PLM V6
for System Engineering

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(Model-Based) System Engineering Challenges

- Manage the increasing complexity of systems (hardware/software)
- Manage (commercial) diversity
- Ensure end-to-end traceability
- Improve collaborations between internal divisions and with external suppliers through exchange of models.
- Integrate existing models and tools
- Ensure compliance with regulations and standards
- Demonstrate a quick Return On Investment
PLM V6 for System Engineering

Single PLM open collaborative platform for Model-Based System Engineering

- Needs
- Requirements Management
  - Functional Analysis
  - Logical Architecture Definition
- PLM V6
- Integration
- Physical Design
- Verification
- Validation
- System

Citizen of Integrated PLM

- Persistence & navigation on system engineering data
- Models, virtual experiences
- Uniform management of diversity
- Versioning, configurations
- Collaborative environment
- Traceability
- Impacts of changes
- Integration of legacy models & tools
System Architecture

- Functional/Logical Editor
  - Definition of functional and organic architectures
  - Early simulation, verification of business rules
  - Carrier for advanced modeling & simulation
  - Integration with 3D
V6 Interfaces Design & Life Cycle Management

- Mandatory for communication between OEM and Suppliers
- Architecture of Systems
  - Definition of Interfaces (ports)
  - Definition of Connections
  - Catalogs of Data/Signal
  - Projections of connections of functions onto connections of equipments
- Life Cycle Management of Interfaces
System Behavior

F/L Editor

Modelica Continuous
Continuous, multi-domain (ODE/DAE)

Modelica Synchrone
Discrete (data-flow, state-charts)

Event Modelica
Event-based (safety analyses)

Co-simulation platform (FMI/Modelisar)

System Experiment Manager
(life-cycle of virtual experiments)
Connection with iSight & Fipper

ENOVIA PLM V6
Openness to non-V6 Tools

F/L Editor

Stateflow

Statemate

Simulink

Co-simulation platform (FMI/Modelisar)

System Experiment Manager
(life-cycle of virtual experiments)
Connection with iSight & Fipper

ENOVIA PLM V6
System Behavior - Modelica

- Multi-Engineering Systems Behavior Modeling & Simulation
  - High level formal language
    - Object-Oriented
    - Built from first-principles (mass, energy, momentum balances)
    - Acausal: describe the problem, not the solution!
  - Open
    - Modelica (non for profit) Association
    - Active community designing libraries & tools
    - Vehicle dynamics (3-dim. mechanics)
    - Drive trains (1-dim. mechanics)
    - Hydraulics
    - Combustion
    - Air Conditioning (Thermofluid systems)
    - Electrical/electronic systems
    - Electrical machines
    - Hierarchical state machines
    - Control (Input/output blocks, ...)

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European Projects created & leaded by DS

Building a large eco-system of users and developers

**EuroSysLib:**
*Knowledge Capture and Reuse*

**Modelisar:**
*From Logical Architecture to Embedded Software*

**ITEA2 Project Initiated by Dassault Systèmes & DLR**
- 2.5 Years Duration: Oct. 2007 – March 2010
- 20 Partners
- > 16 Mill. € total budget
- > 100 man years effort
- > 30 Modelica Libraries to be developed (free + commercial)
  - Mechanics, Electrical, Thermo-Fluid, Control, Safety, Automotive…
  - Already significant new results (e.g. fluid modeling)

**ITEA2 Project “From System modeling to Software running on the Vehicle” Headed by Dassault Systèmes & Daimler**
- 3 Years Duration
- 28 Partners
- > 150 man years effort
- Embedded Control Systems in Vehicles with Modelica and AUTOSAR
- AUTOSAR support in Modelica & code generation from Modelica
- Functional Mock-up Interface (new standard for Model-in-the-Loop, Software-in-the-Loop Simulation)
- Integration in V6 Product Life Cycle Management
Virtual Experiments Life Cycle Management (MSR paradigm)

- Definition of Scenarios
- Scripting
- Workflow and Optimization
- Analysis of the Results (plotting)
- Distribution of calculations

Integrated Platform for Virtual Experiments
Integration, Verification & Validation

An integrated environment for MIL, SIL & HIL

Model In the Loop

Software In the Loop

Hardware In the Loop

Modelica Workbenches

Autosar builder

Artop

Eclipse

Adaptation to Test Bench HW

Co-simulation platform (FMI/Modelisar)

PLM V6

controller

model

plant

dl
dl
dl

dl
dl

dl
dl

AUTOSAR code running on a PC

CAN bus

Board with ECU
Regulations & Standards

**Increasing importance of Regulations & Standards**

- IEC 61508
  - Generic Standard

- IEC 61511
  - Oil & Gas
  - Industrial Processes

- IEC 62061
  - Machinery

- DO 178B
  - Avionic

- EN50126
  - EN50128, EN50129
  - Rail

- ISO 26262
  - MISRA
  - Automotive

- IEC 62513
  - Nuclear

**Functional Safety Life Cycle**

- Management of Safety Standards workflows
- Automated extraction of relevant data from the PLM
- Definition of templates of documents
- Verification of Business Rules