

MODELISAR

An international standard for systems- and embedded software design in vehicles

Impact highlights

- The FMI standard is currently supported by some 100 modelling, simulation, code generation and testing tools offered by more than 50 tool - free or commercial - suppliers.
- Dassault Systemes delivers six FMI compatible tools to dozens of customers who are leading manufacturers of complex systems like aircraft, cars and energy systems. These 'open' tools are key enablers in these companies' product development processes and are now being integrated in the Dassault 3DEXPERIENCE platform to support interoperability in their business processes. The 3DS development platform is in the core strategy of Dassault Systemes.
- FMI helped TWT to boost its innovation offer through many new collaborative projects (ITEA, H2020, ECSEL and national) and business contracts with leading German automotive OEMs.
- Together with major automotive OEMs inside the VDA PLM & ProStep iViP Consortium, AVL has become one of the leading players in interfacing tools for design, validation and optimisation based on FMI.
- Based on the results of MODELISAR and FMI, Siemens Industry Software NV (Belgium) has created two new product categories in its business: Virtual Sensing, and Hardware-in-the-loop & Human-in-the-loop simulations. These categories have contributed significantly to entry into new, rapidly growing markets. After MODELISAR, Siemens continued the R&D in FMI 2.0 with Flemish regional funding from VLAIO and two PhD student projects.
- The FMI standard is now managed and developed as a Modelica Association Project (MAP) through active participation of 16 companies.

Modelling is not new in automotive systems development but enabling interoperability between different subsystem components from various disciplines has presented engineers with a big challenge. The objectives of the MODELISAR project were to boost collaboration and innovation across system and software disciplines and to test the vehicle behaviour earlier, faster and more affordably in the virtual world. During the project, an international and open Functional Mock-up Interface (FMI) standard was developed to conveniently exchange and interoperate models from different modelling and simulation environments.

Project results

MODELISAR set out to improve the design of automotive systems models and embedded software in Electronic Control Units (ECUs) and delivered the FMI standard. This standard supports the automotive open system architecture (AUTOSAR). Generated Functional Mock-Up is the next generation of the Digital Mock-up to enable co-simulation between heterogeneous tools to support large-scale, cross-domain functional mock-ups.

MODELISAR has developed a set of 25 use cases to demonstrate FMI in different areas such as engine combustion, mechatronic control of the gearbox, climate control and virtual reality support, embedded software code generation, test and calibration, and finally management of the simulation components and related data to help design applications in industrial projects. The first version, FMI 1.0, was published in 2010, followed by FMI 2.0 in July 2014. To continue the cooperation beyond MODELISAR, the core FMI development partners founded a new Modelica Association Project "Functional

Mock-up Interface" (FMI MAP) (www.fmi-standard.org). As of today, development of the standard continues through the participation of 16 industry adopters, tool editors and technical working groups.

Exploitation

FMI is exploited in many system design tools in automotive applications by OEMs and their suppliers, with a large variety of areas: engines, engine controls, powertrain and cabin applications like air-conditioning. After MODELISAR, FMI has gained worldwide acceptance in the automotive domain and is spreading widely in non-automotive areas like aerospace, trains, automation, energy, etc.

In automotive, FMI is being used by Daimler in software-in-the-loop simulations in all gearbox projects for Mercedes passenger cars and for all powertrain projects for trucks. FMI is the preferred model exchange and co-simulation format of Robert Bosch GmbH for models at system level enabling the exchange models with internal and external partners (e.g. OEMs) using different modelling tools.

FMI is increasingly used for real-life, complex simulation tasks, since ETAS GmbH and Bosch Rexroth AG subsidiaries support FMI in their software tools. FMI reduces the Volvo Cars tool compatibility matrix considerably to increase the ROI of simulation models. Together with Volvo Group, they developed a tool for ECU software development called ADAPT.

In 2012, Daimler and Ford started an initiative to establish FMI as the standard for simulation model exchange between OEMs and suppliers. They were joined by several OEMs to sign a supporting commitment in 2012, and later by 9 OEMs to form a group of about 20 Automotive adopters.

EDF chose FMI to design and study large energetic systems (mixing physics and ICT), and develops an open source distributed co-simulation master (Daccosim). Dassault Aviation and Liebherr Aerospace consider new process and associated tools based on powerful capabilities of Modelica and FMI to manage heterogeneous models for Aircraft systems assessment.

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PROJECT START	PROJECT END	○ LMS International (currently	○ LMS Imagine	○ ESI-ITI GmbH	○ Volvo
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