OSLC4MBSE Working Group

Axel Reichwein, Koneksys

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OSLC4MBSE WG Members

Parham Vasaiely, Airbus Group, UK

Axel Reichwein, Koneksys, USA

Allison Barnard Feeney, National Institute of Standards and Technology, USA

Yves Bernard, Airbus, France

Markus Brandstaetter, PROSTEP, Germany

Roger Burkhart, Deere, USA

Jim Conallen, IBM Rational, USA

Amit Fisher, IBM, USA

Sandy Friedenthal, SAF Consulting, USA

Sylvere Krima, Engisis, USA

Mike Loeffler, General Motors, USA

Eldad Palachi, IBM, Israel

Chris Paredis, Georgia Institute of Technology, USA

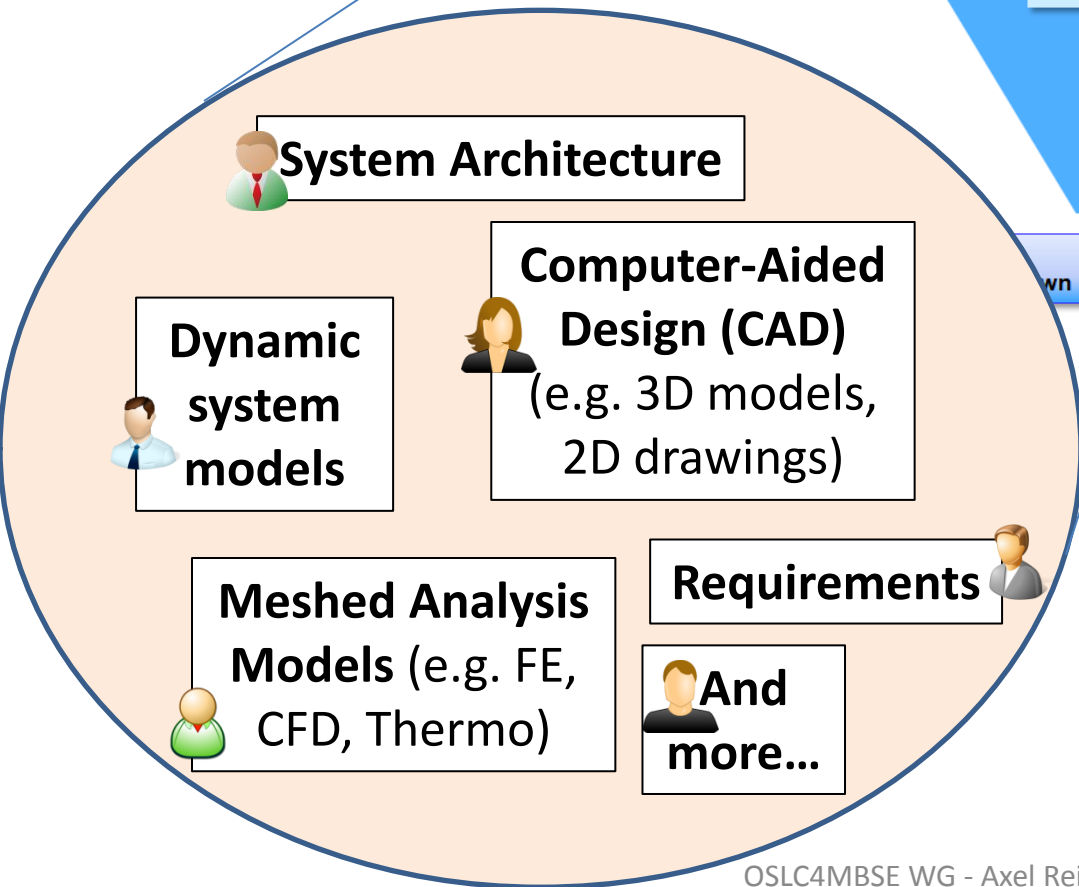Rick Steiner, Raytheon, USA

John Watson, Lockheed Martin, USA
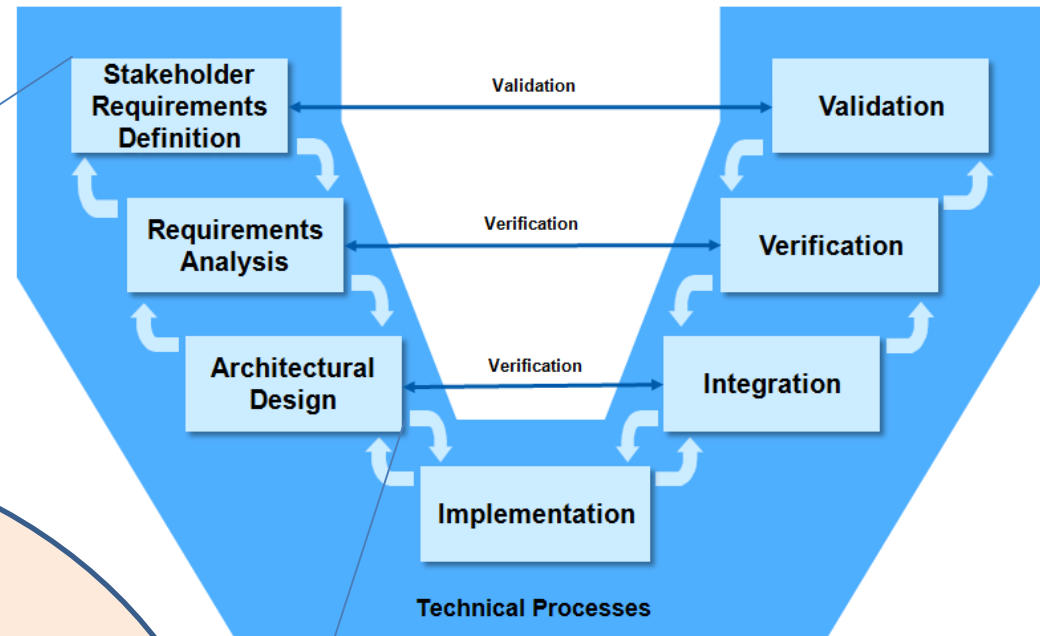
Ron Williamson, Raytheon, USA

Outline

- Integration scenario

- Presentation of OSLC

- What is missing in OSLC?

