

## Project Results

# OPENPROD

## Open modelling for faster whole-product systems development

*The ITEA 2 OPENPROD project set out to develop an open whole-product, model-driven systems development, modelling and simulation (M&S) integrated environment. The OPENPROD environment integrates the leading open industrial software development platform Eclipse with leading open-source modelling and simulation tools such as OpenModelica and industrial M&S tools and applications. The result is an integrated model-based environment that gives computer support and validation of product development all the way from business models and requirements to final executable models and deployable products. This cuts time to market and ensures higher quality through the use of open model-based solutions with high impact.*

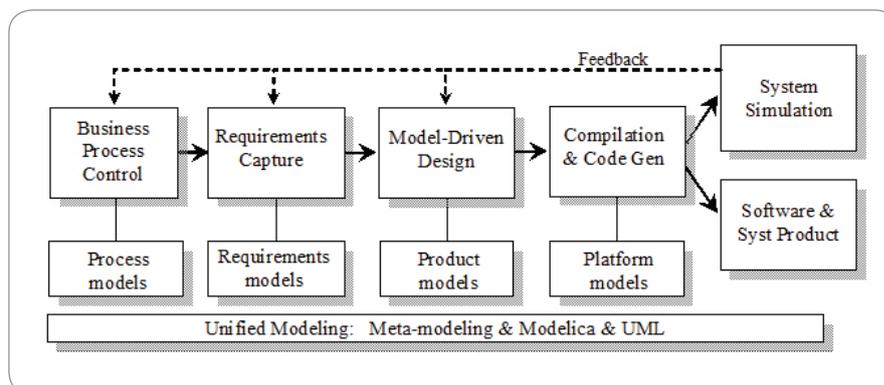
A general tendency in product development is the increasing complexity of technical systems and the distributed networks in which they are designed and manufactured. This complexity involves a higher degree of automation, a greater number of technologies and strong coupling of software and hardware development including hardware such as mechanical and fluid systems. Moreover, strong market trends are towards more complex products that include software and hardware components, requiring more integrated whole-product development approaches. In addition, software and hardware component suppliers are increasingly involved in the design process of the overall system, and they

are expected to validate the functionality of components in the system context at the design stage, long before the system itself is actually built.

The integrated holistic environment developed in OPENPROD generalises model-driven approaches to include most aspects of product development via three key concepts: a holistic whole-product model-driven rapid development and design environment for both software and hardware, open-source tools and components for open reusable solutions, and standardised model representation of products primarily based on Modelica and the unified modelling language (UML).

### BEYOND EXPECTATIONS

Compared with the pre-OPENPROD situation and the end of the project, major progress has been achieved with a whole-product (SW/HW) open model-driven modelling, simulation and development environment, an enhanced OpenModelica model compiler with innovations and vendor specific tool additions as well as advanced industrial application demonstrators and vendor tools. In fact, the achievements frequently exceeded the goals. For instance, the project plan only included full flattening (the first phase of compilation) of Modelica 3.1 language constructs and the MSL 3.1 library due to the lack of resources in OPENPROD. What was actually achieved was 100% flattening of MSL 3.2.1(alpha), which is a much larger library. In addition to that, the project achieved 80% (211/262) full



## OPENPROD (ITEA 2 ~ 08021)

### Partners

APPEDGE  
 Bielefeld University of Applied Sciences  
 Bosch-Rexroth AG  
 CEA LIST  
 EADS Innovation Works  
 Electricité De France  
 Equa Simulation AB  
 ETH Zürich  
 Fraunhofer FIRST  
 IFP New Energy  
 INRIA Rocquencourt Sophia Antipolis  
 Linköping University  
 LMS Imagine  
 MathCore Engineering AB  
 Metso Automation  
 Modelon AB  
 Nokia Corporation  
 Peugeot Citroën Automobiles SA  
 Plexim GmbH  
 Pöyry Finland Oy  
 Siemens AG  
 Siemens Industrial Turbomachinery AB  
 SKF Sverige AB  
 Technical University Clausthal  
 TLK Thermo GmbH  
 University of Lyon-INSA  
 VTT Technical Research Centre of Finland  
 XRG Simulation GmbH

### Countries involved

Finland  
 France  
 Germany  
 Sweden  
 Switzerland

### Project start

June 2009

### Project end

December 2012

### Contact

Project Leader :  
 Sune Horkeby, Siemens Industrial  
 Turbomachinery AB  
 Email :  
[sune.horkeby@siemens.com](mailto:sune.horkeby@siemens.com)

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compilation of MSL 3.2.1 (alpha) and 69% (180/262) simulation, which was not included in the project plan either.

