Model-Based Systems Engineering and Prescriptive Simulation

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Where Innovation Is Tradition
Agenda

• Architecture Challenge of Big Data

• Model-based Systems Engineering

• Prescriptive Simulation in Model-based System Engineering
Big Data Challenge

Source: http://www.opengeospatial.org

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Big Data Challenge

Google's self-driving cars gather nearly 1GB of sensor data every second -- would you trust them?

By Wayne Williams  Published 1 day ago  Follow @waynewill1

Source: http://betanews.com/Where Innovation Is Tradition
Stages of the Analytics Process

Data Collection
- Sensor
- Sensor
- Human
- Sensor

Data Integration
- Structure (Observable)
- Integration Platform
- Behavior (Non-observable)

Big Data

Filter

Decision Support

Big Data

A Dataset

Simulation
Optimization
Regression
Challenges

1. How do we architect this system?

2. How do we make decisions under the big-data environment?
   - Quickly
   - Accurately
How do we architecture the system for Big Data?
Model-based Systems Engineering

Model-based systems engineering (MBSE) is the formalized application of modeling to support systems requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases.

(Source: INCOSE Systems Engineering Vision, 2007)
SysML

SysML is designed to provide simple but powerful constructs for modeling a wide range of systems engineering problems.

It is particularly effective in specifying requirements, structure, behavior, allocations, and constraints on system properties to support engineering analysis.

(Source: OMG SysML Specification)
Key point: *One* model integrates all four aspects (and it can support execution/computation)
Model of Data Integration
Model of Data Integration
Behavior
Function Relationship
How do we analyze using simulation?
Demo

SysML model (using MagicDraw as authoring tools) to the discrete-event simulation model (AnyLogic).
Model Transformation

No need to learn a specific simulation language.
No need to know the transformation. The transformation algorithm is built based on meta-models.
System structure and behavior are both transformed.
No stereotype is required.
Simulation Generator--Structure

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Simulation Generator--Behavior
Summary

1. SysML provides a formal approach to architecture system structure, behavior, requirements and the corresponding data.

2. The model transformation technology enables a SysML model to transform to the corresponding simulation model.
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