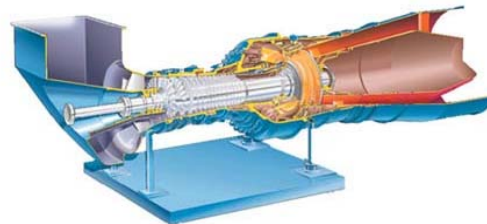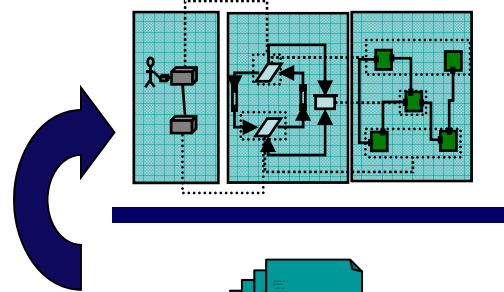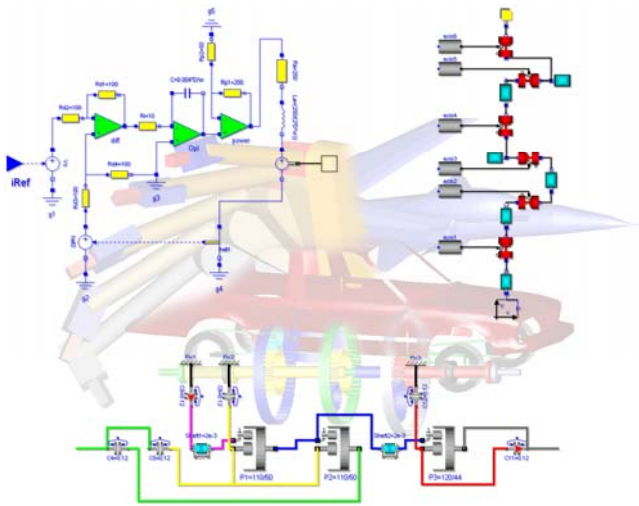# Are Special Architecture Description Languages Needed?

Panel at FESA workshop, KTH 2010-04-12

Peter Fritzson
Linköping University
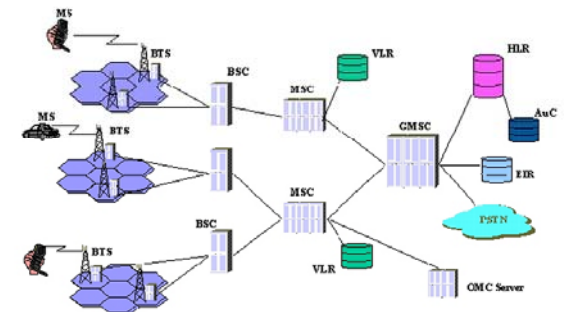
Vision of Integrated Model-Based Software-Hardware Product Development
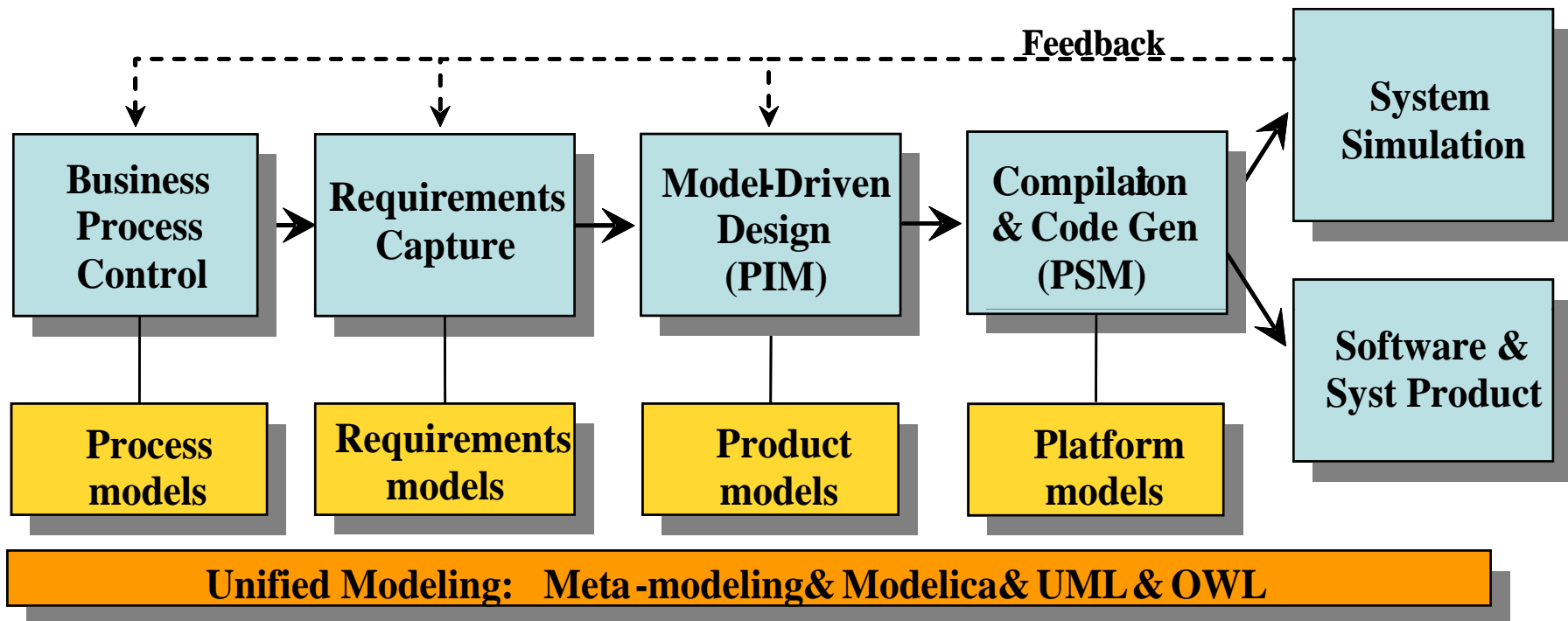
MODPROD Vision of unified modeling framework for model-driven product development from platform independent models (PIM) to platform specific models (PSM)

