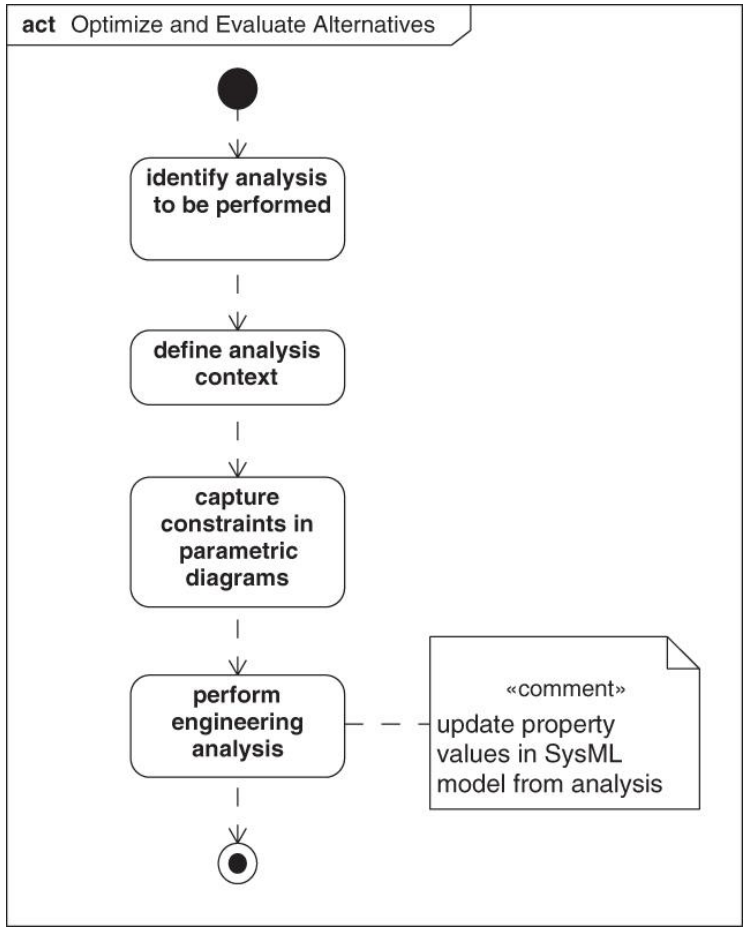
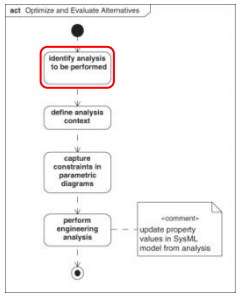


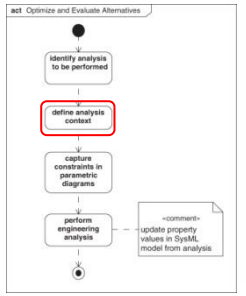
Figure 17.48

Identify Analyses to be Performed



- Identify analysis to:
  - Characterize or predict some aspect of the system, such as performance, reliability, mass properties, or cost
  - Optimize the design through sensitivity analysis
  - Evaluate and select a preferred solution from alternative designs
  - Verify a design satisfies its requirements using analysis
  - Support risk analysis
- Capture as an analysis block

«block»
«analysis»
Availability Analysis



Define Analysis Context

- Analysis Context composed of analysis blocks to specify each engineering analysis
  - Includes a Cost Effectiveness Analysis block for evaluating the overall effectiveness of the system
  - Each analysis composed of constraint blocks and the subject of the analysis

