

Model Based System Engineering with SysML

Course Outline

Module 1: System Engineering Transformation

- What is System Engineering Transformation?
- Engineering Challenges
- INCOSE Definition of MBSE
- MBSE Benefits
- An Architectural Approach
- Document Generation
- Activity: Discussion of modeling needs
- Review Questions
- References
- Chapter Summary

Module 2: Modeling Process and SysML Overview

- Historical Context System Engineering
- Waterfall to Agile/DevOps Tie In
- Iterative and Incremental Development
- Historical Context SysML
- UML Roots
- UML Diagram Set
- Early vs Late Iteration
- SysML Diagram Overview (9 not 13)
- Four pillars of MBSE
- Laying out a Model
- Case Study – Shop and Go Smart Cart
- Exercise 2.1 – Creating and Organizing a Model with SysML
- Review Questions
- References
- Chapter Summary

Module 3: Modeling Functional Requirements

- What are Requirements?
- Requirement Classification
- Activity: Discussion – are these requirements?
- Inputs to Requirements
- Why start with the functional model?
- Shop and Go Brief Description
- SysML Notational Elements
- Use Case Diagrams
- Use Case Text
- Activity Diagrams
- Developing Use Cases
- Identifying Actors
- Exercise 3.1 – Discussion Identifying Actors and Use Cases
- Debrief

- Exercise 3.2 – Hands-On Adding Use Cases in SysML
- Review Questions
- References
- Chapter Summary

Module 4: The Structural Model

- Composite Structure Diagrams (not in SysML)
- Replaced by Block Definition Diagrams (BDDs)
- <<block>> icon and symbology
- Hierarchical Diagrams
- Instances vs Type
- Instances on BDDs
- Exercise 4.1 – Overall Discussion of a Smart Cart
- Debrief
- Exercise 4.2 – Implementing and using BDDs
- Debrief
- Specialization on BDDs
- Activity 4.3 – Demonstration of serialization
- Correlating Different Diagrams
- Software/Firmware Modeling within a System
- Creating UML Class Diagrams
- Process steps
- Associations and Roles
- Exercise 4.4 – Hands-On creating a Class Diagram
- Debrief
- Package Diagrams
- Review Questions
- References
- Chapter Summary

Module 5: Second Requirements Iteration

- Six Goals of MBSE (6 slides)
- How Much modeling is needed?
- Modeling Process Walkthrough
- Collaboration
- Stakeholder Concerns
- Capturing and Coordinating Concerns
- Adding new requirements
- Exercise 5.1 – Demonstration of upgrading a model
- Requirements Diagrams
- <<Satisfies>> and <<Validates>> relationships
- Copy and Trace
- Don't Panic – it is simpler than it looks
- Exercise 5.2 – Hands-On Adding a Requirements Diagram
- Review Questions
- References
- Chapter Summary

Module 6: The Behavioral Model

- Moving from Structure to Behavior
- Nature of Sequence Diagrams
- Relating Activity Diagrams and Sequence Diagrams
- Exercise 6.1 – Group Discussion – Flow of Make Purchase use case
- Debrief
- Exercise 6.2 – Hands On – Creating a Sequence Diagram
- Debrief
- State Modeling
- What is State?
- What is State Really?
- Nature of State Diagrams
- Sub-States
- Ensuring absolutely every path is understood
- Actions and guard conditions
- Error detection vs error prevention
- Exercise 6.3 – Group Discussion – States in Make Purchase
- Debrief
- Exercise 6.4 – Hands On – Adding a State Diagram
- Debrief
- Review Questions
- References
- Chapter Summary

Module 7: Parametrics and Simulation

- Know before you build
- What are parametrics?
- Defining a mathematical condition by formula
- Exercise 7.1 – Group Discussion How big should the battery be?
- Debrief
- Exercise 7.2 – Hands-On Adding a Parametric Diagram
- Debrief
- Prove before you build
- Automated validation of model elements
- Running a simulation
- Manual simulation
- Automated simulation
- Exercise 7.3 – Hands-On Running a Manual Simulation
- Review Questions
- References
- Chapter Summary