OSLC4MBSE Use Case Scenario

OSLC4MBSE Working Group

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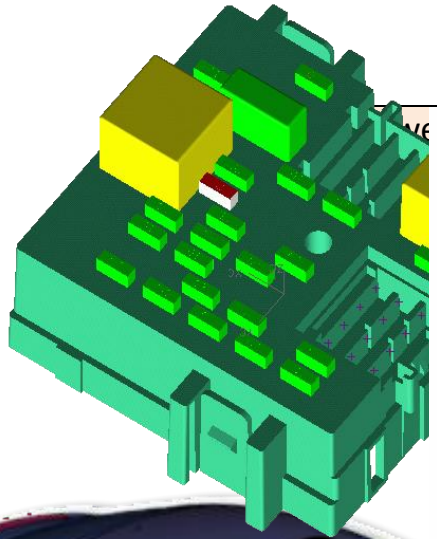
Integration & MBSE

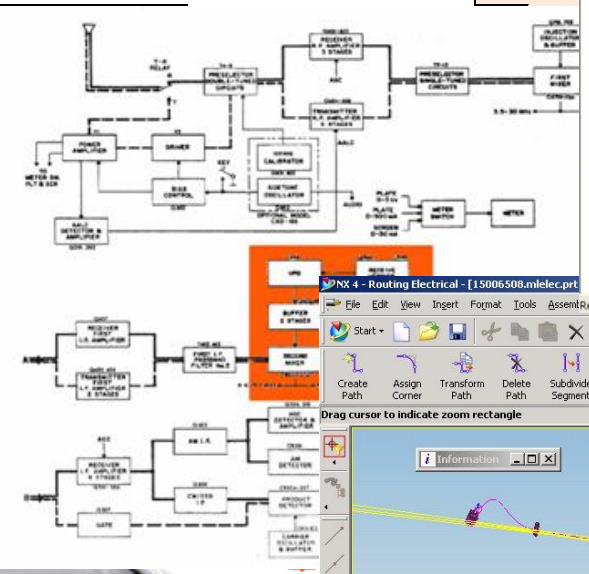
- Integration is an important topic in the OMG/INCOSE MBSE Initiative!

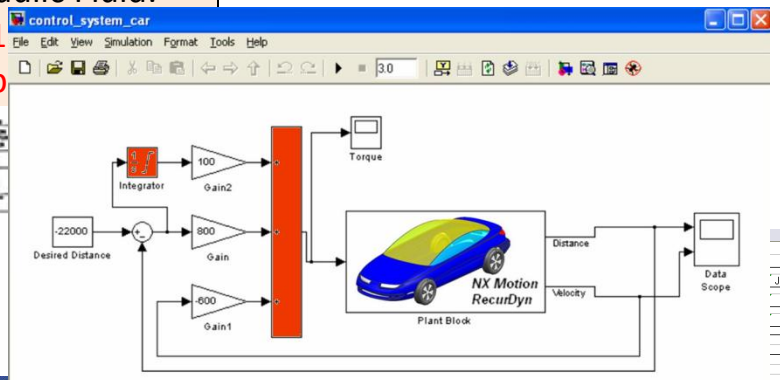
- See Example on next slide from the MBSE Initiative Overview (http://www.omgwiki.org/MBSE/lib/exe/fetch.php?media=wiki:mbse_initiative_overview-111209.pptx)