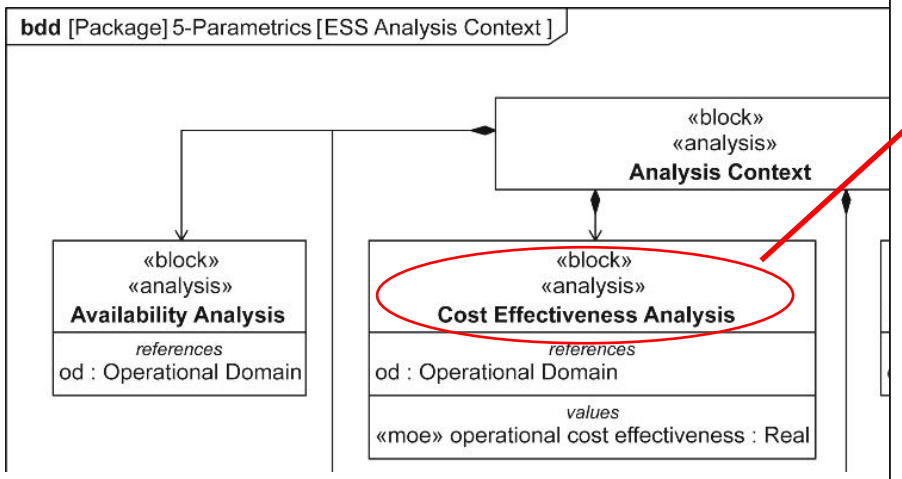


Figure 17.49

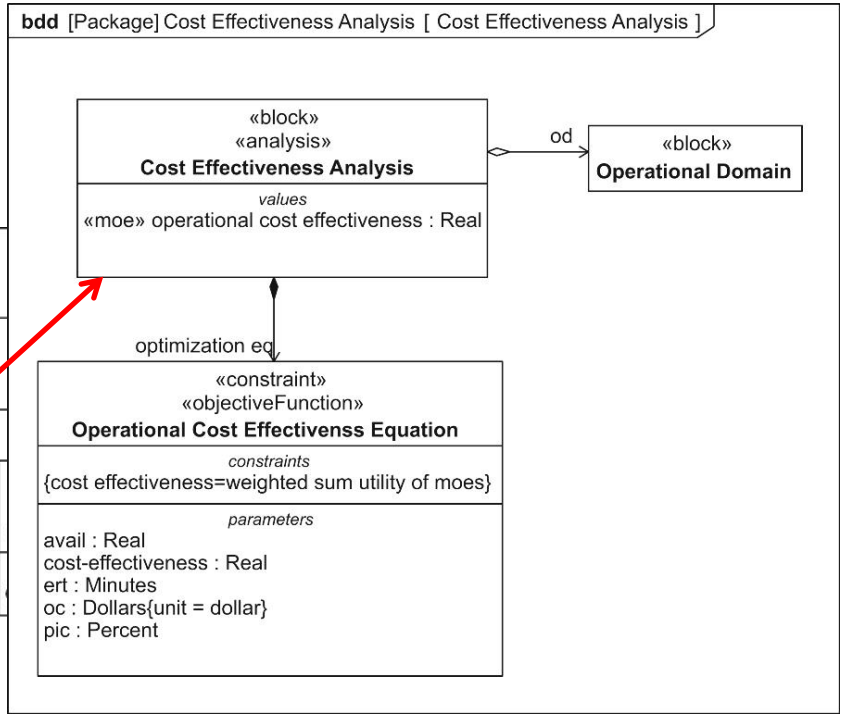
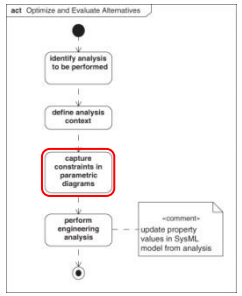
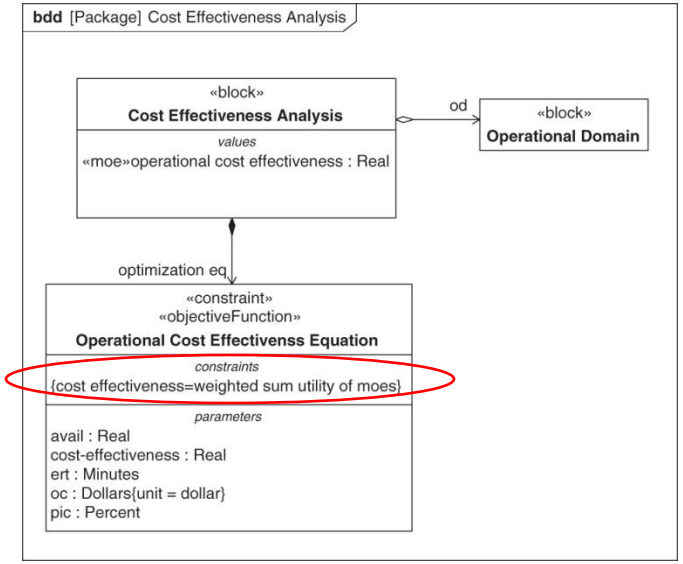


