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Systems Engineering with SysML

3 Days

1. Introduction

The Unified Modeling Language (UML) has become the de-facto standard language for modeling object oriented SW systems. Over the past years the OMG has worked on adapting the UML to the special needs of Systems Engineering. One of the results of this effort is known as the SysML which is becoming the de-facto standard language for System Engineers.

SysML simplifies the UML but also adds a number of new and specialized diagrams and elements to the UML which address the specific needs of system engineers. Among other, SysML allows to model structure, data and performance characteristics of systems.

2. Course Description

In this very intensive course you will learn the SysML notation and a systematic approach to express requirements and then design a solution describing the structural and behavioral aspects of the proposed system.

We will first present the SysML standard notation and diagrams needed to show requirements, structure and system dynamics. The notation part is accompanied by examples that exemplify the theory. Then we will present a process for effectively applying SysML leading to a seamless transition of model and information from the system level down to the subsystem level, so that the output from the system levels serves as a constructive input for the subsystem level.

As explained after the course outline, we suggest extending this 3 day training by a tool and a sample project workshop. The workshops interleave with the basic course outline.

3. Goals

The primary goals of this course are to:

- Learn the various SysML diagrams and their application.
- Understand the concept of Model Based System Engineering (MBSE)
- Learn a systematical Agile approach to systems engineering and how to derive an initial set of requirements to the sub-system level based on system architecture.

4. Participants

The course is meant for system engineers and project managers who need to understand the applicability of SysML for their tasks.

5. Pre-requisites

Experience in systems engineering and some background in object oriented concepts.

Course Outline

Introduction

In this section you will get some background information on UML and SysML. The following subjects will be covered:

- The history of UML and SysML – Overview on the SysML – How SysML extends UML – Overview on system engineering process.

Structure Diagrams:

In this section you will learn how system structure, hierarchy and composition can be modeled using SysML. We will present the following diagrams:

- Block Definition diagram – Internal Block Diagram – Package Diagram – Parametric Diagram – Requirement Diagram.

Behavior Diagrams

In this section you will learn how functional requirements, system and subsystem dynamics can be modeled using SysML. We will present the following diagrams:

- Use Case Diagram – Activity Diagram – State Machine Diagram – Sequence Diagram.

System Engineering Process

In this section we will present a process of how to apply the SysML in real life system engineering process. The proposed process is based on a middle out iterative process creating a seamless transition between the system and subsystem level. We will cover the following topics:

- **Requirements Capture**

  Developing and documenting the vision and system domain – Capturing functional and supplementary requirements.

- **Analysis**

  Describing a conceptual system solution – effective use block definition, sequence and state chart diagrams – Demonstrating how requirements are realized based on the proposed structure.

- **Design**

  Creating system hierarchy and/or independent and reusable system blocks – Modeling physical structure – Preparing the requirements for the next level – Modeling traceability.

Suggested Extensions

- **2 day Workshop: Performing systems engineering on a sample project.**

  This 2 day extension that is interleaved with the study of the engineering process, allows participants to apply and exercise the process of capturing system requirements and performing system analysis and design using the SysML. This exercise is done on the sample project from your domain. Some preparation prior to the course is required in order to scope the exercise. Without this module, the System Engineering Process part of the course is purely theoretical!

- **1-2 day: Applying SysML with Enterprise Architect or Rhapsody**

  This 1-2 day extension that is interleaved with the study of the SysML, allows participants to learn and exercise how to use Enterprise Architect or Rhapsody for modeling systems using the SysML.