- What is the OSLC4MBSE working group doing?
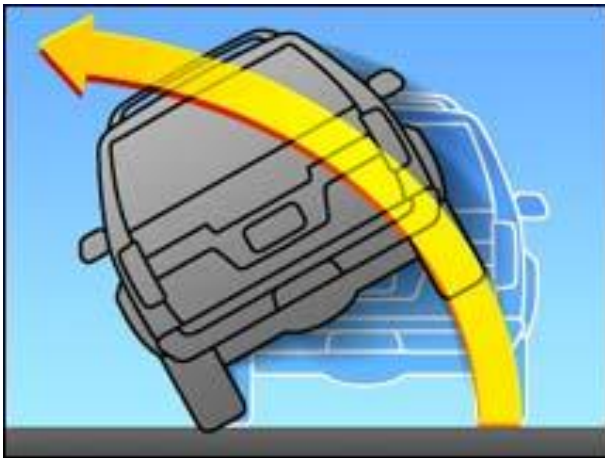
Models for Architectural Design

ISO/IEC/IEEE 15288-Based SE Process V-Model

Many Relationships between Models

Stakeholder Requirements Definition	→ Validation →	Validation
Requirements Analysis	→ Verification →	Verification
Architectural Design	→ Verification →	Integration

Implementation

Technical Processes

Only the core SE Technical Processes are shown.
...wn are the Transition, Operations, Maintenance, and Disposal Processes.

System Architecture

Dynamic system models

Computer-Aided Design (CAD) (e.g. 3D models, 2D drawings)

Meshed Analysis Models (e.g. FE, CFD, Thermo)

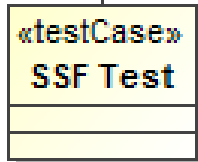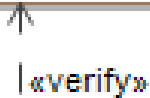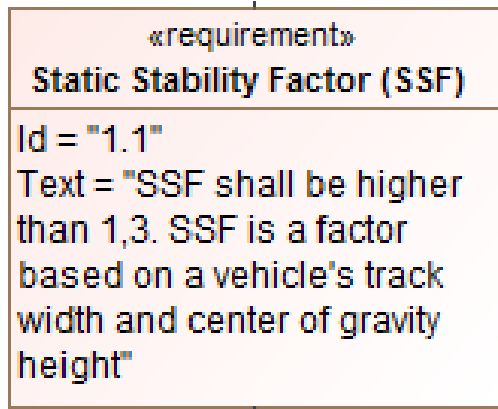**Requirements**

And more...

Problem: Rollover Risk of SUVs

- Higher center of gravity -> higher risk of rollover
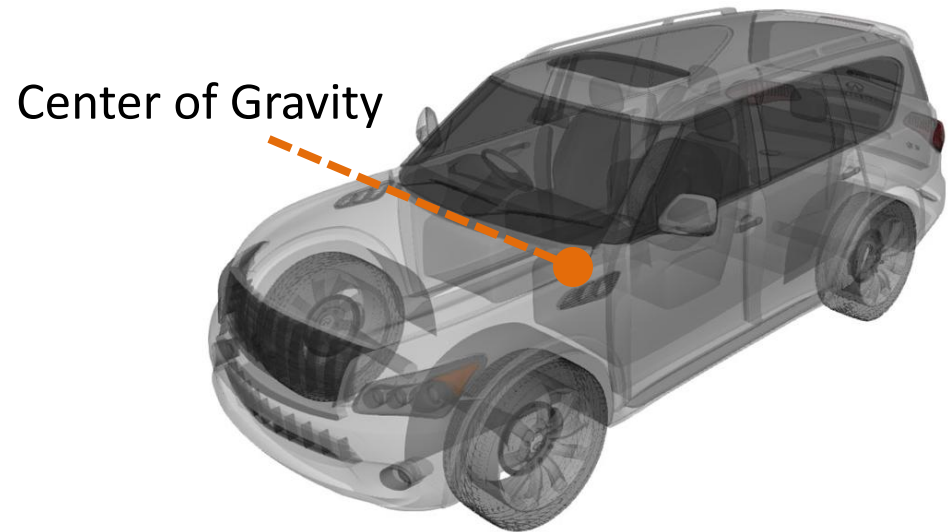- More than a third of all *fatal* crashes in the US are rollovers!

http://www.cars.com/go/crp/buyingGuides/Story.jsp?section=SUV&story=suvSafe2012&subject=stories&referer=&year=New

Static Stability Factor Test

«requirement»
Static Stability Factor (SSF)

Id = "1.1"
Text = "SSF shall be higher than 1,3. SSF is a factor based on a vehicle's track width and center of gravity height"
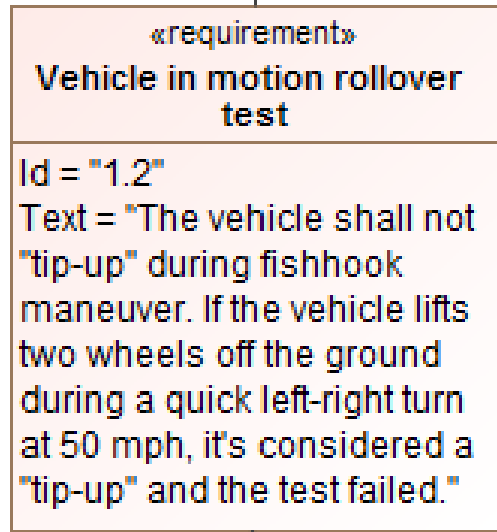
«verify»

«testCase»
SSF Test
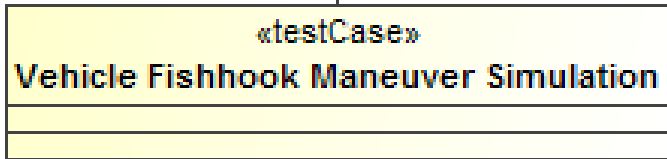
System Engineer defines SSF Test Case