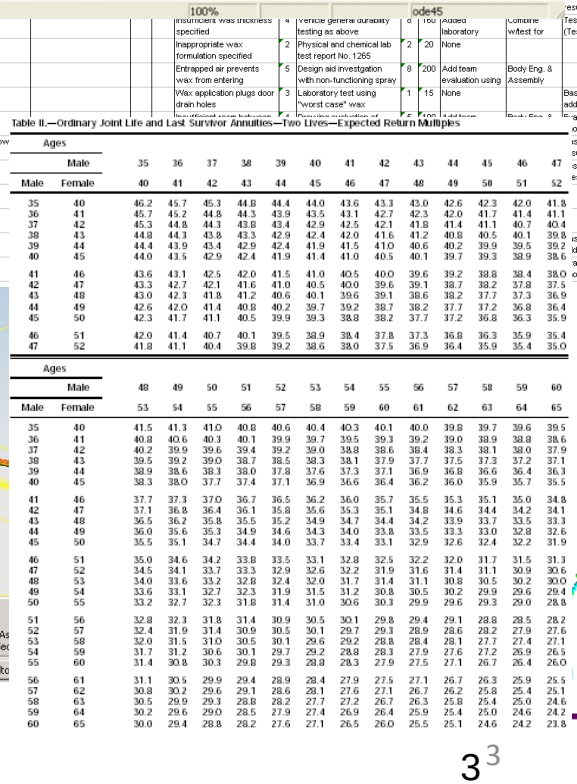
Integrated Systems Engineering Vision

Hydraulic Fluid:
SAE 1
comp







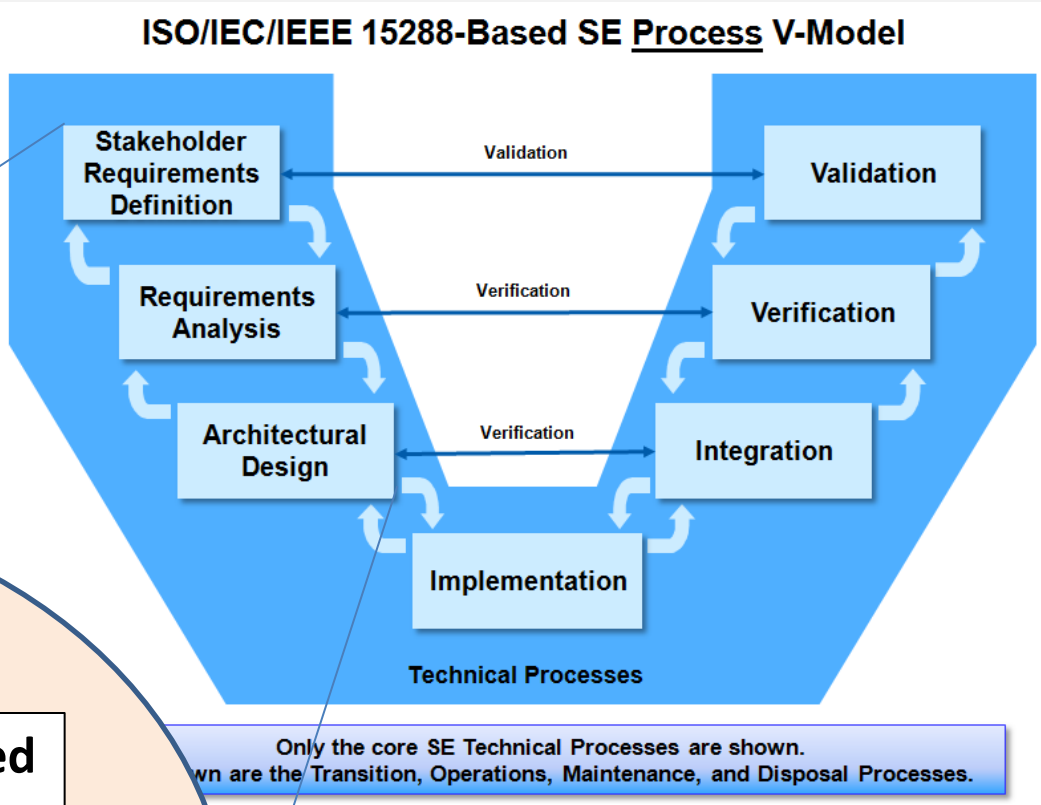


Minimum Turn Radius: 24 ft.
Dry Pavement Braking Distance at 60 MPH : ~~110 ft~~. 90 ft

OSLC4MBSE Scenario

- Similar to the „Integrated Systems Engineering Vision“ Scenario
- Based on the Hybrid SUV example (http://www.omg.org/ocsmp/HSUV.pdf)
- Including a system model
- Considering dependencies between system model and simulation models

