

## Project Results

# Speeding automotive ECU development

## Multidisciplinary modelling speeds simulation and software programming

**Electronic control units (ECUs) play an important role in modern vehicles. The ITEA 2 MODELISAR project developed a Functional Mock-up Interface (FMI) for use in the design of the ever growing number of these ECUs. This allows dynamic modelling of different systems for model-, software- and hardware-in-the-loop simulation and for embedded software. Initial versions of the open FMI standard for model exchange, co-simulation and product life management (PLM) simulation data and process management can already be downloaded and a range of tools are available incorporating the MODELISAR approach.**

MODELISAR set out to improve the design of embedded software in automotive ECUs. It supports the automotive open system architecture (AUTOSAR) jointly developed by carmakers, their suppliers and tool developers in the simulation environments of MODELISAR partners. It also encourages use of Modelica – a non-proprietary, object-oriented, equation-based language widely used by carmakers to simplify modelling of complex physical systems.

### OPEN INTERFACE STANDARD

Modelling allows definition of the physical behaviour of a system and the parts around it early in the design process.

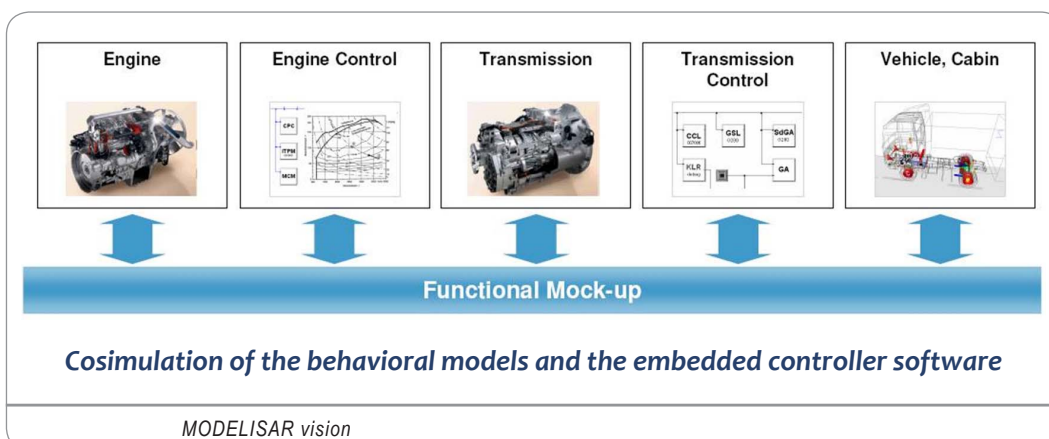
However, vehicles involve many different disciplines – electrical, mechanical, hydraulic, etc. – all of which have to be taken into account, especially with their own approach and tools.

MODELISAR focused on advanced *run-time interoperability*. FMIs offer an open standard enabling models from different simulation environments and disciplines to be used conveniently in other environments – by either model coupling or co-simulation. Additionally a light and flexible way to handle simulation data from PLM to the simulation master is proposed.

### FLEXIBLE SIMULATOR INTEGRATION

FMIs offer flexible simulator integration with production and exchange of Functional Mock-ups and co-operation via a master. Various simulator hardware and operating systems can function independently while profiting from standardised services. Different disciplines can work on the models with the own software and tools while the FMI offers standardised application programming interfaces.

The proof of concept for the FMI standard and its support in both Modelica and non-Modelica tools, AUTOSAR editors, simulation editors and schedulers was carried out in 25 industrial automotive scenarios.



## MODELISAR (ITEA 2 ~ 07006)

### Partners

AIT  
Altran  
ARMINES  
ATB  
Atego Systems  
AVL  
Daimler  
Dassault Systèmes  
Dassault Systèmes AB  
David  
DLR  
FhG First, IIS EAS, SCAI  
Geensoft  
Halle University  
IFP Energies nouvelles  
INSPIRE  
ITI  
LMS Imagine  
LMS International  
QTronic  
SIMPACT  
Trialog  
Triphase  
TWT  
Verhaert  
Volkswagen  
Volvo

### Countries involved

Austria  
Belgium  
France  
Germany  
Sweden

### Project start

July 2008

### Project end

December 2011

### Contact

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http://functional-mockup-interface.org  
info@functional-mockup-interface.org

## Project Results

These included multiple scenarios such as engine combustion, power-lift gate, cabriolet opening system, mechatronic gear change, chassis control and climate comfort.

Additionally, the data, models and software can now be incorporated into existing PLM design systems to integrate tools and manage work flow, versions and variants over the product life.

### ENSURING CONTINUITY

FMI will be further developed as an *open international standard* through the Modelica Association framework to ensure continuity. Modelica Association by-laws have been drawn up for an organisation to provide support and allow FMI extension beyond the Modelica language to any other system engineering modelling language and simulation tools.

### INDUSTRY VALUE

Main MODELISAR outcomes are:

- High quality FMI specifications for model exchange, co-simulation and PLM with work continuing on application coupling; FMI specifications are available on <http://www.modelisar.com>;
- 10 FMI prototypes – model exchange, co-simulation and PLM – for the industrial use cases;
- 10 supporting scientific studies including AUTOSAR, co-simulation, timing and bus; and
- Modelica evolution proposals for the benefit of FMI and AUTOSAR.

FMI is already being implemented for commercial software with the growth of potential applications in the automotive industry. Since, FMI has been defined technically independently of the industry domain, attention can also be given to other domains, such as aerospace, rail transport, wind turbines, industrial machinery and construction equipment.

Some *34 FMI-compatible tools* have been announced with 25 available commercially. Nearly half of these products come from suppliers not involved in MODELISAR. A reference book of these FMI-compatible tools includes a list of demonstrations and a FMI summary.

Research institutes are working on FMI implementation for multi-platform models as well as easy exchange of scientific-technical software libraries for modelling and simulation. They are also promoting use of FMI to non-MODELISAR tool vendors.

Industrial partners are starting to exploit FMI as a fast and efficient way to exchange virtual prototypes. FMI makes possible early integration of suppliers and development partners into cross-domain co-simulation. Use of FMI by automotive industry original equipment manufacturers should become a standard. Daimler will apply it to gearboxes in Mercedes Benz cars and power-train design in Daimler Trucks. TWT is looking at its use in all-electric aircraft research.

## Major project outcomes

### DISSEMINATION

Total of 110 communication actions including:

- 67 publications/papers/articles
- 47 presentations at conferences/fairs

### EXPLOITATION

- 34 FMI-compatible tools announced by 20 organisations  
See <http://functional-mockup-interface.org/tools.html>
- 4 new products, related to the FMI innovation

### STANDARDISATION

- Creation of the FMI Modelica Association Project (FMI MAP), hosted by the Modelica consortium

### PATENTS

- 1 patent application (TWT)

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■ 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.

