Model-Based Systems Engineering and Prescriptive Simulation

Edward Huang

Assistant Professor

Systems Engineering and Operations Research Department

George Mason University

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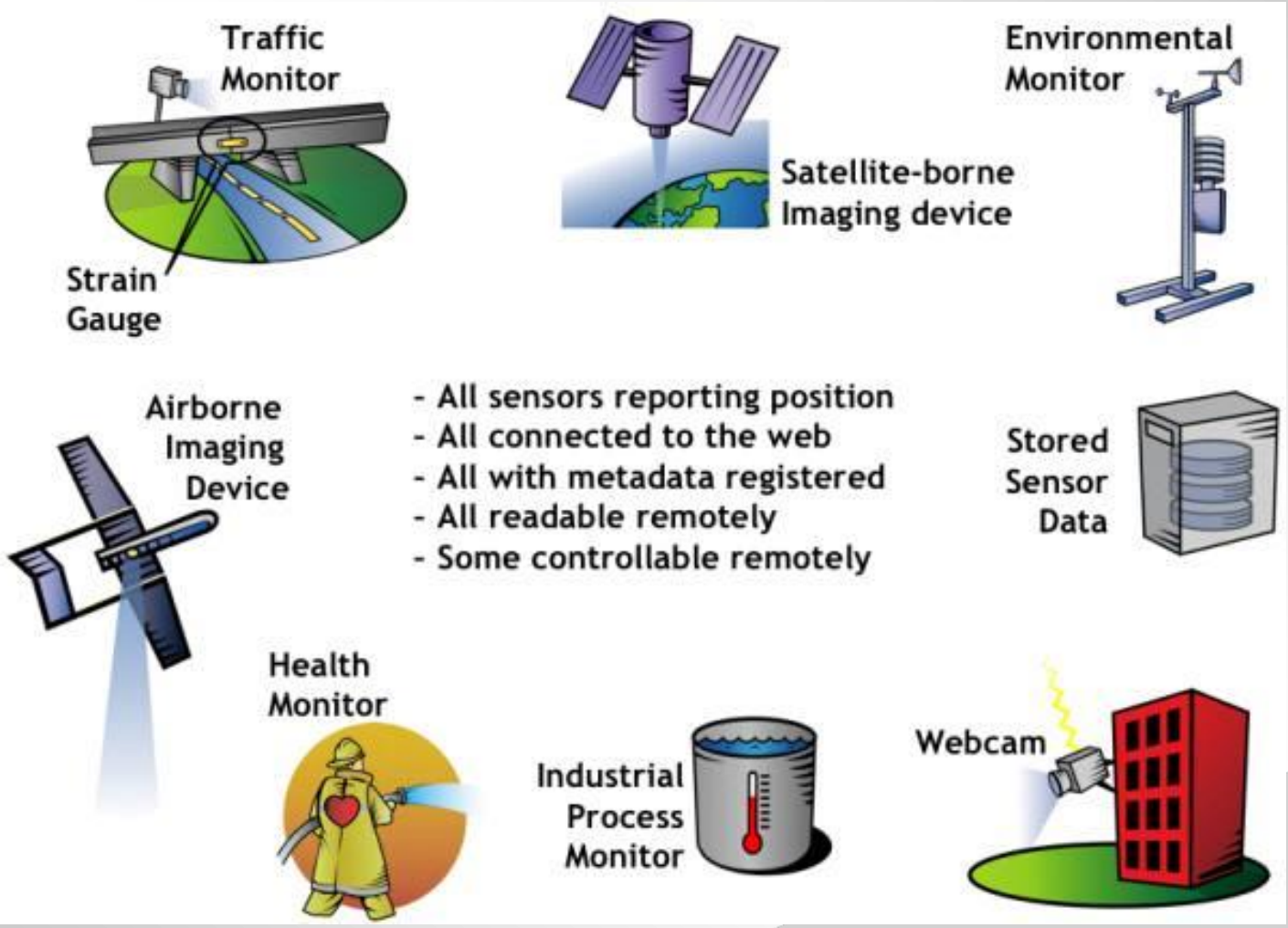
Agenda

- Architecture Challenge of Big Data
- Model-based Systems Engineering
- Prescriptive Simulation in Model-based System Engineering

Big Data Challenge



Source: http://www.opengeospatial.org

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

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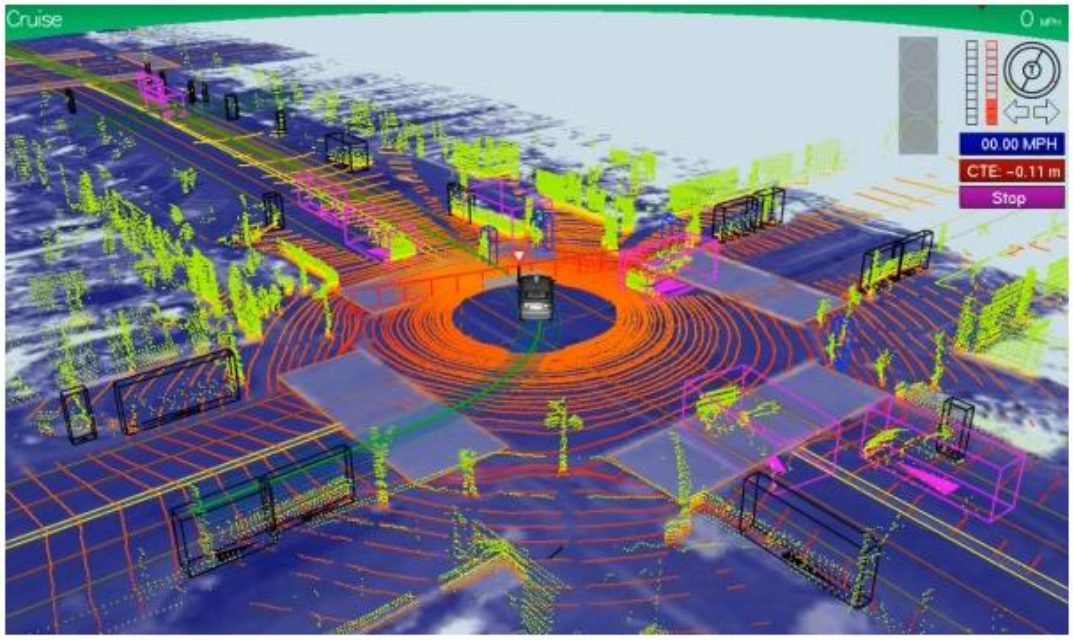
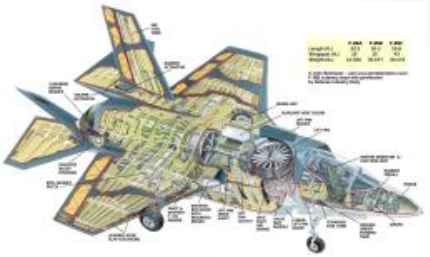


Source: http://betanews.com/

Stages of the Analytics Process

Domains



Data Collection

Sensor

Sensor

Human

Sensor

Data Integration

Structure (Observable)

Integration Platform

Behavior (Non-observable)

Big Data

Big Data

Filter

A Dataset

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Decision Support

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.