Models for Architectural Design



Many relationships between models

System Architecture

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

Dynamic system models

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

Requirements

And more…

Scenario Example: SUV with Rooftop Payload

New Requirement: **SUV shall support a Rooftop Payload (300kg)**

Example #1: Solar panels incorporated in glass for supporting vibrations

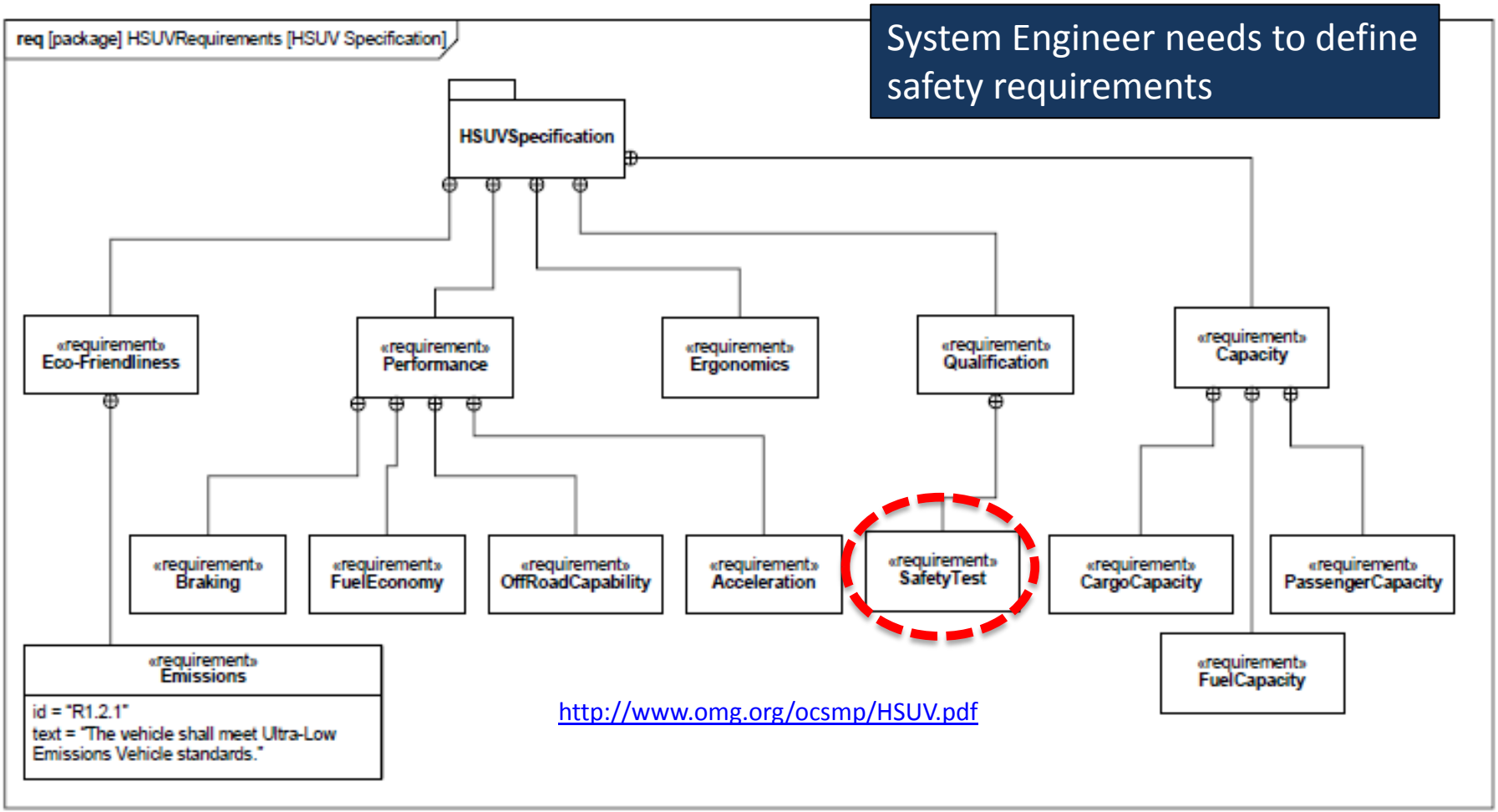
Example #2: Cargo

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!*

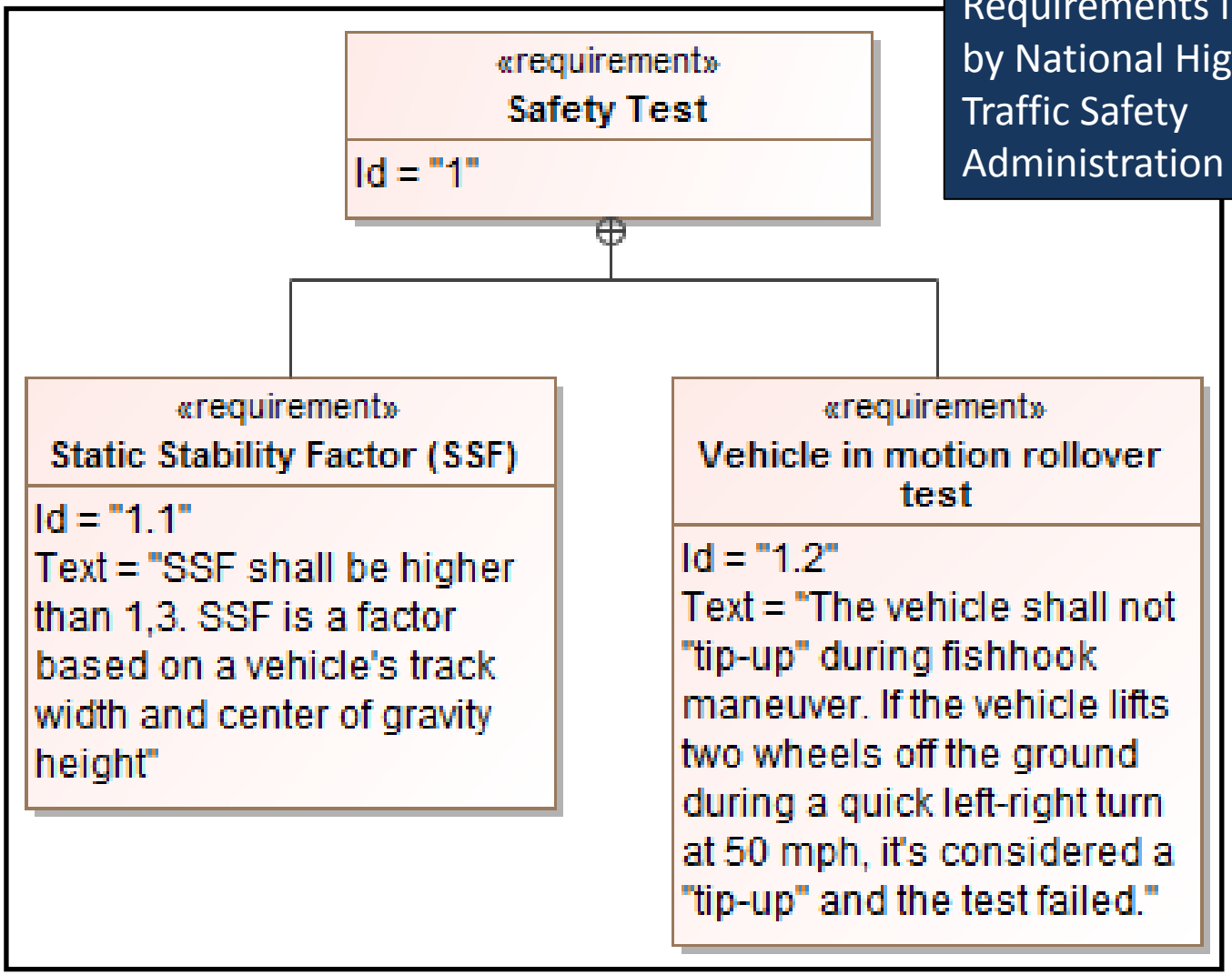
*http://www.cars.com/go/crp/buyingGuides/Story.jsp?section=SUV&story=suvSafe2012&subject=stories&referer=&year=New