Current work based on Modelica UML/SysML, Eclipse

Architecture as a View of System Model

- **Instead of separate languages:**

- An architecture as a conceptual structural **view** of an **integrated** system **model**

- Still need to define domain-specific abstractions

What is Modelica?

A language for modeling of complex physical and/or embedded systems

i.e., Modelica is **not** a tool

Free, open language specification:

There exist several free and commercial tools, for example:

- OpenModelica from OSMC
- MathModelica by MathCore
- Dymola by Dassault systems / Dynasim
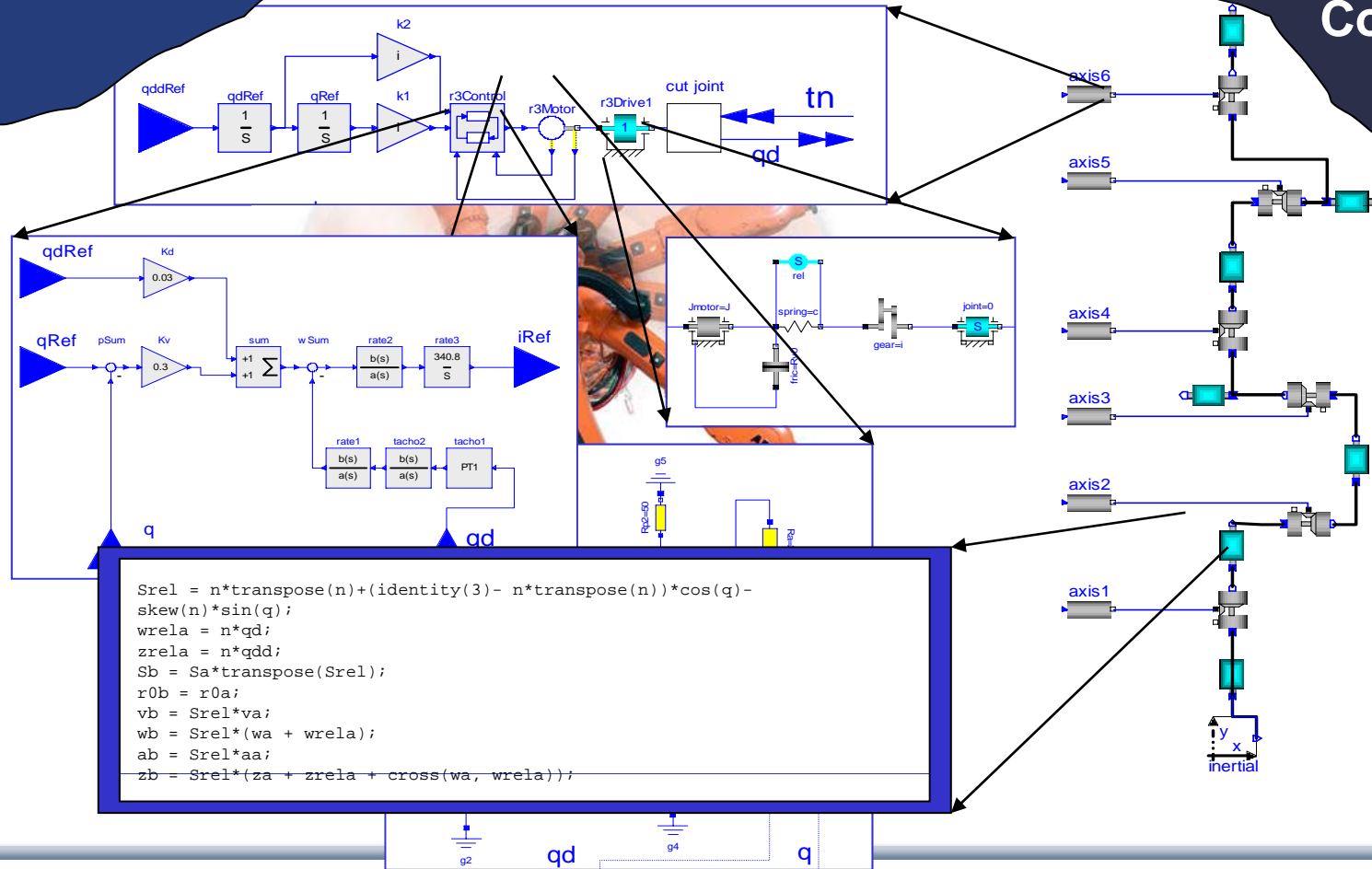- SimulationX by ITI
- MapleSim by MapleSoft