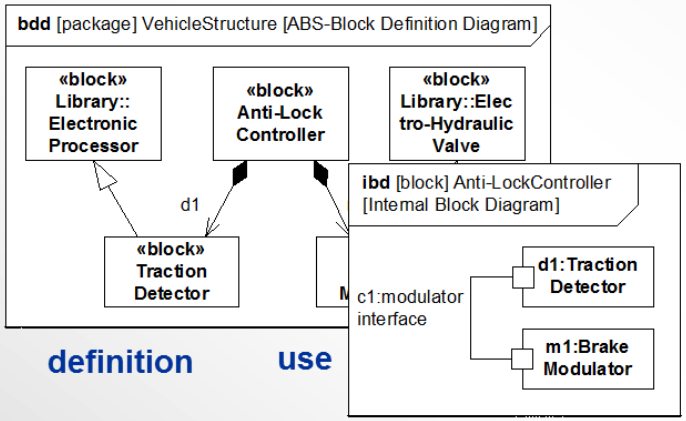
It is particularly effective in specifying requirements, structure, behavior, allocations, and constraints on system properties to support engineering analysis.

(Source: OMG SysML Specification)

SysML

OMG SysML™: Systems Modeling Language

1. Structure

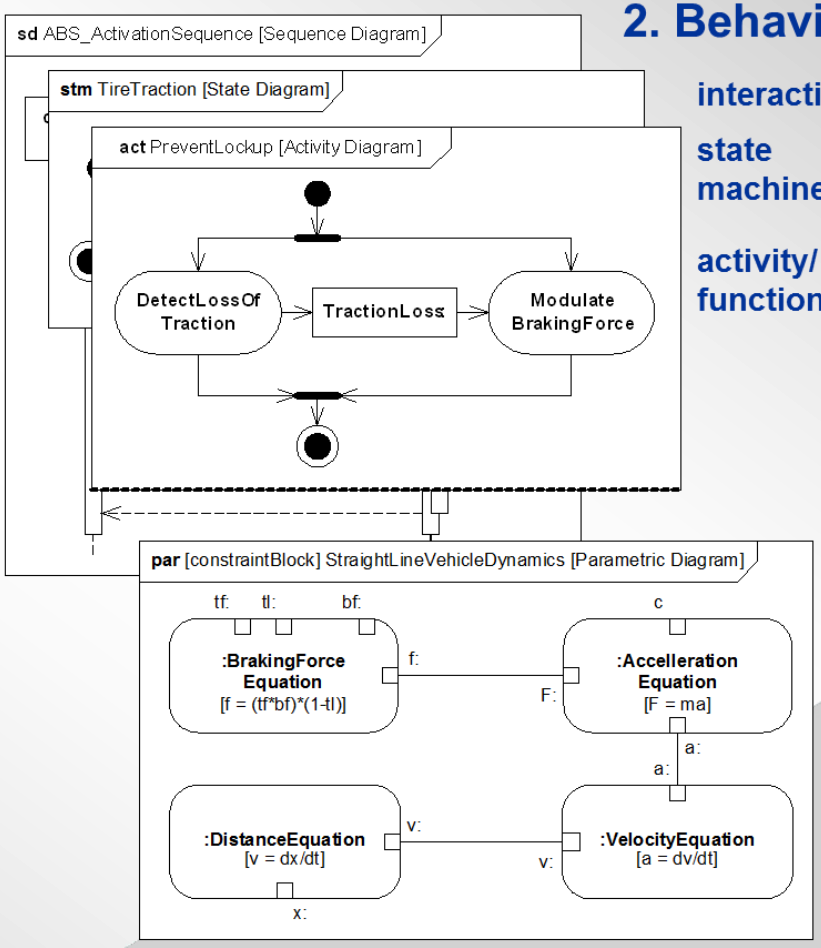


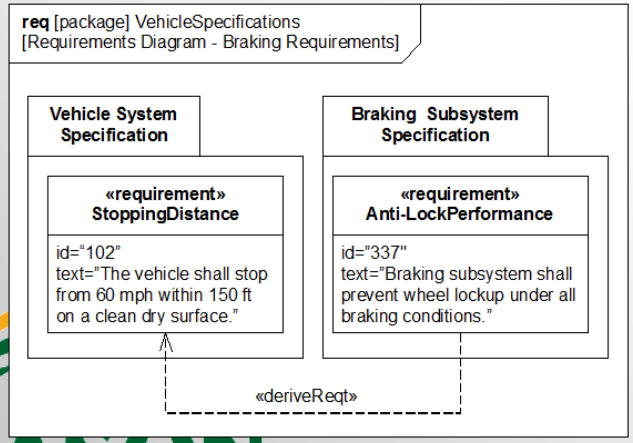
2. Behavior

interaction