Center of Gravity

Mechanical Engineer computes center of gravity height of new vehicle with payload through geometric model

Fishhook Maneuver Simulation

«requirement»
Vehicle in motion rollover test

Id = "1.2"
Text = "The vehicle shall not "tip-up" during fishhook maneuver. If the vehicle lifts two wheels off the ground during a quick left-right turn at 50 mph, it's considered a "tip-up" and the test failed."
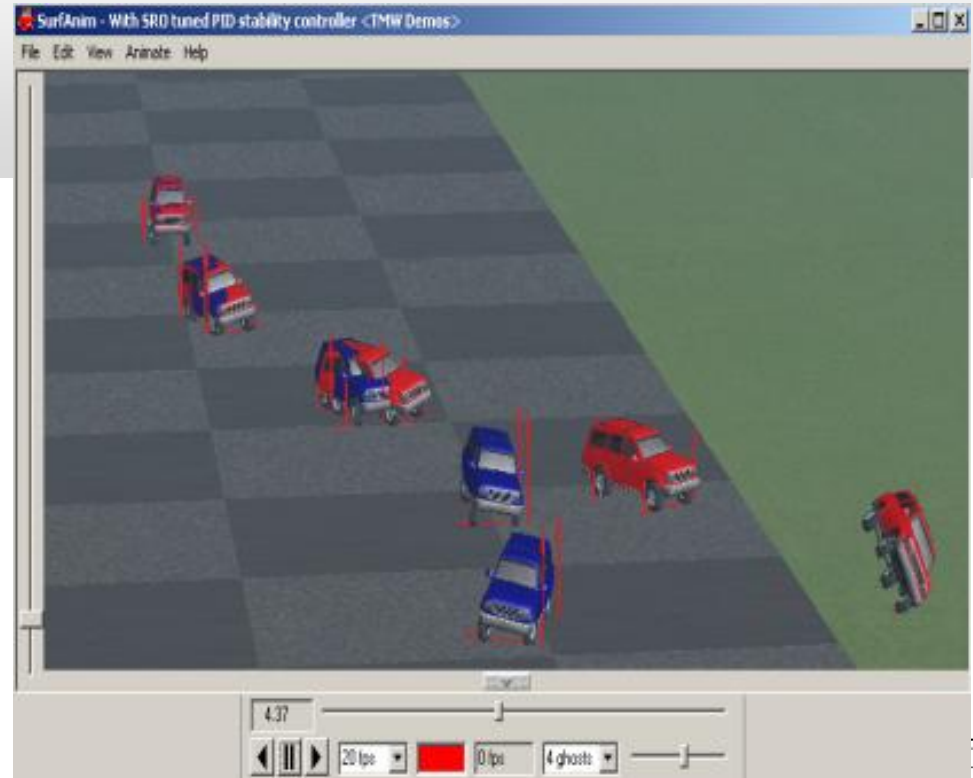
↑
«verify»

«testCase»
Vehicle Fishhook Maneuver Simulation
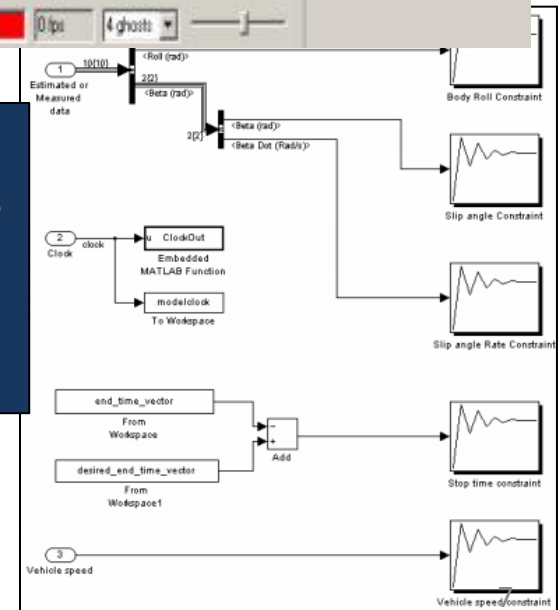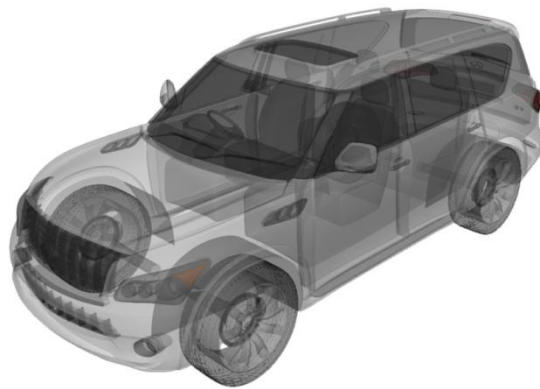
System Engineer defines simulation test case

Mechanical Engineer performs simulation with dynamic system model
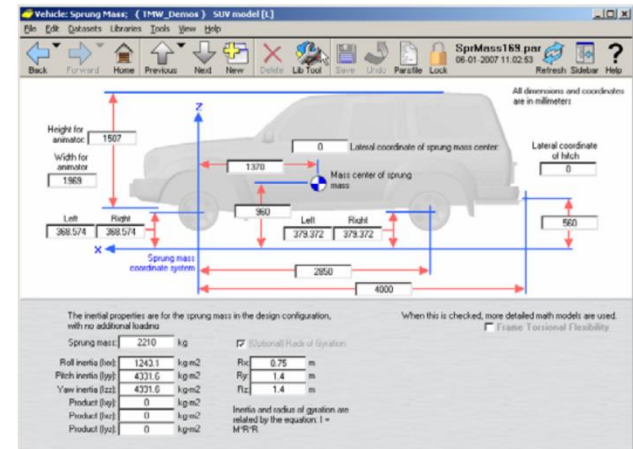
http://www.mathworks.com/tagteam/49380_2008-01-0579_Cherian_Final_1.10.08.pdf