- Standardized by Modelica Association

- Available at: www.modelica.org

Architectural System Views in Modelica

Multi-Domain Modeling

Hierarchical system modeling

Visual Acausal Hierarchical Component Modeling

```
Srel = n*transpose(n)+(identity(3)- n*transpose(n))*cos(q)-
skew(n)*sin(q);
wrela = n*qd;
zrela = n*qdd;
Sb = Sa*transpose(Srel);
r0b = r0a;
vb = Srel*va;
wb = Srel*(wa + wrela);
ab = Srel*aa;
zb = Srel*(za + zrela + cross(wa, wrela));
```

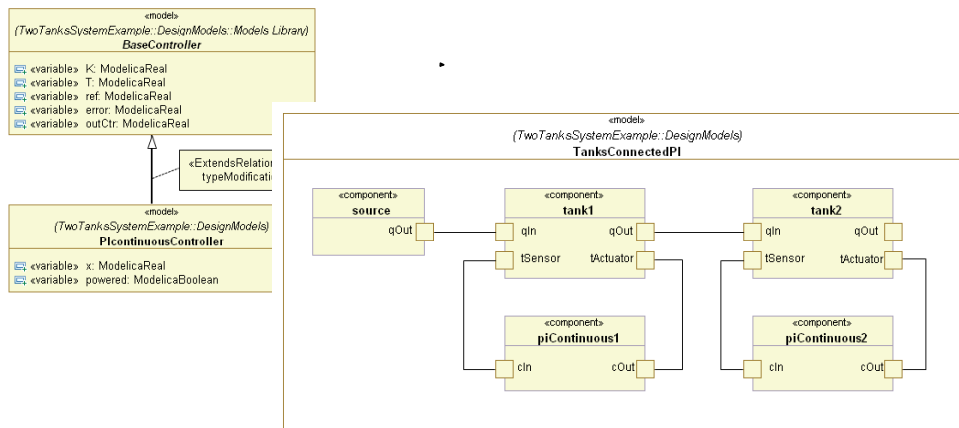Peter Fritzson   Courtesy of Martin Otter