state machine

activity/ function





4. Requirements

3. Parametrics

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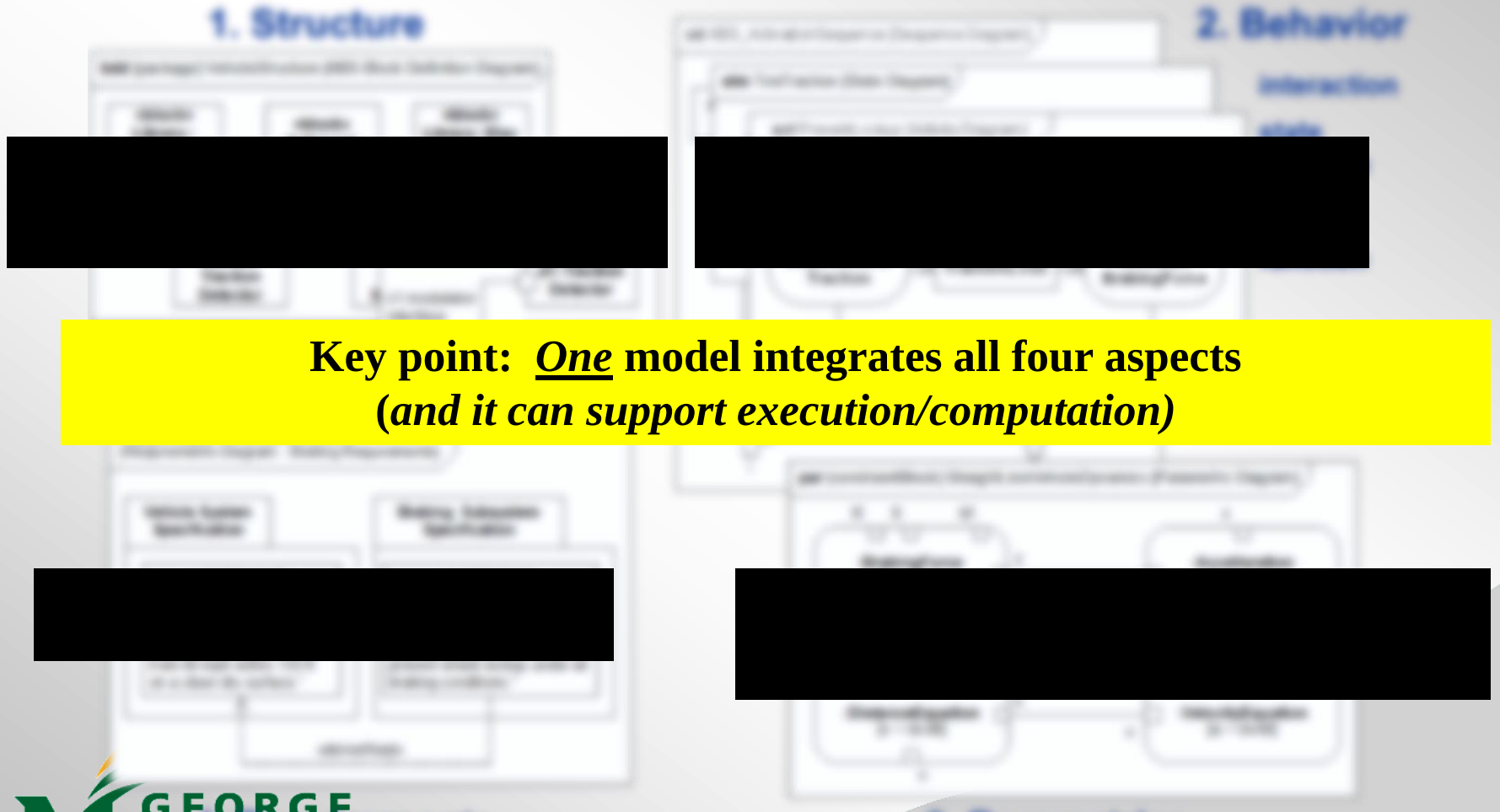

Key point: *One* model integrates all four aspects
(*and it can support execution/computation)*

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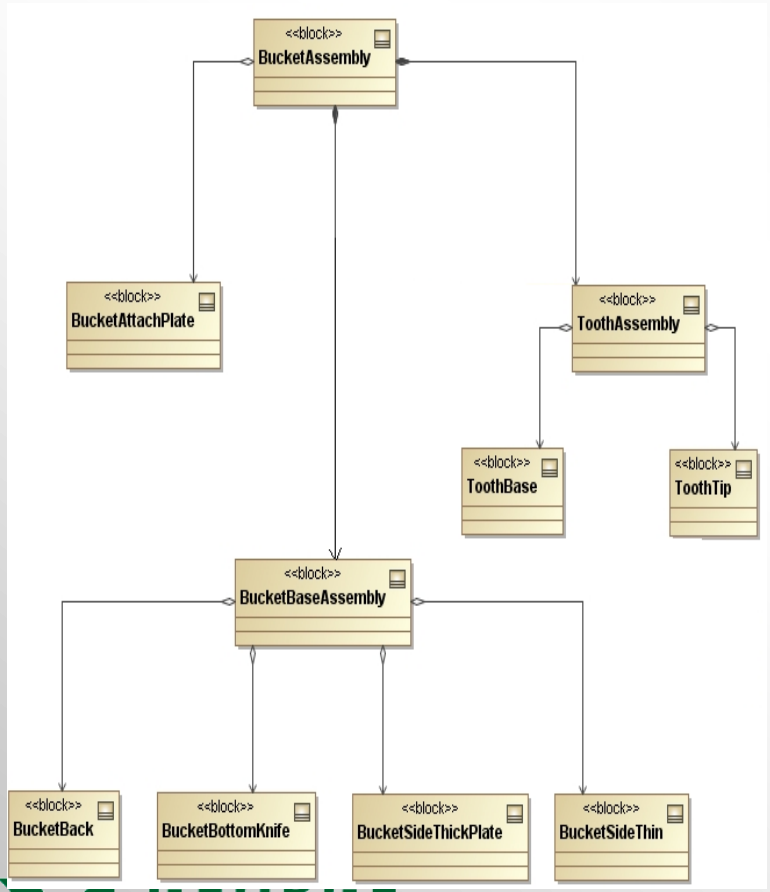
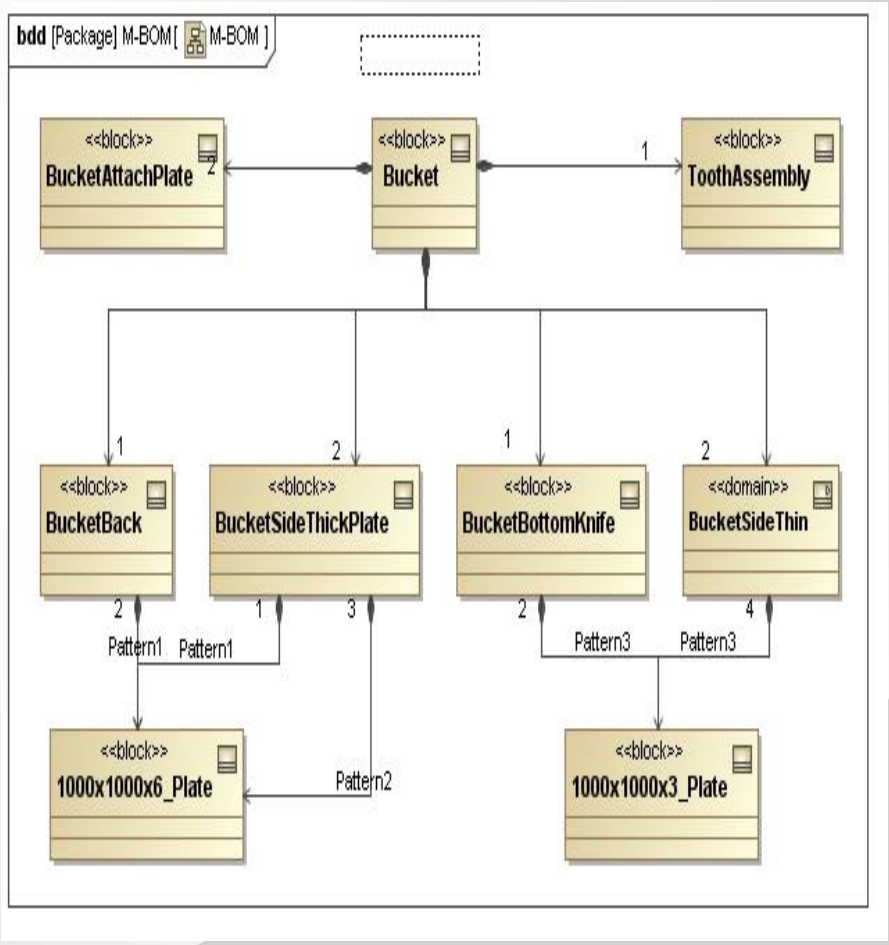
Structure