Figure 17.50

Capture Constraints in Parametric Diagram



- Create a parametric diagram for each analysis
  - Start with top level objective function
  - Bind the analysis parameters to the moe's
  - Specify next level parametric diagrams to analyze each moe (next slide)



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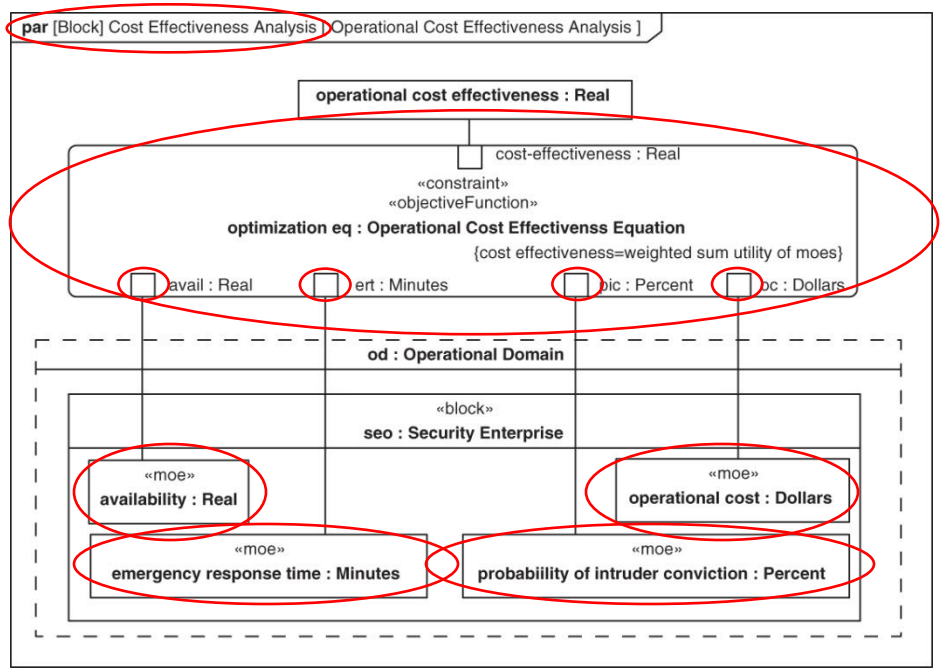
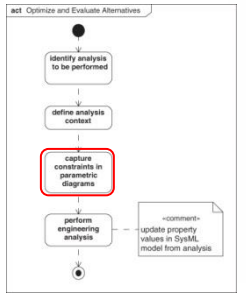
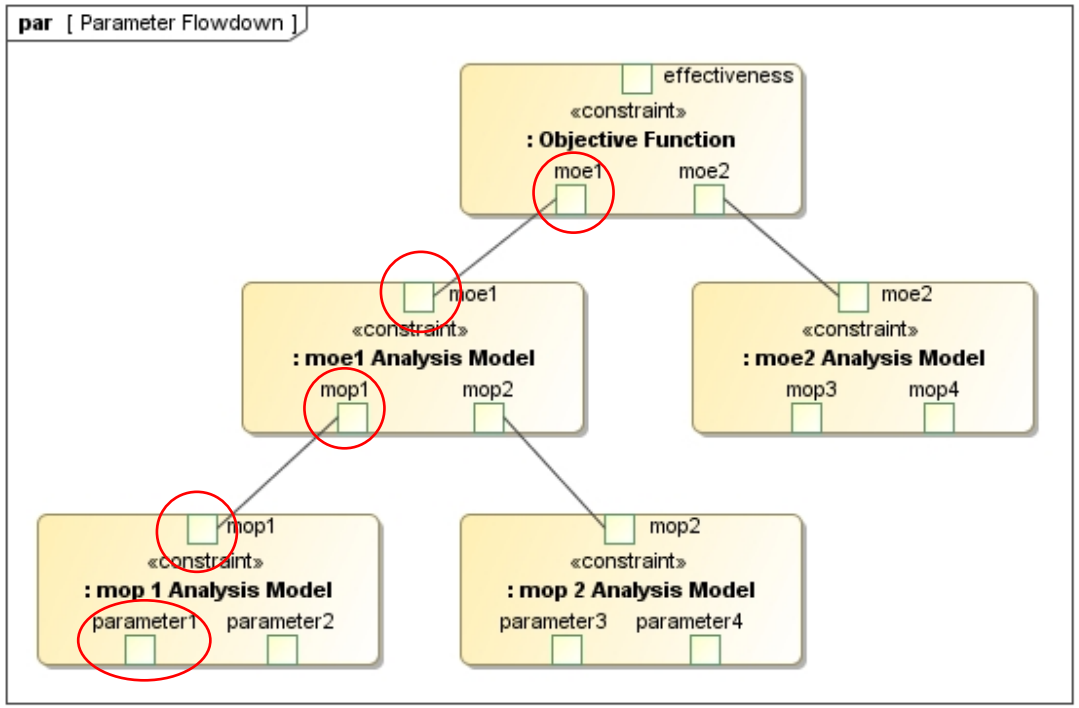