Some Ongoing Related Work and Projects

ModelicaML Modelica-UML Integration
Also OMG SysML-Modelica working group

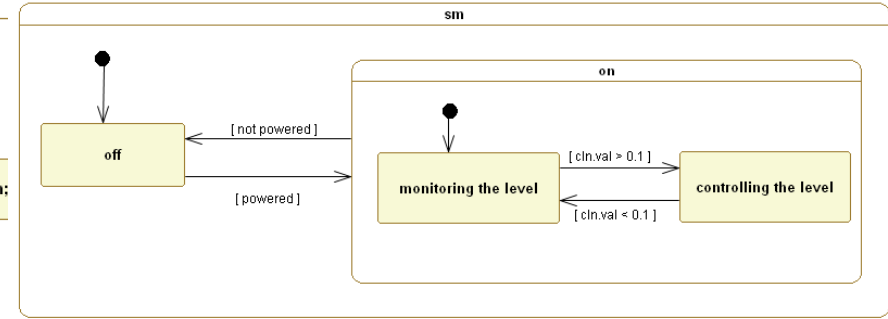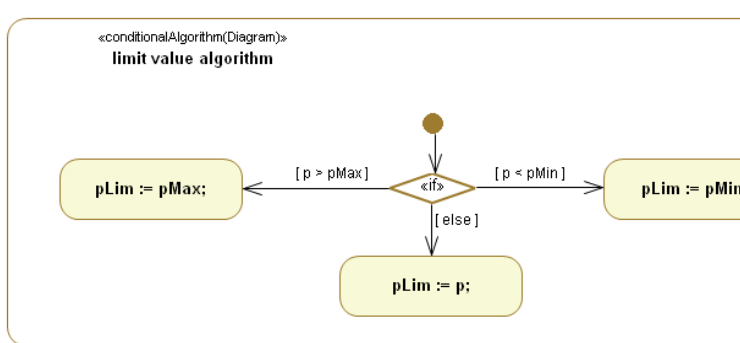- **Translation of SysML/UML to Modelica as Action Language**
- **Papyrus and OpenModelica**
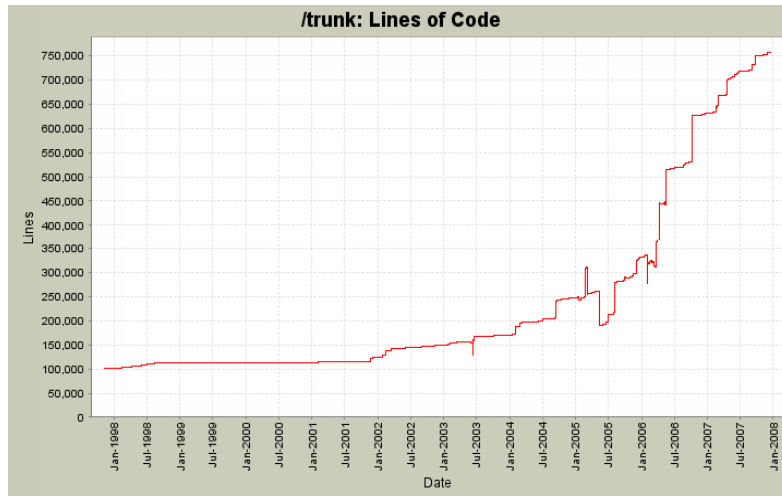
OSMC – Open Source Modelica Consortium
Model-based Development Tools, 29 members Feb 2010

Founded Dec 4, 2007

Open-source community services

- **Website and Support Forum**
- **Version-controlled source base**
- **Bug database**
- **Development courses**
- **www.openmodelica.org**

Code Statistics

/trunk: Lines of Code

Industrial members (16)
- ABB Corporate Research
- Bosch-Rexroth AG, Germany
- Siemens Turbo Machinery AB
- CDAC, India
- Creative Connections, Prague
- Equa Simulation AB, Sweden
- Frontway AB
- IFP, Paris, France
- InterCAX, Atlanta, USA
- MostforWater, Belgium
- MathCore Engineering AB
- MapleSoft, Canada
- TLK Thermo, Germany
- VI-grade, Italy
- VTT, Finland
- XRG Simulation AB, Germany

University members (13)
- Linköping University, Sweden
- Ghent University, Belgium
- Hamburg University of Technology/TuTech, Germany
- Technical University of Braunschweig, Germany
- Université Laval, the modelEAU group, Canada
- Griffith University, Australia
- University of Queensland, Australia
- Politecnico di Milano, Italy
- Mälardalen University, Sweden
- Technical University Dortmund, Germany
- Technical University Dresden, Germany
- Telemark University College, Norway

MODPROD Center for Model-based Product Development – Linköping University + 14 Companies www.modprod.liu.se