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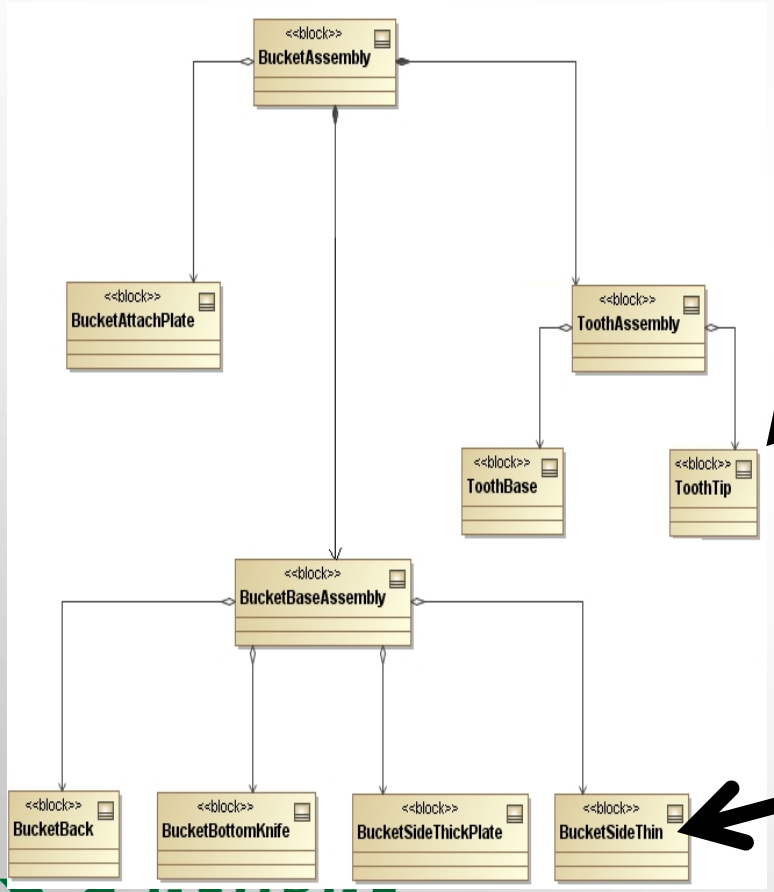
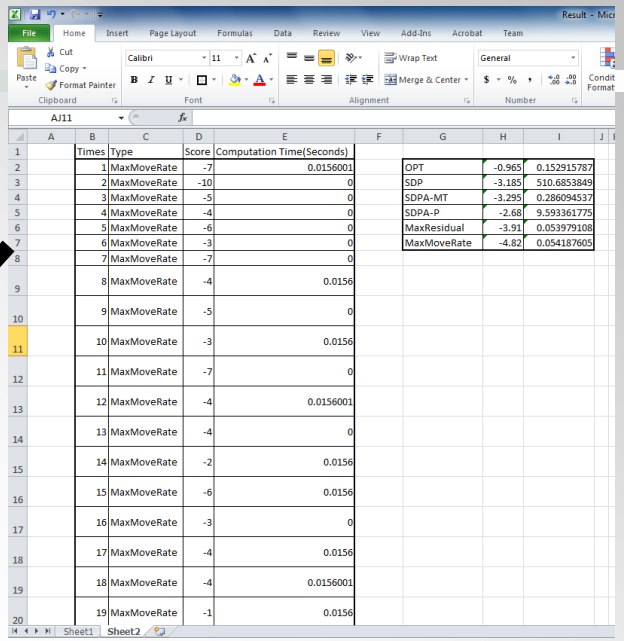
Model of Data Integration





