Crystal Automotive Demonstrator

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PUC Automotive

- Cross-UC demonstrator integrating tools from multiple vendors
  - Based on different industrial use cases
  - Reference implementation
Supported Engineering Methods

- Semi-formalization of requirements
- Heterogeneous simulation
- Change Management
- Validate Design Against Requirements
Validate Design Against Requirements

Challenge: Data consistency

Semi-formalization of requirements

Challenge: Standardized data exchange

Heterogeneous simulation

Challenge: Joint simulation of models with different formalisms based on standards
Validate Design Against Requirements

PTC MODELER

PTC INTEGRITY

REFINE

Mapping editor

AVL Model.Connect

AVL VeVaT/Magic

Virtual Integration

ICoS
4.6 If clutch pedal signal = 0, the Hybrid system shall enable the recuperation.
4.7 The Hybrid system shall enable the recuperation when the Driver activates the service brake.
4.8 The Hybrid system shall enable the recuperation when vehicle in motoring mode.
4.9 The Hybrid system shall keep the temperature of HV battery within 10 and 30 degree Celsius.
4.10 The Hybrid system shall be able to conform to the NVH criteria.
4.11 The Hybrid system shall enable the recuperation when vehicle speed greater than 60 km/h.
4.12 While motoring recuperation, the Hybrid system shall decelerate the vehicle less than 10 m/s².
4.13 The charging power of Hybrid system shall depend on the HV SOC.
4.14 The Hybrid system shall maintain the HV SOC less than 75%.
4.15 If the internal reaches the temperature safety limits, the Hybrid system shall not charge the HV battery.
4.16 If the HV battery reaches the temperature safety limits, the Hybrid system shall not charge the HV battery.
4.17 If the DODC Converter reaches the temperature safety limits, the Hybrid system shall not charge the HV battery.

Powertrain requirements

5.1 The use of a hybrid drive train should be saving of 5 - 10 % of fuel compared to the conventional drive train.
5.2 The vehicle shall have a fuel consumption of max. 7.5 l/100 km.
Validate Design Against Requirements
Validate Design Against Requirements

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REFINE

PTC INTEGRITY

AVL VeVaT/Magic

24-Jun-16

PUBLIC
Validate Design Against Requirements
<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C18_Maximum_Charge</td>
<td>25000</td>
</tr>
<tr>
<td>C1_Gas_Tank_Volume</td>
<td>0</td>
</tr>
<tr>
<td>C18_Initial_Charge</td>
<td>92</td>
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<tr>
<td>C20_Initial_SOC</td>
<td>0</td>
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<tr>
<td>C1_Frontal_Area</td>
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<tr>
<td>C1_Gross.Weight</td>
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<tr>
<td>C1_Curb.Weight</td>
<td>0</td>
</tr>
<tr>
<td>C18_Nominal_Voltage</td>
<td>160</td>
</tr>
</tbody>
</table>

**Mapping**

Name
---
Acc. Signal [Components.Acceleration Pedal] 1
Acceleration Pedal Position [Components.Acceleration Pedal] 1
Art-Nr [Library (BETA).LV2 Functional Group] 2
Break Pedal Position [Components.Brake Pedal] 2
Break Signal [Components.Brake Pedal] 2
CellCap [Components.Battery] 2
Charging Amperage [Components.Battery] 2
Clutch Signal [Components.Clutch] 2
Current Gear [Components.Transmission] 2
Data transfer rate [Library (BETA).Interface] 2
Fuel Consumption [Components.Vehicle] 2
Fuel consumption [Components.Control] 2
Idle Revolutions [Components.Engine] 2
Max. Revolutions [Components.Engine] 2
Max. Speed [Components.Control] 2
Max. Velocity [Components.Vehicle] 2
Min. Revolutions [Components.Engine] 2
Nr. of Gears [Components.Transmission] 2
SOC [Components.Battery] 2
Temperature [Components.Battery] 2
Torque [Components.Engine] 2
Type [Components.Vehicle] 2
Type [Components.Transmission] 2

**Run Simulation**
Change Management Process

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Change Request

Change Order

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Mapping editor

AVL Model.Connect

Virtual Integration

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Mapping editor

AVL

VeVaT/Magic

REFINE
Get requirements from requirements management tool

Requirements handling
Creating, Reading, Updating and Deleting requirements

Process requirements
Read requirements from validation settings or validation results

Test case/Test series
io_Hybrid

Test ID:

Requirements group:
REG I PU

Requirement ID:

Requirements transfer platform:
Excel file (.xlsx)

Link to requirements:
Requirements - CRYSTAL IX.xlsx

Transfer requirement(s) via OSCL
Get requirements from requirements management tool

Requirement Server URL:
http://scs/deploy/10030/mos.eas/serviceProvider/13

Requirements properties:
attribute_data

Assigned property columns:
ABCDEF

Create Change Request

JVM specific tasks
Preparing parameters for JVM, simulating VEFAT calls from JVM...

Miscellaneous tasks and utilities

Some short hints:

Please enable VBA macros - otherwise VEFAT operating won't work!

Double click to horizontal bars shows/fades grouped tasks and parameters

Double click to operating buttons invokes the assigned tasks

User documentation:
Quick Guide

VEFAT log file:
Log File

Open issues list:
Open Issues
Summary

- significant step closer to an integrated tool chain to support Model Based Systems Engineering
- profound understanding of interoperability needs
- gained expertise with respect to technological solutions, standards, and tool
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