Software/Hardware Modeling

- Combitech Systems AB
- SAAB AB
- Siemens Industrial Turbomachinery AB
- Configura AB (SME)
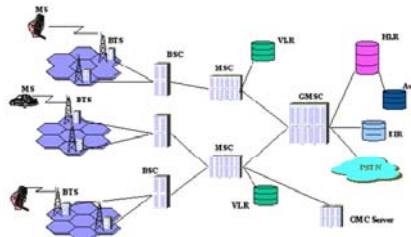
Hardware Modeling
(mostly)

- ABB Corporate Research AB
- ACE Simulation AB (SME)
- BT Products AB
- Mathcore Engineering AB (SME)
- Melerit Medical AB (SME)
- Parker Hannifin AB
- SKF AB

Business Process Modeling

- Saab AB
- ABB
- Siemens

Software Modeling

- Ericsson AB
- IFS AB
- IBM-Telelogic AB

MODELICA   pelab

OPENPROD – Large 3-year ITEA2 EU Project

28 partners from 5 countries: 11 large industries,
7 SMEs, 5 research institutes, and 5 universities.
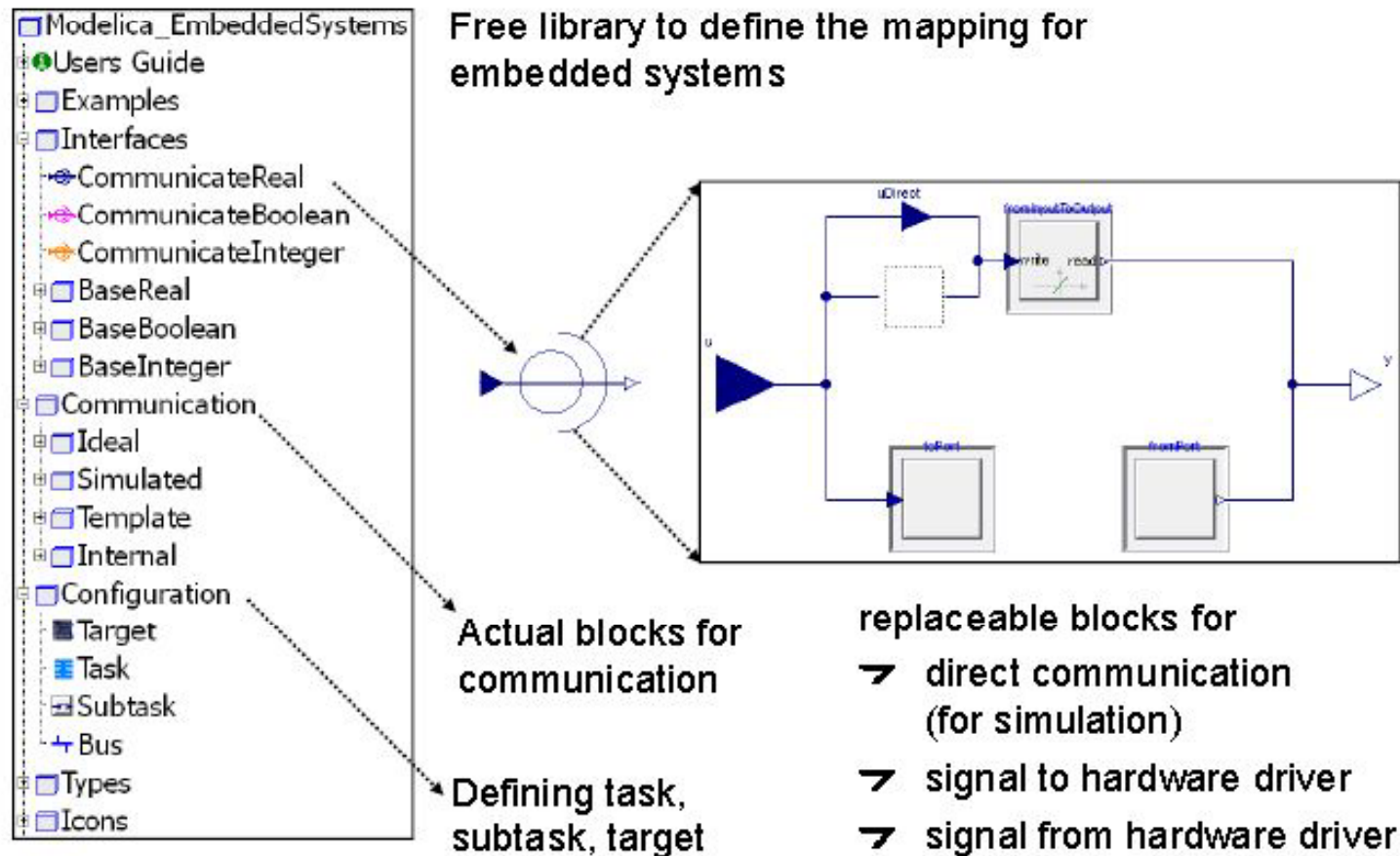Project size: > 90 person years,
Budget: About 11 Mill. €, Duration June 2009 - Aug 2012.