	A	B	C	D	E	F	G	H	I
1		Times	Type	Score	Computation Time(Seconds)				
2		1	MaxMoveRate	-7	0.0156001		OPT	-0.965	0.152915787
3		2	MaxMoveRate	-10	0		SDP	-3.185	510.6853849
4		3	MaxMoveRate	-5	0		SDPA-MT	-3.295	0.286094537
5		4	MaxMoveRate	-4	0		SDPA-P	-2.68	9.593361775
6		5	MaxMoveRate	-6	0		MaxResidual	-3.91	0.053979108
7		6	MaxMoveRate	-3	0		MaxMoveRate	-4.82	0.054187605
8		7	MaxMoveRate	-7	0				
9		8	MaxMoveRate	-4	0.0156				
10		9	MaxMoveRate	-5	0				
11		10	MaxMoveRate	-3	0.0156				
12		11	MaxMoveRate	-7	0				
13		12	MaxMoveRate	-4	0.0156001				
14		13	MaxMoveRate	-4	0				
15		14	MaxMoveRate	-2	0.0156				
16		15	MaxMoveRate	-6	0.0156				
17		16	MaxMoveRate	-3	0				
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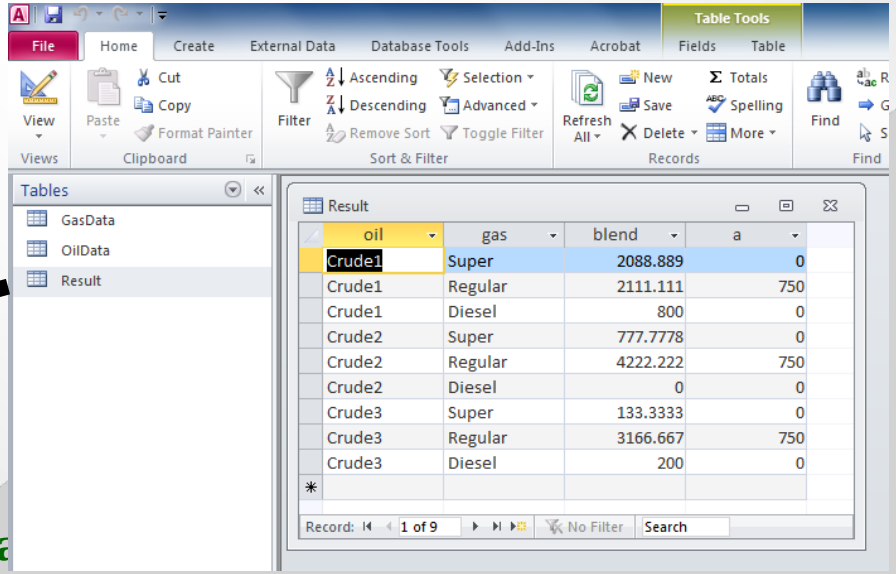

Result

oil	gas	blend	a
Crude1	Super	2088.889	0
Crude1	Regular	2111.111	750
Crude1	Diesel	800	0
Crude2	Super	777.7778	0
Crude2	Regular	4222.222	750
Crude2	Diesel	0	0
Crude3	Super	133.3333	0
Crude3	Regular	3166.667	750
Crude3	Diesel	200	0

Record: 1 of 9

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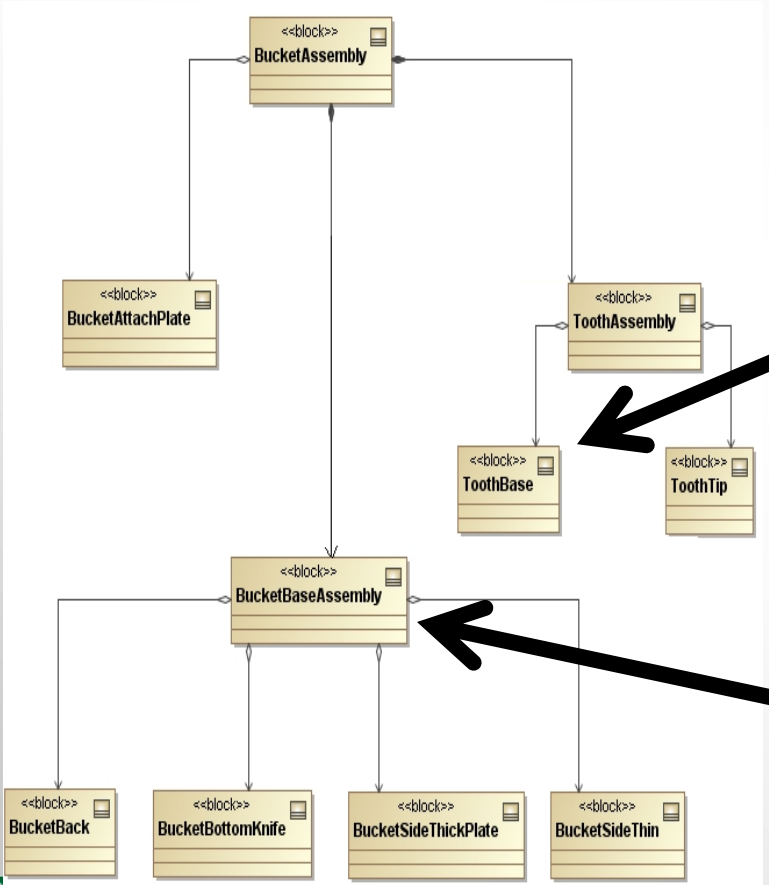
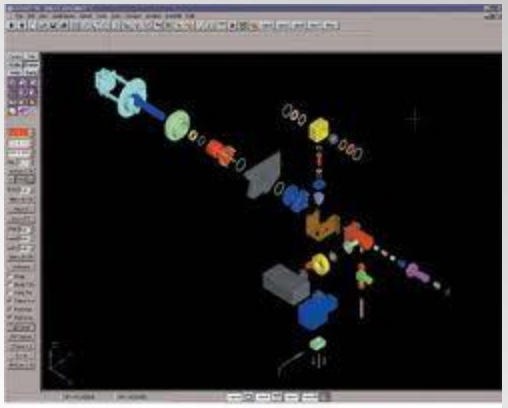
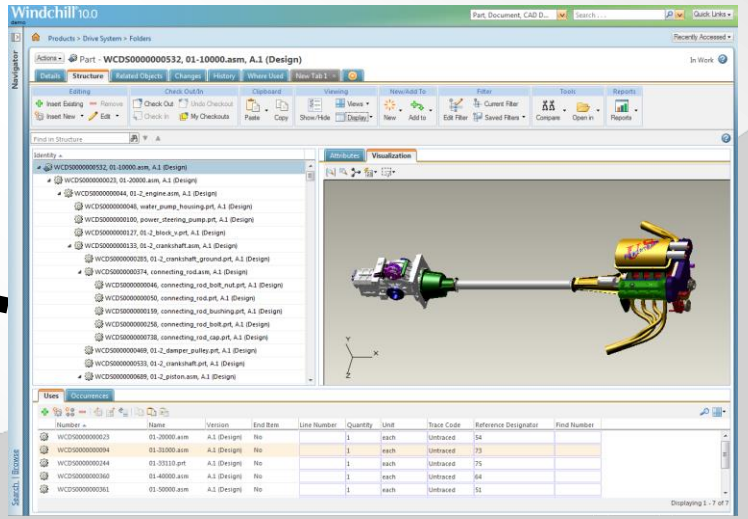
Model of Data Integration