Link between COG Parameter
of Geometric Model and Simulation Model
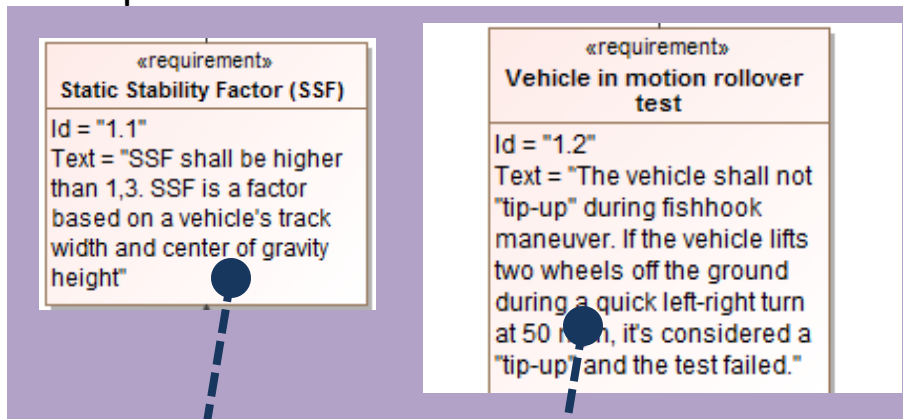

Center of Gravity

+ Moment of Inertia

Center of gravity in geometric model

Center of gravity in simulation model

Relationships between Engineering Data

Requirements

«requirement»
Static Stability Factor (SSF)

Id = "1.1"
Text = "SSF shall be higher than 1,3. SSF is a factor based on a vehicle's track width and center of gravity height"

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Simulation Model

Test Cases

«testCase»
SSF Test

«testCase»
Vehicle Fishhook Maneuver Simulation

Geometric Model

In Reality: Many more Relationships!

Requirements

«requirement»
Static Stability Factor (SSF)

Id = "1.1"
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Vehicle in motion rollover test

Id = "1.2"
Text = "The vehicle shall not "tip-up" during fishhook maneuver. If the vehicle lifts two wheels off the ground during a quick left-right turn at 50 mph, it's considered a "tip-up" and the test failed."

Software

Simulation Model

Test Cases

«testCase»
SSF Test

«testCase»
Vehicle Fishhook Maneuver Simulation
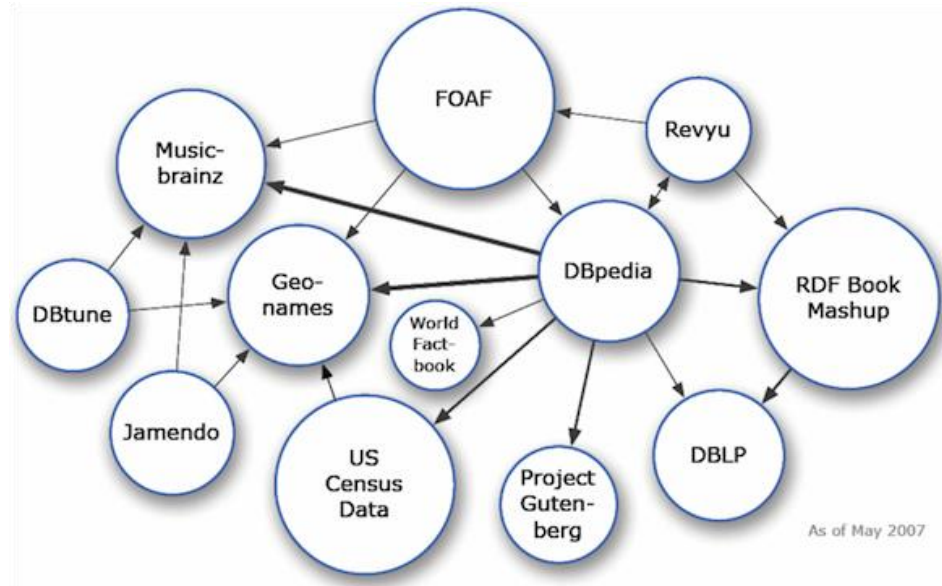
Geometric Model

System Architecture

Relationships on the Web

Linked Web Pages
(Unstructured Data)

Linked Data
(Structured Data)

Linked Data Example

Example Query: Capitals in Europe?