Scientific coordination by Peter Fritzson, PELAB

France

Finland

Switzerland

Sweden

Germany

MODELICA pelab

Modelica Embedded Systems Library

3. Modelica_EmbeddedSystems Library

Modelica_EmbeddedSystems
- Users Guide
- Examples
- Interfaces
  - CommunicateReal
  - CommunicateBoolean
  - CommunicateInteger
  - BaseReal
  - BaseBoolean
  - BaseInteger
- Communication
  - Ideal
  - Simulated
  - Template
  - Internal
- Configuration
  - Target
  - Task
  - Subtask
  - Bus
- Types
- Icons

Free library to define the mapping for embedded systems

Actual blocks for communication

Defining task, subtask, target

replaceable blocks for
- direct communication (for simulation)
- signal to hardware driver
- signal from hardware driver

Courtesy Hilding Elmqvist

MODELICA pelab
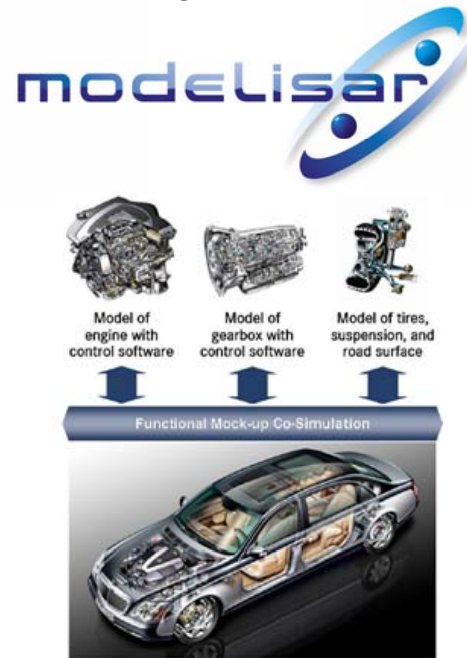
EU ITEA2 Modelica Research Projects

- **54 M€, 370PY, 2007–2012**, EUROSYSLIB, MODELISAR,OPENPROD.

- Libraries, including **Embedded Systems, Stategraph2**

EUROSYSLIB
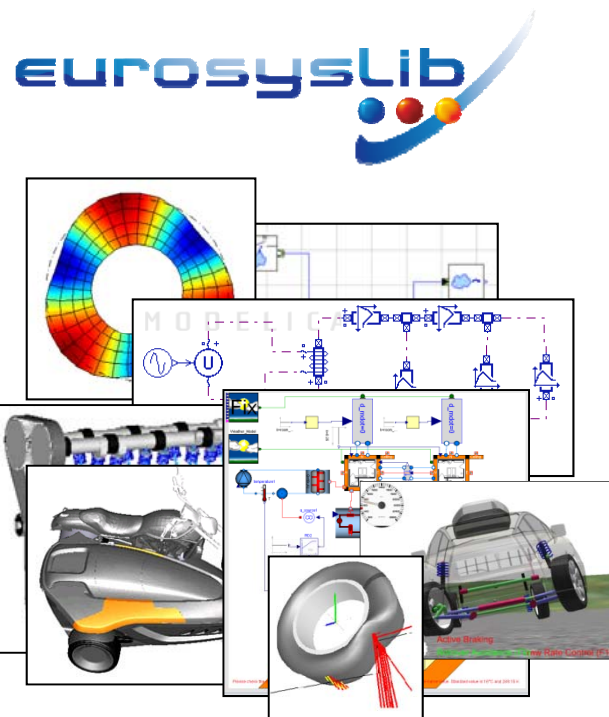
Modelica Libraries

modelisar

Model of engine with control software | Model of gearbox with control software | Model of tires, suspension, and road surface

Functional Mock-up Co-Simulation

Model integration + Autosar-Modelica

OPENPROD

- Enhanced OpenModelica

- Modelica, UML, Eclipse

- Multi-Core models

Open Tools

Courtesy Martin Otter

MODELICA   pelab