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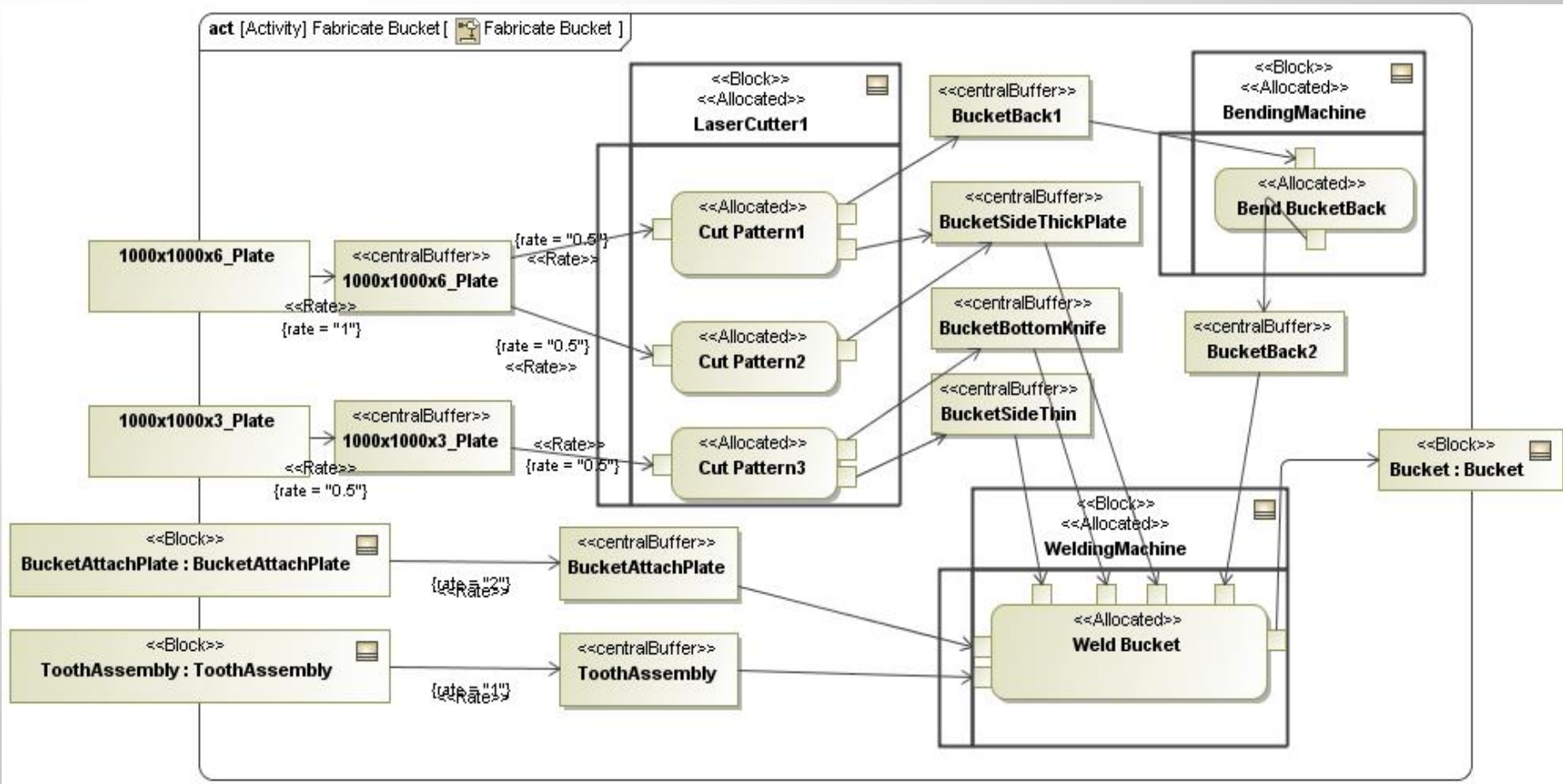
Behavior



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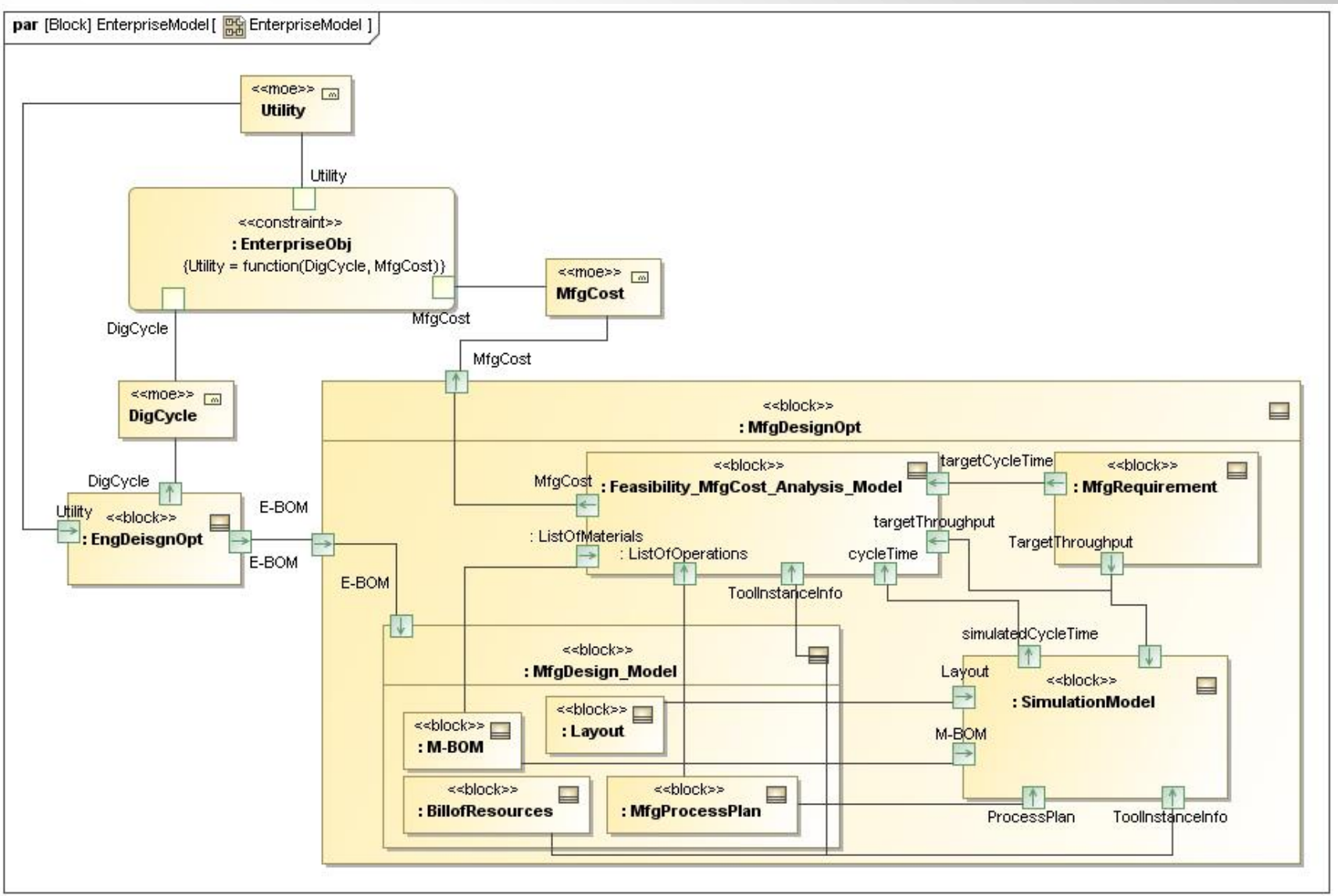
Function Relationship