Rendering **DBpedia** Data with Google Map
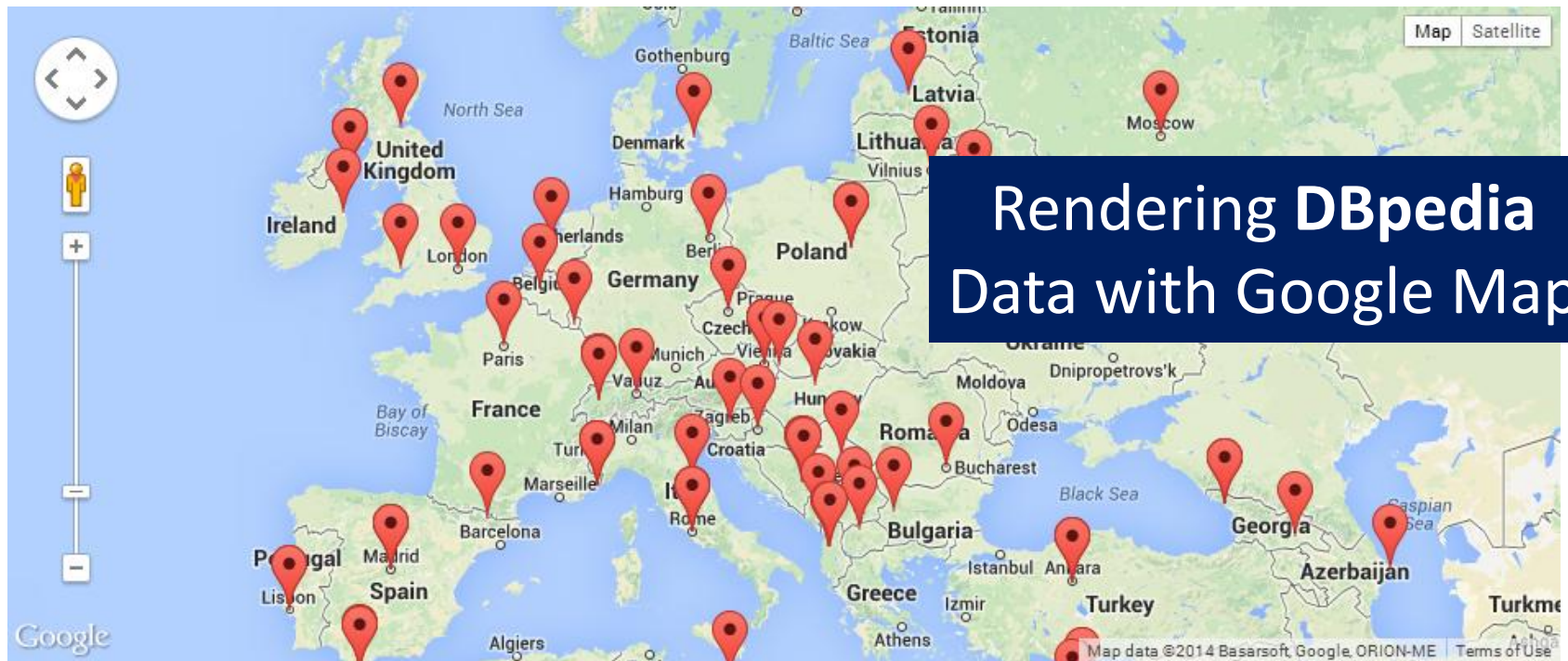
Open Services for Lifecycle Management (OSLC)

- OSLC = Reusing the Web for tool integration

- Based on Web standards **(Linked Data and RESTful Web Services)**

- Initiated by IBM

- Adopted by many tool vendors

- Managed by OASIS

Linked Data Principle 1

Use **URIs** to denote things

«requirement»
Master Cylinder Efficacy

Id = "S5.4.1"
Text = "A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment."

Requirement in
Systems Engineering Tool

URI of Requirement

http://myDomain/myTool/myProject/requirements/S5.4.1

Linked Data Principle 2

Use HTTP URIs so that these things can be referred to and looked up

URI of Requirement

«requirement»
Master Cylinder Efficacy

Id = "S5.4.1"
Text = "A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment."
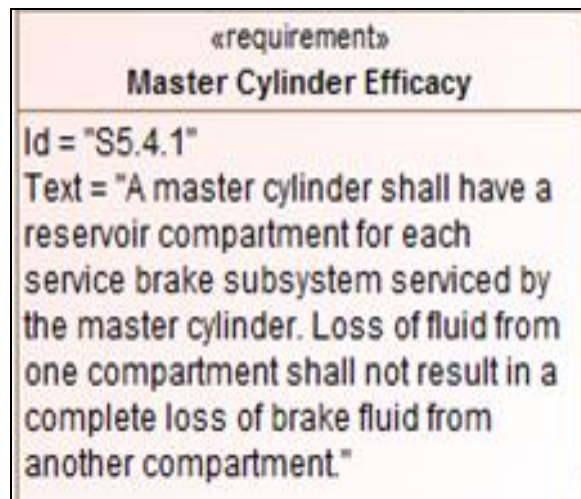
http://myDomain/myTool/myProject/requirements/S5.4.1

HTTP

PDF   HTML   RDF

Requirement in
Systems Engineering Tool

Linked Data Principle 3

Provide useful information about the thing when its URI is dereferenced, leveraging standards such as **RDF**, SPARQL.

«requirement»
Master Cylinder Efficacy

Id = "S5.4.1"
Text = "A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment."

Requirement in
Systems Engineering Tool

URI of Requirement

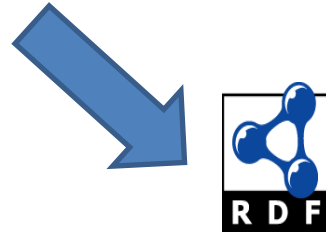**http://myDomain/myTool/my Project/requirements/S5.4.1**
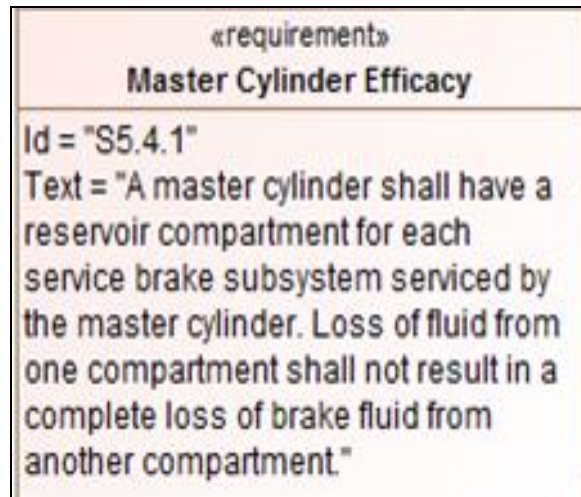
HTTP

W3C standard for data interchange on the Web
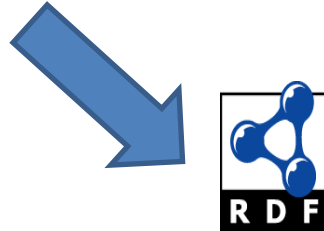
Resource Description Framework (RDF)

«requirement»
Master Cylinder Efficacy

Id = "S5.4.1"
Text = "A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment."

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy"	**name**	„Master Cylinder Efficacy"
Requirement „Master Cylinder Efficacy"	**id**	„S5.4.1"
Requirement „Master Cylinder Efficacy"	**text**	„A master cylinder shall…"
Requirement „Master Cylinder Efficacy"	**type**	Requirement

Resource Description Framework (RDF)

«requirement»
Master Cylinder Efficacy

Id = "S5.4.1"
Text = "A master cylinder shall have a reservoir compartment for each service brake subsystem serviced by the master cylinder. Loss of fluid from one compartment shall not result in a complete loss of brake fluid from another compartment."