Safety Requirements



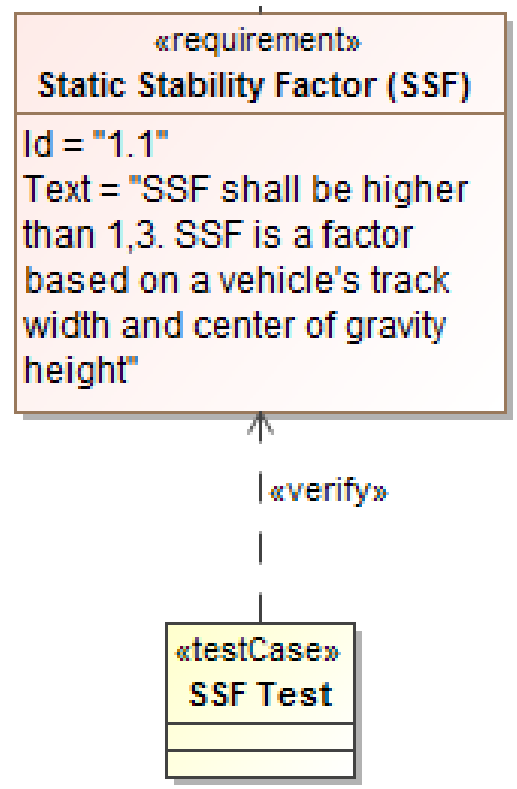
Safety Requirements

Requirements imposed by National Highway Traffic Safety Administration (NHTSA)



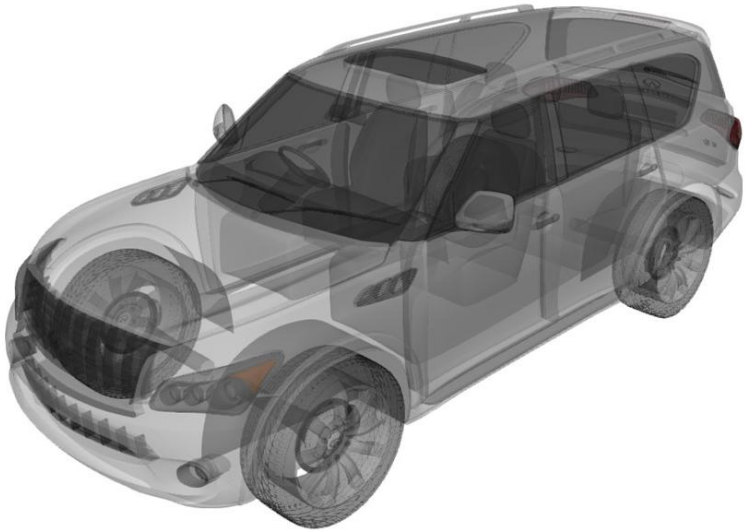
http://www.consumerreports.org/cro/2012/02/rollover-101/index.htm

