

Project Results

Speeding software system development

Modelling and managing variability in software-intensive embedded systems



The ITEA 2 project MoSiS has developed a common variability language (CVL) for modelling and managing variability and several domain-specific languages (DSLs) for model-driven development of software-intensive systems. Domain-specific languages (DSLs) allow model-driven development of software-intensive systems and have been demonstrated in sectors such as railway signalling, communications and manufacturing. A series of tool prototypes supports MoSiS DSLs and CVL.

Embedded-systems software is critical in the global marketplace in terms of quality and the huge number of variants required. MoSiS realised that embedded-systems engineers building highly complex systems needed better tools to increase productivity, crucial for Europe competitiveness.

The ITEA 2 project focused on model-driven engineering (MDE) – not only in modelling single systems but also in modelling variability across product families. The key benefit of MDE is the automation of parts of the engineering work. Automatic production of software from high-level models cuts costs and shortens time to market. It also offers a good way to document and structure the systems involved.

MDE is not new but has not been widely used in embedded systems. There has been a lack of tools to tackle key problems, in particular handling non-functional requirements such as limited memory, energy or CPU power – constraints not found outside the embedded-systems area.

The overall goals of MoSiS were to:

- Extend modelling languages, techniques and tools for handling variability of both system functions and non-functional properties;
- Standardise a variability-modelling language;
- Extend current approaches for model-driven development to highly configurable embedded systems; and
- Evaluate and demonstrate results through industrial case studies in communications, energy, manufacturing and railway signalling.

MDE AND VARIABILITY

The most innovative achievement of MoSiS is the Common Variability Language (CVL) – a language for modelling variability. When engineering products or systems, a set of products may have the same basic requirements but vary in size or complexity. Modelling variability involves describing such differences at product or complete systems level.

MoSiS built on work on product lines and variability in earlier ITEA projects such as FAMILIES. CVL has means to specify any variability formally such that executing the variability specification with resolutions will yield a product model, thus automating parts of the engineering processes. As a result, the outcome is expected to have a major impact on products and product-development processes.

MDE AND DSLs

Use of CVL and DSLs will lead to more cost-efficient production – the DSL case studies indicate a ten-times improvement.

MoSiS (ITEA 2 ~ 06035)

Partners

@-portunity
Combitech
Grupo ETRA
European Software Institute
ICT-Norway
MetaCase
Nokia Siemens Networks
Sintef
Telefónica I+D
Telvent
Universidad Politécnica de Madrid
University of Oslo
University of Skövde
VTT Technical Research Centre of Finland

Countries involved

Finland
The Netherlands
Norway
Spain
Sweden

Project start

July 2007

Project end

June 2010

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Project Results

Such automation also means that what took weeks or months before can now be achieved in hours.

NON-FUNCTIONAL REQUIREMENTS

Good results have been obtained for modelling non-functional requirements (NFRs) such as performance. MoSiS has provided tool support for the NFR+ Framework developed by VTT, supporting traceability and bridging the gap between requirements engineering and software engineering.

GENERIC TECHNOLOGY

On the product side, well-defined models allow for more complex systems – and in a more reliable manner. Moreover, the major MoSiS results are generic technology, so they can be used in all domains across the whole embedded-systems sector; applications are already seen in automotive development, communications, defence, energy, health and transportation. It can also be used outside of the embedded-systems sector.

USE ALREADY STARTING

Several companies have started to use MoSiS technology, including ABB and Nokia Siemens Networks (NSN). Tool vendor MetaCase is applying it in tools

which make it possible to define the language for a specific domain – for example for NSN in the development of base transceiver stations for mobile communications networks. Engineering consultant Combitech has applied the results to the development of a system for a fighter aircraft. European Software Institute is providing enhanced product line consultancy services that support CVL and supports the standardisation efforts.

For ABB a major MoSiS result is the Train Control Language (TCL) which allows modelling of railway stations. This graphical language employs industry-standard symbols for railway lines, points, etc. TCL modelling makes it possible to generate automatically a major part of the code required for the railway signalling system.

CVL tool prototypes are available as open source through SINTEF. The combination of domain-specific languages with CVL will also allow automatic generation of tests for systems variants in the future. Moreover, CVL is now being standardised through the Object Management Group (OMG). MoSiS is heading a submission team which includes IBM. Submissions are expected in late 2010 with OMG selecting the best approach.

Major project outcomes

DISSEMINATION

- 56 papers (34 papers, 6 keynotes, 12 tutorials & 4 panels)
- 24 presentations/demos at events (14 seminars, 6 presentations, 2 doctoral symposia & 2 workshops)
- 8 articles
- 20 other dissemination activities like webinars, technical reports, and master theses
- 1 book *Domain-Specific Modeling: Enabling Full Code Generation*. ISBN: 978-0-470-03666-2

EXPLOITATION

- Results used/to be used for 5 new products:
NSN: base transceiver stations, ABB: railway signalling systems, Combitech: fighter aircraft, MetaCase: DSM tool, SuperOffice: CRM
- 2 new services:
European Software Institute: enhanced product line consultancy, VTT: requirements modelling
- Results used/to be used for 3 new systems (1 for internal use):
Agresso: ERP, Telefonica: workforce management, Telvent: Wizard for SOA interfaces

STANDARDISATION

- Ongoing standardisation process: CVL is now being standardised through the Object Management Group (OMG)

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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.