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **http://.../requirements/S5.4.1**	**text** **http://.../myvocabulary/text**	„A master cylinder shall…"
Requirement „Master Cylinder Efficacy" **http://.../requirements/S5.4.1**	**type** **http://.../myvocabulary/type**	**Requirement** **http://.../myvocabulary/requirement**

Resource Description Framework (RDF)
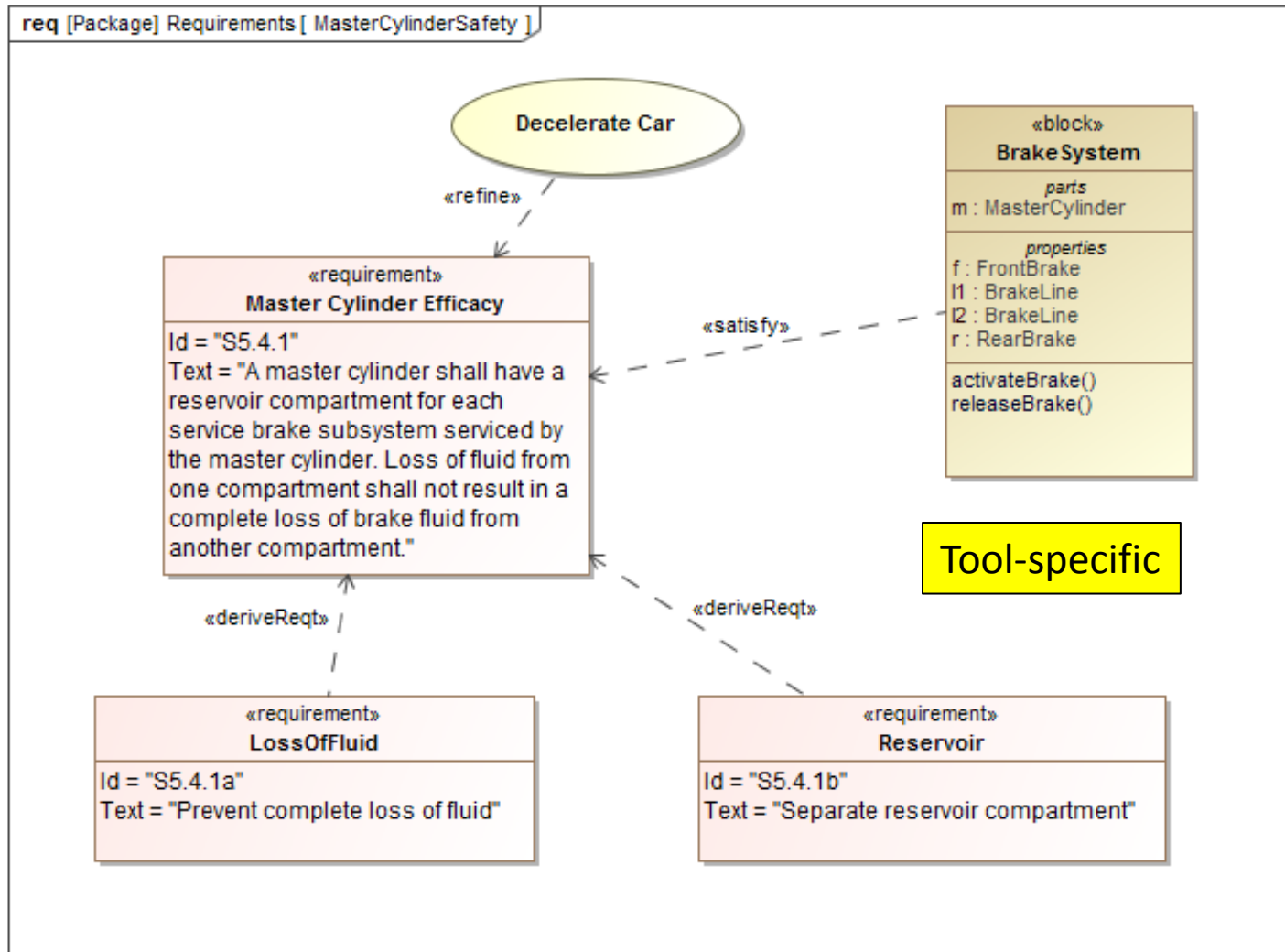
Requirement „Master Cylinder Efficacy"

http://.../requirements/S5.4.1

http://.../myvocabulary/text

http://.../myvocabulary/type

String literal

„A master cylinder shall..."

Requirement Resource type
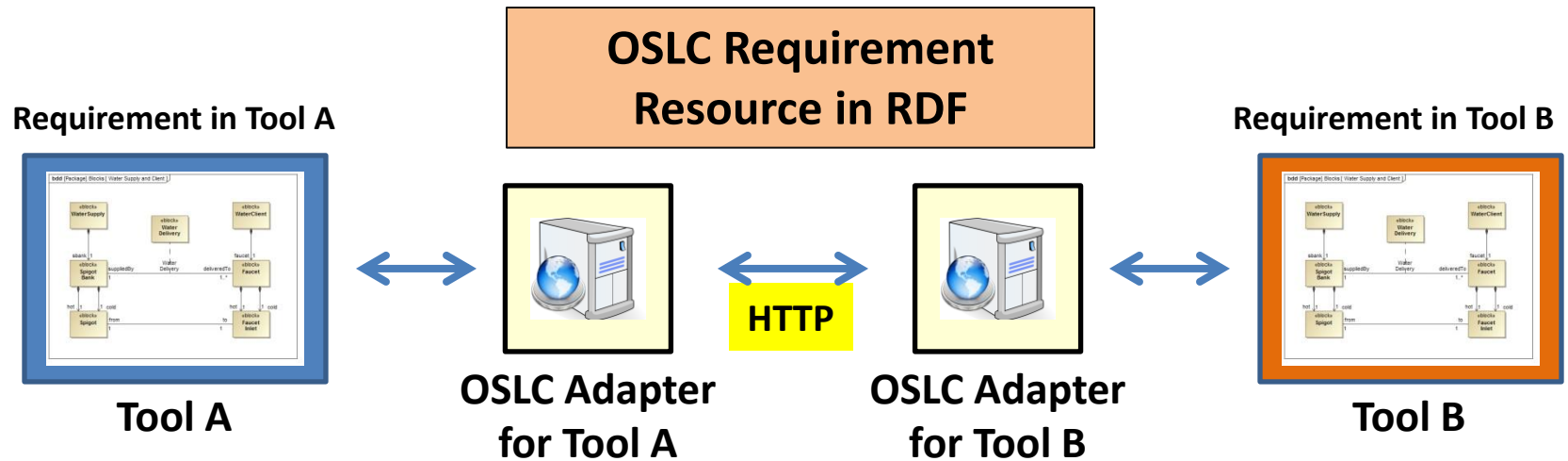
http://.../myvocabulary/requirement