How do we analyze using simulation?

Demo

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

Model Transformation

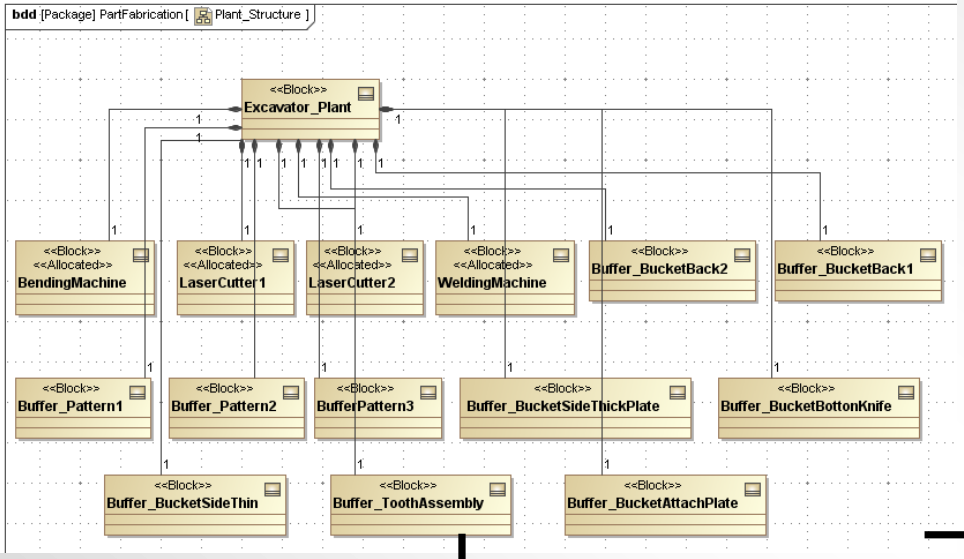
No need to learn a specific simulation language.

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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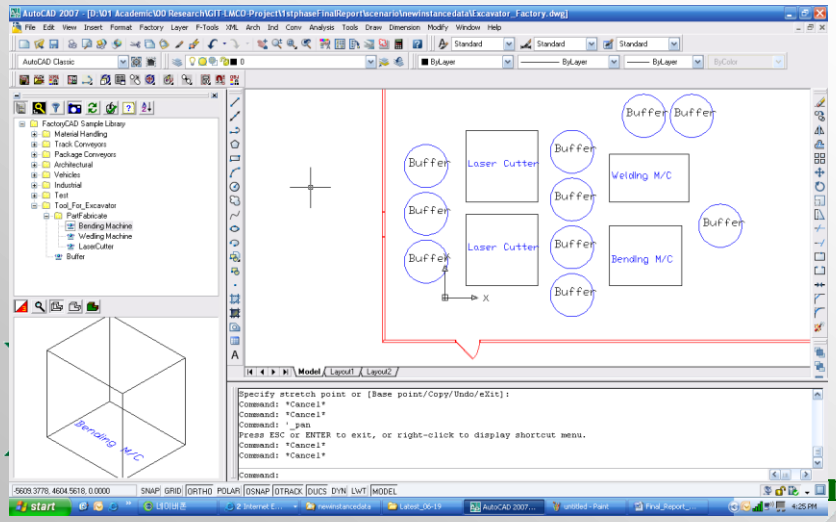

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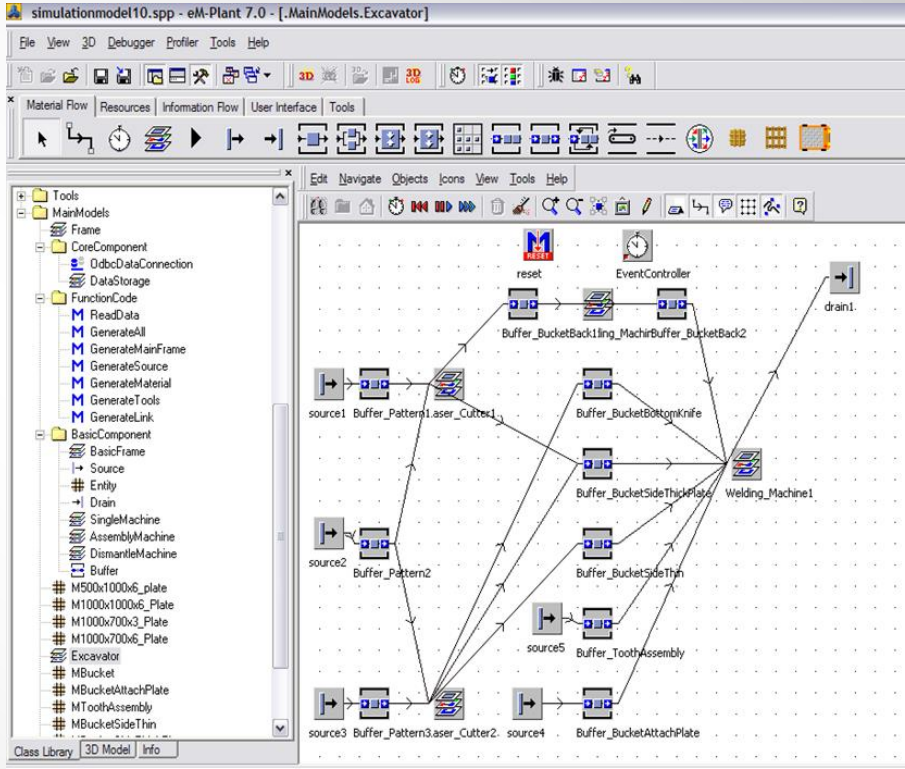
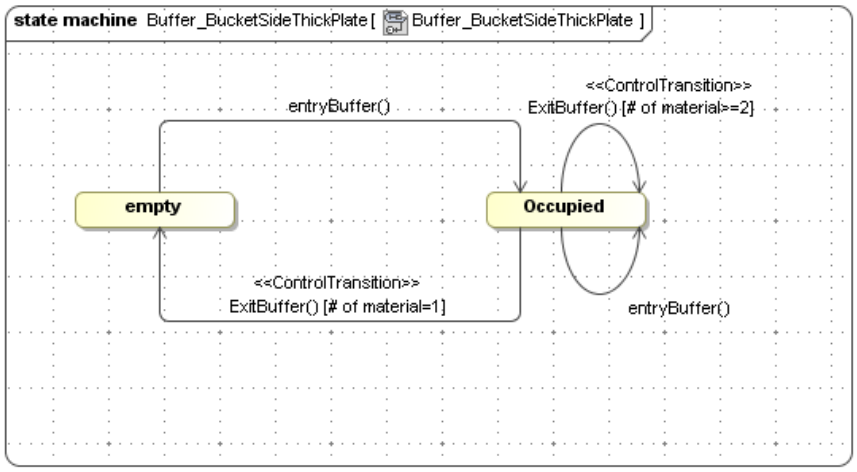