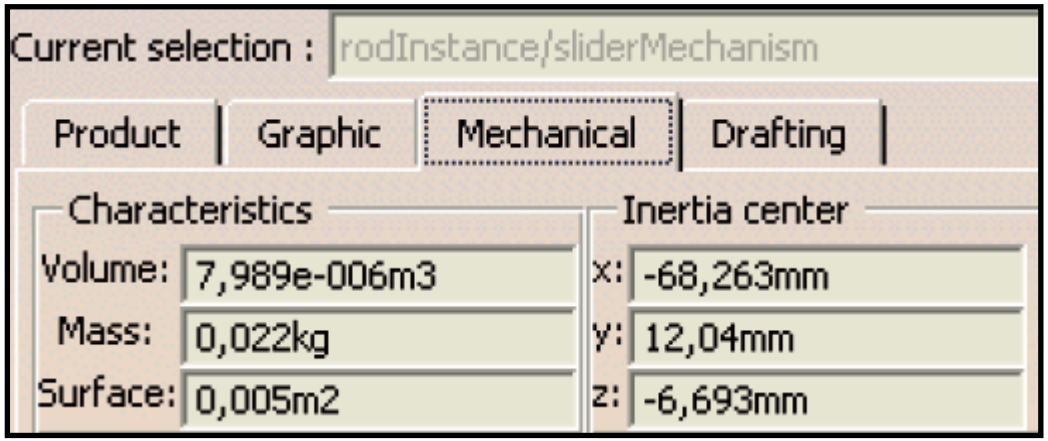
Static Stability Factor Test



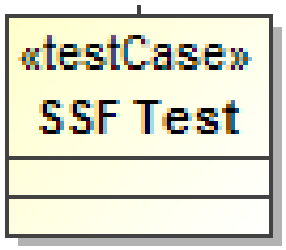
System Engineer defines SSF Test Case

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





Links between TestCase and Geometric Model

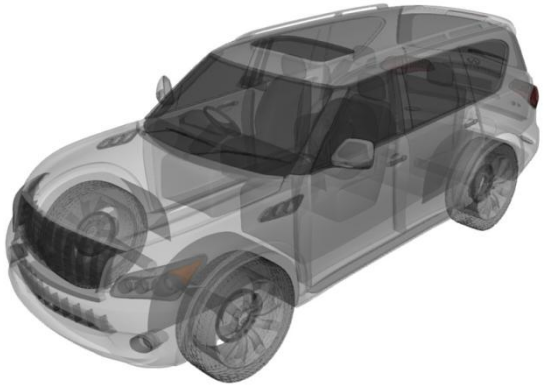


Links

relatedModel

observerElement

(based on observer pattern)



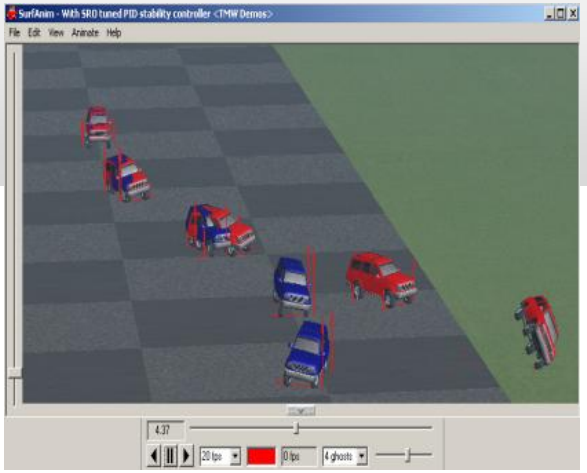
Test case in system model

Vehicle assembly geometric model

System Engineer would like to know the specific geometric model associated with the test case.

- Traceability: The system engineer can check how the test case is implemented
- Automatic notification: If the geometric model is modified, the test case needs to be performed again

