Synergy of UML and Simulink

Agenda

- Why should we think about multiple tools?
- Requirements or how to choose the right tool?
- Examples for synergetic application of UML and Simulink
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Complexity facts

- A Peugeot 607 contains more software than an AIRBUS A310 from 1982
- A luxury vehicle is controlled by up to 80 electronic control units
- Each of them is more powerful than the controller inside Apollo 11 on its way to the moon

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Technological tendencies

- Growth of communication and networking functions and their influence, e.g. message based systems
- (Dynamically) distributed functions
- Operating systems with management functionality
- Encapsulated, parallel tasks on one ECU
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Hybrid?

Pure Software
(The programmers view)

Discrete time, distributed systems

Continuous time physics and control, signal flows

Physical Reality
(The engineers View)

Hybrid character of the actual system

The System Engineers View

Goal definition:
- Consistent, traceable, measurable specifications
- Early definition of quality goals and tests
- Support of the individual views of all process rolls
  - Organizational: OEM, Supplier, Authorities
  - Process: Customer, Specification engineer, Developer, Tester, Quality assurance
- Efficient experimentation and target implementation environment

Requirements
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BMW Principle

1 nach Prof. Schnieder, TU Braunschweig

- Beschreibungmittel (Means of description)
- Methode (Method)
  - How to apply the means of description?
- Werkzeug (Tool)
  - Technical realization of means of description and method

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Influencing Factors
Solution: Divide and conquer

- System
  - Function vs. Topology
- Method
  - Support of staggered, distributed processes
- Tool & Notation

and their integration?

Partitioning und Abstraction

Abstraction
- Reduction to the essentials
- Generalization
- Leads to simplification

Partitioning
- Grouping of objects to sub-systems
- Interfaces
  → Different mechanisms that have to be applied together
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Abstraction and Partitioning

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Process Integration – STEP-X®

DOORS
ARTiSAN
Matlab/Simulink
ASCET
TargetLink/RTW/ASCET

Source: STEP-X Workshop, Braunschweig, 10.02.03

Source: STEP-X Workshop, Braunschweig, 10.02.03
### Classification of coupling tools

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<th>Static</th>
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### Co-Simulation Principles

- **Coordination**
- **Synchronization**
- **Communication**
- **Information**

Distributed model
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Co-Simulation und Code integration

Simulink
- Plant model
- Continuous Control

Rhapsody in C
- Discrete Control and Communication

Real
- Embedded Controller
- Plant
- C-Code

Integration platform
Both worlds (UML and Simulink) are necessary.

They can be used together leveraging strength from both sides.

Real-world application depends on processes and actual conditions. Long term strength requires also separations of concern when it comes to the definition of a tool chain.