Linked Data Principle 4

Include links to other related things (using their URIs) when publishing data on the Web.

Interoperability Through OSLC

OSLC Requirement Resource in RDF

Requirement in Tool A

Tool A

OSLC Adapter for Tool A

HTTP

OSLC Adapter for Tool B

Requirement in Tool B

Tool B

Interoperability Through Standardized URIs

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**text** **http://.../myvocabulary/text**	„A master cylinder shall…"
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**type** **http://.../myvocabulary/type**	**Requirement** **http://.../myvocabulary/requirement**

Interoperability Through Standardized URIs

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**description** **http://purl.org/dc/elements/1.1/description**	„A master cylinder shall…"
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**type** **http://www.w3.org/1999/02/22-rdf-syntax-ns#type**	**Requirement** **http://open-services.net/ns/rm#Requirement**

URIs With Namespace Prefixes

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**description** **dcterms: description**	„A master cylinder shall…"
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**type** **rdf:type**	**Requirement** **oslc_rm: Requirement**

URIs from OSLC
Requirements Management Vocabulary

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**elaboratedBy** **oslc_rm:elaboratedBy**	**Use Case** „Decelerate Car" **Any HTTP URI**
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**satisfiedBy** **oslc_rm:satisfiedBy**	**Block** „Brake System" **Any HTTP URI**

Extensible Resources

Subject	Predicate	Object
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**elaboratedBy** **oslc_rm:elaboratedBy**	**Use Case** „Decelerate Car" **Any HTTP URI**
Requirement „Master Cylinder Efficacy" **Any HTTP URI**	**hyperlink** **my_vocab: hyperlink**	**Wiki page** **Any HTTP URI**

Standardized RDF Vocabularies for Interoperability

OSLC Requirement Management Vocabulary in RDFS

refers to

Standardized URIs for resource properties and resource types

OSLC Requirement Resource in RDF

Requirement in Tool A
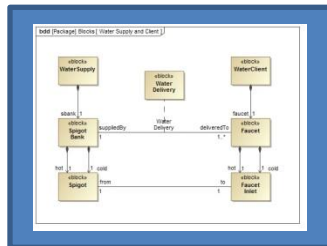
Requirement in Tool B
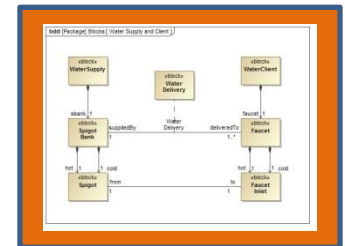
HTTP

Tool A

OSLC Adapter for Tool A

OSLC Adapter for Tool B

Tool B

OSLC Resource Shapes for Defining Additional Constraints on RDF data
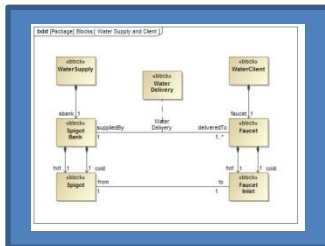
OSLC Requirement Management Vocabulary in RDFS

OSLC Requirement Resource Shape defined with OSLC Core Vocabulary
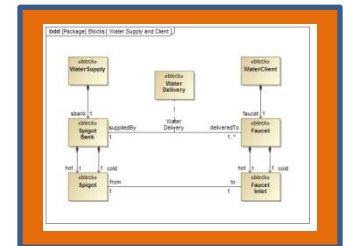
refers_to

conforms_to

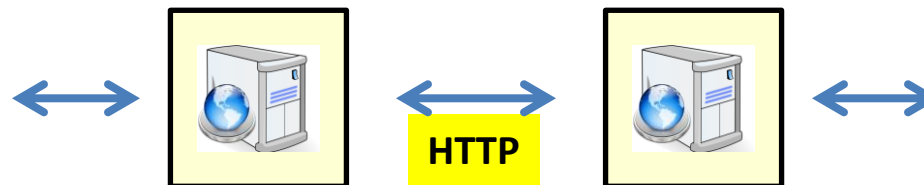**OSLC Requirement Resource in RDF**

Requirement in Tool A

Requirement in Tool B

Tool A

OSLC Adapter for Tool A

HTTP

OSLC Adapter for Tool B

Tool B

| Domain	Status
Core	2.0
Architecture Management	2.0
Asset Management	2.0
Automation	2.0
Change Management	2.0
Performance Monitoring	2.0
Quality Management	2.0
Reconciliation	2.0
Requirements Management	2.0
Reporting	Converge
ALM/PLM Interoperability	Draft
Estimation and Measurement	Draft
Configuration Management	Scope