Fishhook Maneuver Simulation



«requirement»
Vehicle in motion rollover test

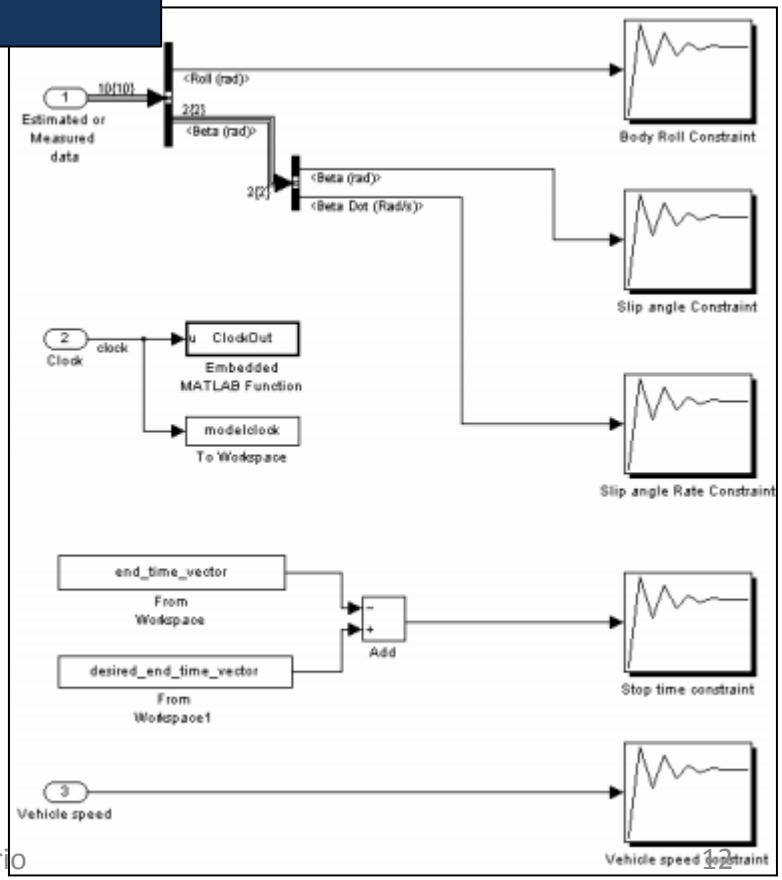
Id = "1.2"
Text = "The vehicle shall not "tip-up" during fishhook maneuver. If the vehicle lifts two wheels off the ground during a quick left-right turn at 50 mph, it's considered a "tip-up" and the test failed."

«verify»

«testCase»
Vehicle Fishhook Maneuver Simulation

Mechanical Engineer performs simulation with dynamic system model

System Engineer defines simulation test case



http://www.mathworks.com/tagteam/49380_2008-01-0579_Cherian_Final_1.10.08.pdf

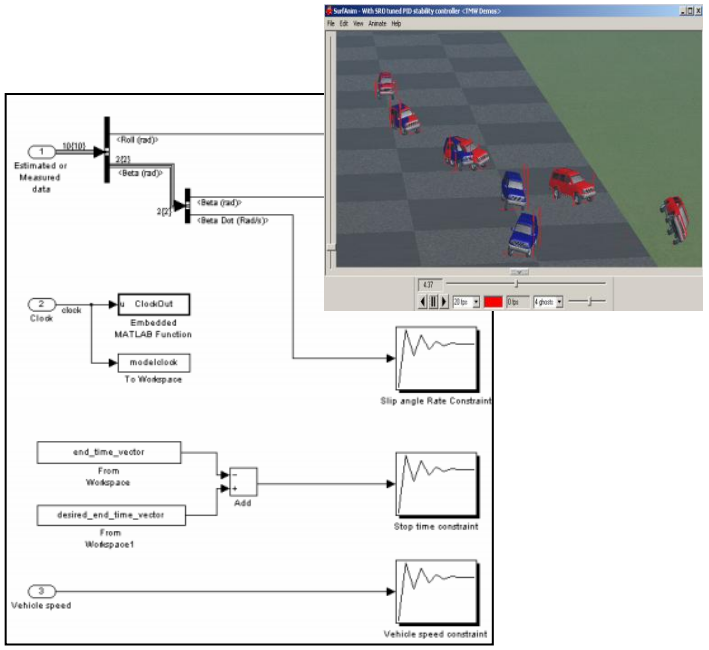
Links between Test Case and Simulation Model

«testCase»
Vehicle Fishhook Maneuver Simulation

Test case in system model

relatedModel

observerElement

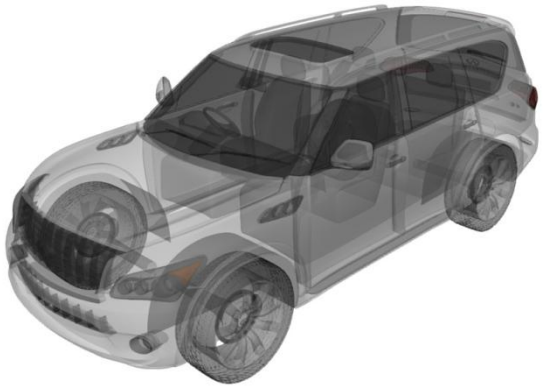


Simulation model

System Engineer would like to know the specific simulation model associated with the test case.