The new OpenModelica release provides an improved OMC model compiler that simulates many more models than previous versions. It also contains the full OMPython functionality that allows Python scripting with OpenModelica, and a new ModelicaML version with verification of requirements as opposed to design models in requirements-driven modelling updated to the latest Eclipse and Papyrus releases. The new release includes an improved Full Mock-up Interface (FMI) import to prepare for FMI co-simulation. The integration of the 3D graphics animation library from Fraunhofer FIRST into OpenModelica has been accomplished. Moreover, support for the Fluid library is improving greatly with the new symbolic instantiation module now mostly completed with the goal of completion for the final OpenModelica 1.9.0 release.

The improved speed of Modelica applications generates many new possibilities, with Siemens, IFP and Bosch Rexroth having improved their respective Gas Turbine, Engine and Hydraulic Simulators and models. These simulations run in real time together with the hardware from the control system (hardware-in-the-loop system). This will boost future development and enhance performance tuning to comply with the green technology requirements from the market.

### DELIVERING SOLUTIONS

In terms of integrated open whole-product rapid development and lifecycle support for complex products, based on hardware and software models, team features and requirement capture, OPENPROD delivered a range of solutions, namely the ModelicaML Modelica-UML profile, Modelica3D, ontology-

based simulation, simulation PDM/PLM integration using business product modelling and model-driven product optimisation. Full model compiler support for future Modelica with selected UML and novel extensions includes stronger early consistency checking of model library components and certainties handling. Improvements in separate compilation enable the shipping of binary model components. Also the synchronicity support for embedded systems applications has been improved.

Code generation and run-time issues were addressed through the automatic translation of high-level specifications written in Modelica into efficient numerical schemes, efficient methods for parallelisation of both continuous-time and discrete-time model-based code, and efficient run-time system and numerical solver schemes to interact with the generated code. Interoperability between tools and better re-use of tool components have enhanced modelling and simulation with model components in different formalisms. The faster design process using modelling and simulation and more optimised product results developed in the project were demonstrated and validated on industrially relevant applications.

Closed proprietary solutions are often a hindrance to widespread dissemination and uptake. The use of open-source and open solutions in OPENPROD makes it more adaptable and more affordable for users – especially small and medium-sized enterprises – to integrate results in their products. The success of the Modelica next-generation language and tools will enable it to become a widespread international standard exchange format for reusable object-oriented model components in multi-domain simulation.

## Major project outcomes

### DISSEMINATION

- 9 publications
- 101 presentations at conferences/fairs

### EXPLOITATION

- 21 new/or updated IT applications

### STANDARDISATION

- Contribution to specification FMI 2.0. Functional Mock-up Interface (FMI) is a tool independent standard to support both model exchange and co-simulation of dynamic models using a combination of xml-files and compiled C-code
- OMG SysML / Modelica Integration WG (ongoing) Main target: Integration of Modelica (executable) models into (descriptive) SysML models.

### ITEA 2 Office

High Tech Campus 69 - 3  
5656 AG Eindhoven

The Netherlands

Tel : +31 88 003 6136

Fax : +31 88 003 6130

Email : [info@itea2.org](mailto:info@itea2.org)

Web : [www.itea2.org](http://www.itea2.org)

■ ITEA 2 – Information Technology for European Advancement – is Europe's premier co-operative R&D programme driving pre-competitive research on embedded and distributed software-intensive systems and services. As a EUREKA strategic Cluster, we support co-ordinated national funding submissions and provide the link between those who provide finance, technology and software engineering. Our aim is to mobilise a total of 20,000 person-years over the full eight-year period of our programme from 2006 to 2013.

■ ITEA 2-labelled projects are industry-driven initiatives building vital middleware and preparing standards to lay the foundations for the next generation of products, systems, appliances and services. Our programme results in real product innovation that boosts European competitiveness in a wide range of industries. Specifically, we play a key role in crucial application domains where software dominates, such as aerospace, automotive, consumer electronics, healthcare/medical systems and telecommunications.

■ ITEA 2 projects involve complementary R&D from at least two companies in two countries. We issue annual Calls for Projects, evaluate projects and help bring research partners together. Our projects are open to partners from large industrial companies and small and medium-sized enterprises (SMEs) as well as public research institutes and universities.



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