Missing OSLC Specifications

System Architecture
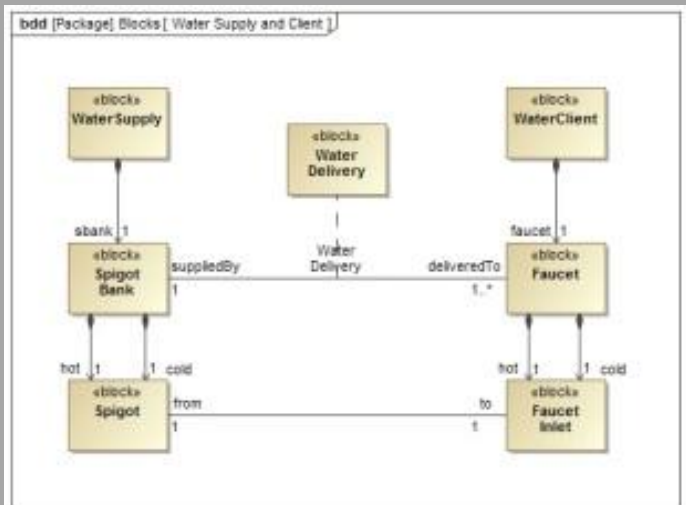
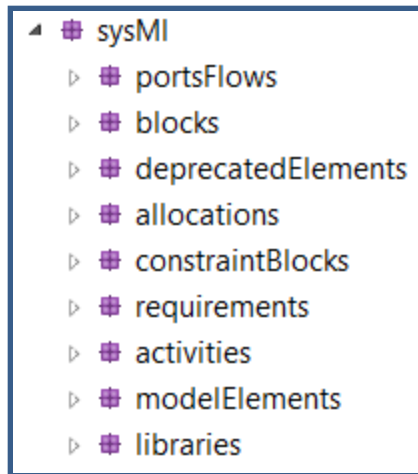**Dynamic Simulation**
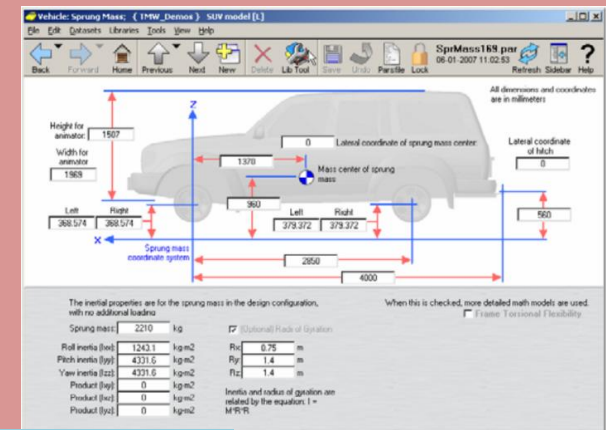
3D Geometry (CAD)
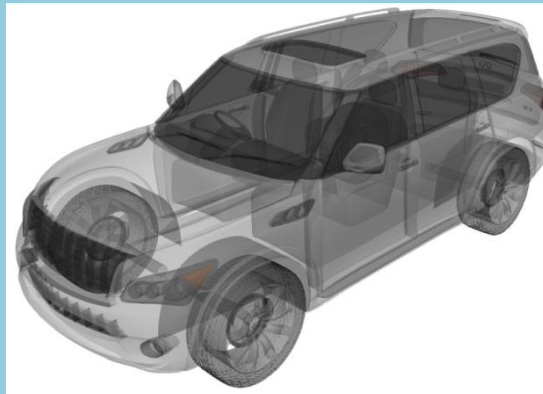
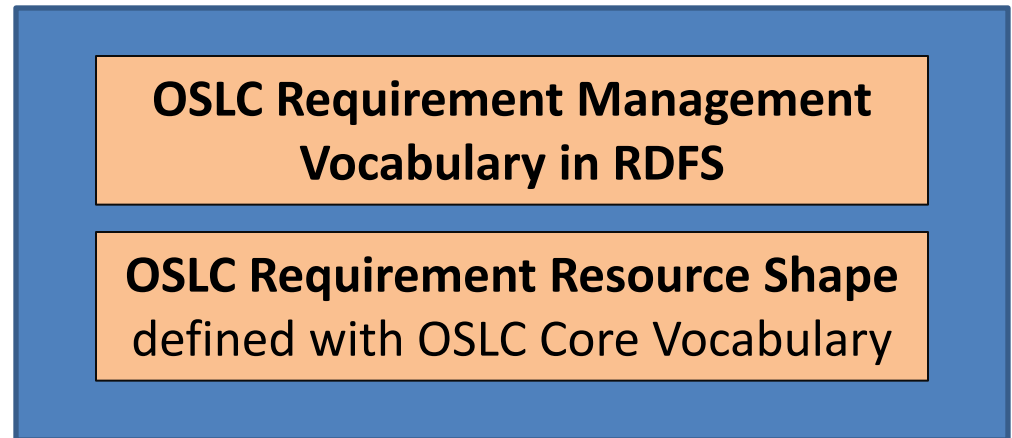# Defining OSLC Spec for System Architectures

- Reuse existing SysML standard

- Convert SysML standard into OSLC specification (RDF Vocabulary + OSLC Resource Shapes)

- Align RDF vocabulary for SysML with existing RDF vocabularies

- Standardize the RDF vocabulary for SysML

Model-driven Generation of OSLC Specification

SysML Metamodel

```
▲ ⊞ sysMl
   ▷ ⊞ portsFlows
   ▷ ⊞ blocks
   ▷ ⊞ deprecatedElements
   ▷ ⊞ allocations
   ▷ ⊞ constraintBlocks
   ▷ ⊞ requirements
   ▷ ⊞ activities
   ▷ ⊞ modelElements
   ▷ ⊞ libraries
```

OSLC Specification

> **OSLC Requirement Management Vocabulary in RDFS**
>
> **OSLC Requirement Resource Shape** defined with OSLC Core Vocabulary

OSLC4MBSE Tasks

- Define OSLC Specification for describing system architectures

- Collect use case scenarios from the systems engineering community

- Share use case scenarios with OSLC community

- Get technical feedback from OSLC community

Summary

- **OSLC** = Reusing the Web infrastructure for tool integration

- **Interoperability** through standardized RDF vocabularies

- **OSLC4MBSE** Working Group
  - Definition of new RDF vocabularies for engineering data
  - Bridge between systems engineering and OSLC communities