Figure 17.10

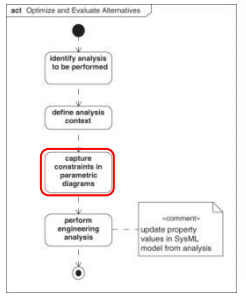
Parameter Flowdown



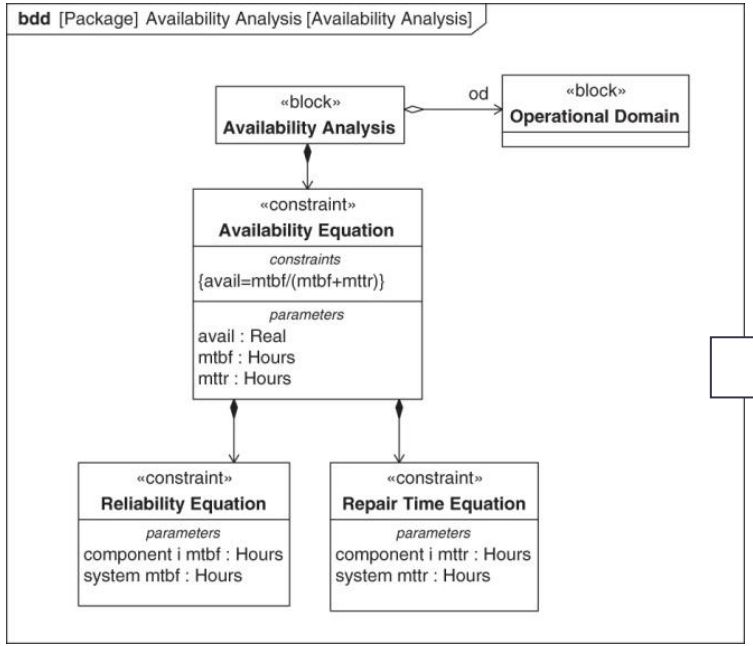
- Parametrics can be used to flow parameters down
  - mission measures of effectiveness (moe's) to system measures of performance (mop's) to lower-level critical parameters



Parameter Flowdown (cont.)



- Availability analysis used to flowdown availability moe to reliability and maintainability mop's
  - Create parametric diagram with nested constraints