Simulation Generator--Behavior



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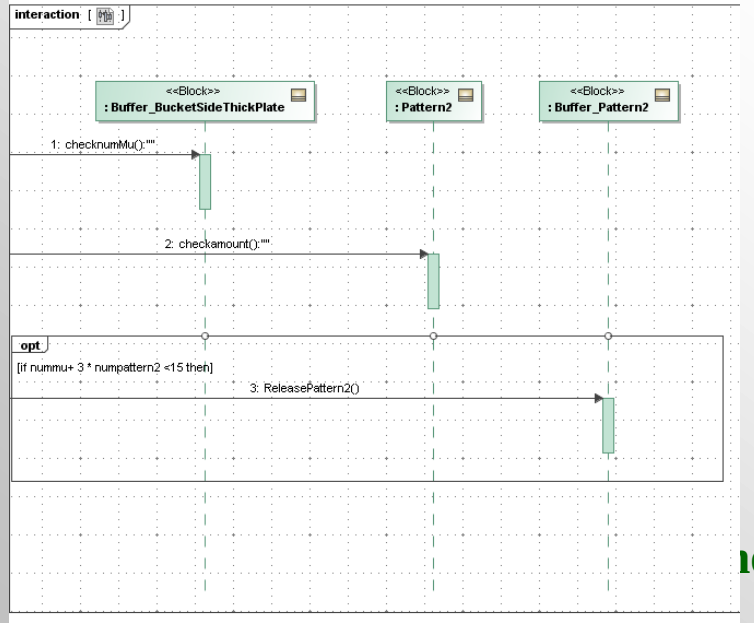

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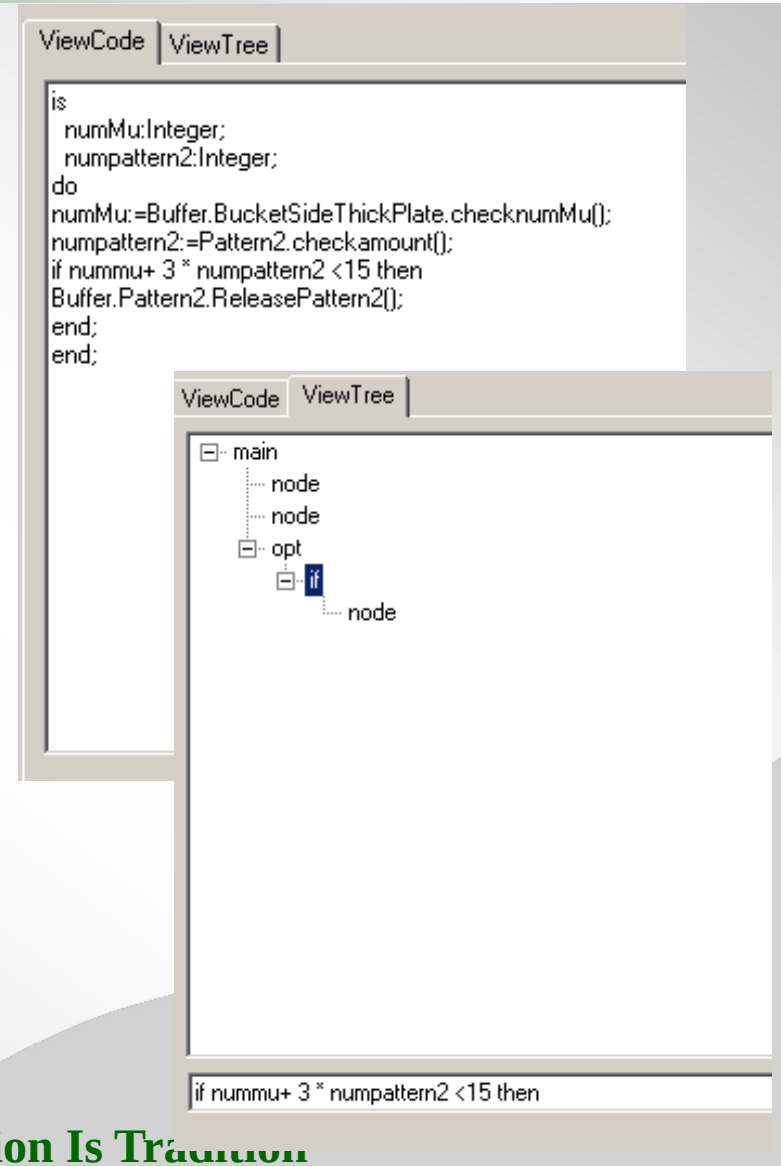

Summary

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.

For more information:

chuang10@gmu.edu

703-993-1672

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