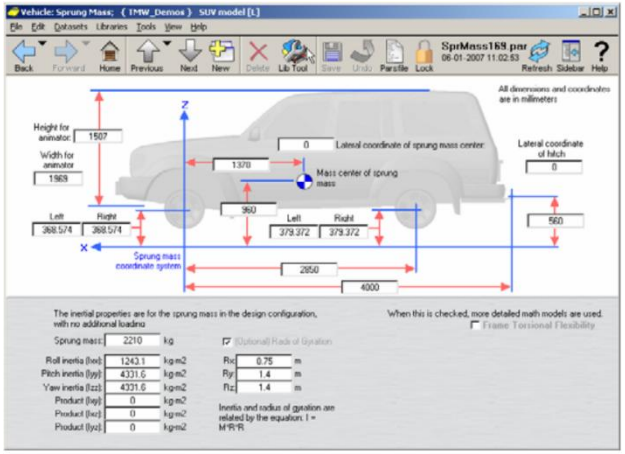
- Traceability: The system engineer can check how the test case is implemented.
- Automatic notification: If the simulation model changes, the test case needs to be performed again.

Link between COG Parameter of Geometric Model and Simulation Model



observerElement →

← originOfValue



Center of gravity in geometric model

Center of gravity in simulation model

Mechanical Engineer would like to know the geometric model associated with the simulation model

- Automatic notification: When a measure in the geometric model changes (e.g. center of gravity), the corresponding parameter in the simulation model needs to be updated

Trade Studies

- Solution alternatives if rollover safety requirements are not met:
  - Add weight to lower center of gravity
  - Reposition components to lower center of gravity
  - Make suspension harder
  - Reduce tire grip (smaller tires)
  - Make chassis wider
  - Reduce roof top payload
  - Adapt electronic stability system

- Multiple alternatives should ideally be evaluated and compared to find the optimal solution (optimal compromise)
- Efficiently changing/updating models is critical for exploring many solution alternatives

Rooftop Payload Requirement

System Engineer needs to define new payload requirement

«requirement»
Cargo Capacity
Id = "1.3"

System Engineer needs to define new system component

«requirement»
Rooftop Payload Capacity
Id = "1.3.1"
Text = "The SUV roof shall support a payload of 300kg."

«satisfy»

«block»
Cargo Box Mounting Structure
values
mass : kg = 30

Links between Block and Geometric Model

Links

relatedModel

relatedElement

Component in system model

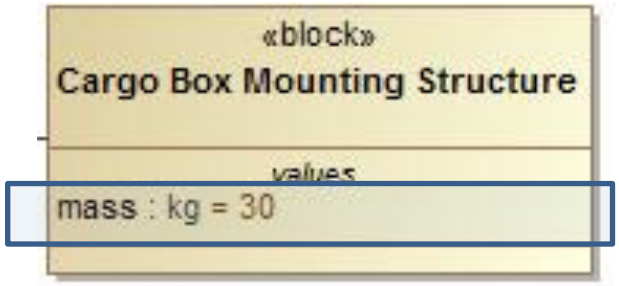
CAD part

System Engineer would like to know the geometric model associated with a system component.

- Reuse: If you want to reuse a system component in a different project, you know which CAD part you can reuse.
- Change management: If you modify a system component, you know which CAD part to update and vice versa

Links between System Property and Spreadsheet Parameter

Links



originOfValue

observerElement

	Mass [kg]
SUV Cargo Box	42.3

Parameter in system model

Parameter in spreadsheet

Initial assumption from system engineer needs to be validated/updated by mechanical engineer.

Exact mass is specified in spreadsheet from supplier.

System Engineer would like to know the specific value of a system parameter.

- Verification: The system engineer can check the origin of the parameter value.
- Update management: when the parameter value changes in the original model, the system parameter needs to be updated.