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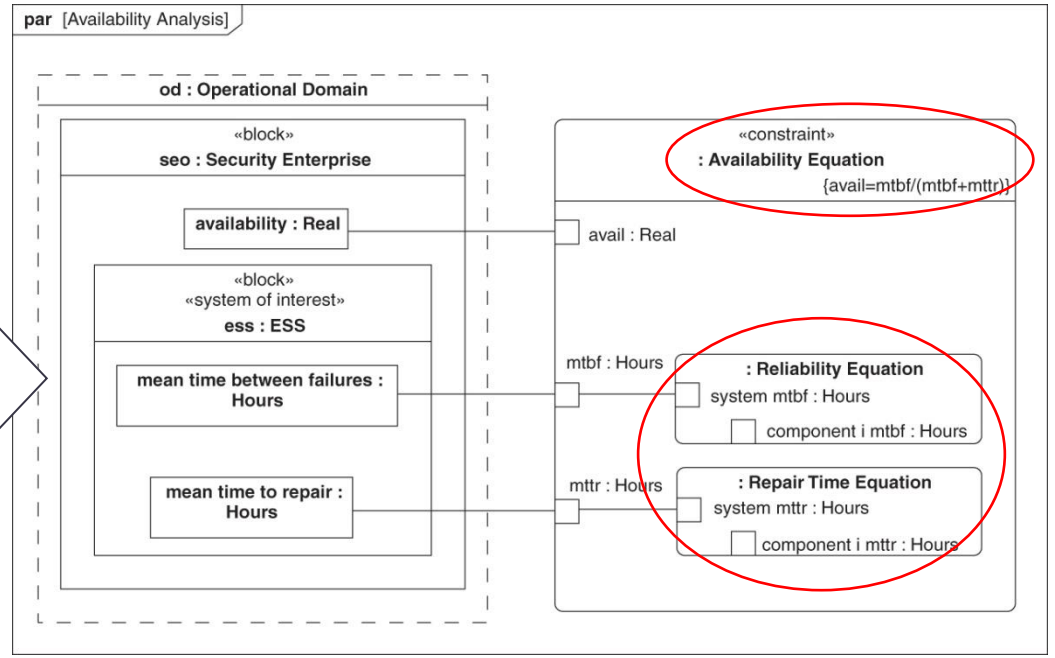
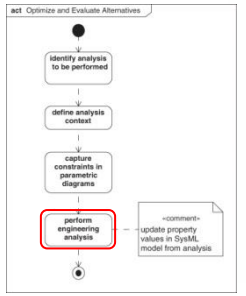
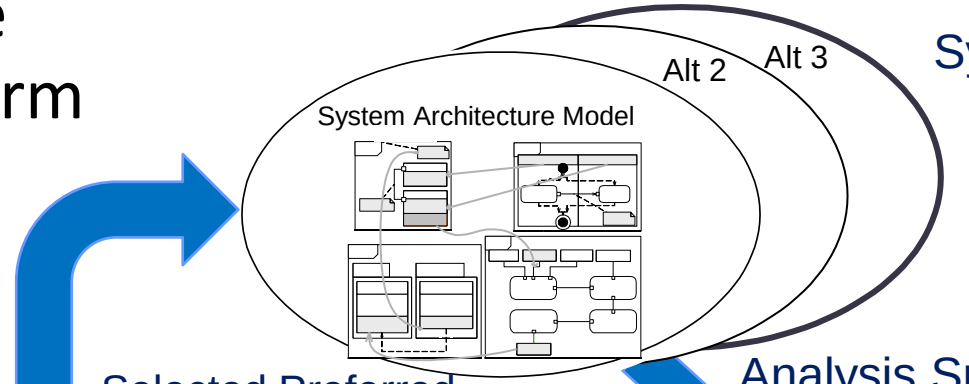


Figure 17.50

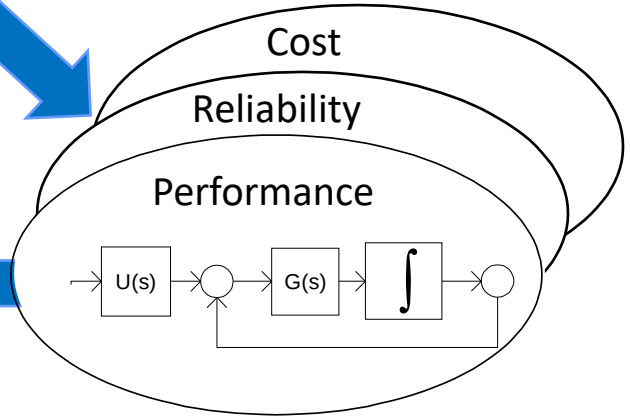
Perform Engineering Analysis



- Execute the equations in the parametric diagram to perform the trade study and analysis



Analysis Specifications



Analysis

Selected Preferred System Design & Analysis Results

Criteria	Weight	Alt 1	Alt 2	Alt 3
Performance	0.5	7	5	5
Reliability	0.2	4	6	5
Cost	0.3	3	5	8
Effectiveness		5.2	4.2	**5.9**

Trade-offs

Summary

- Optimize and Evaluate Alternatives is invoked throughout the design process to support architecture trade-off, optimization, and verification
- Each analysis model can be specified with a parametric diagram and then executed by an analysis tool to facilitate synchronization between design and analysis
- Parametric diagrams provide a mechanism to establish relationships between the top-level MOEs and their flow down to critical system, element, and component properties