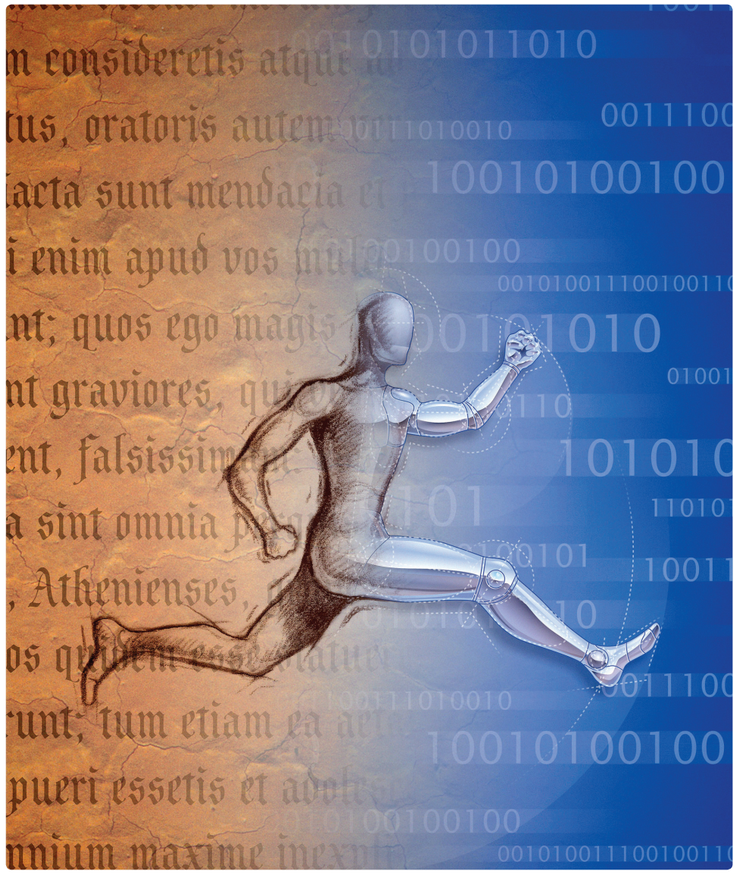
MoSiS
(ITEA 2 06035)

Hans Petter Dahle, ICT-Norway
Norway

Model-driven software engineering improves productivity in the embedded systems industry



The ITEA 2 MoSiS project 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. The use of DSLs combined with CVL markedly improves productivity in the development of highly configurable embedded software systems. MoSiS has demonstrated best-practice processes in industries such as railway signalling, communications, consumer electronics and manufacturing. A range of open-source tool prototypes and ready to apply commercial tools was also made available supporting the MoSiS languages. The common variability language is now a base for ongoing standardization in Object Management Group (OMG).

Embedded systems software is becoming increasingly critical in the global marketplace in terms of the quality and huge number of systems variants required. MoSiS intended to speed-up engineering work, increase quality, improve cost efficiency and produce more complex products in a reliable manner to ensure the global competitiveness of the European embedded systems sector.

MoSiS realised that embedded systems engineers striving to build highly complex systems needed better tools to increase productivity, particularly important for Europe competitiveness. It saw a major opportunity by working with model-driven engineering (MDE) – not only in modelling single systems but also in modelling variability across product families.

AUTOMATING SOFTWARE PRODUCTION

The key benefit of MDE is the automation of parts of the engineering work. Automatic production of software from high-level models is very valuable as it cuts costs and shortens time to market. It also offers a good way to document and structure the systems involved.

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

MoSiS involved 12 partners from 5 countries, including two ITEA 2 founding companies: Telefónica and Telvent. The consortium consisted of large industries, small and medium-sized enterprises (SMEs), research institutes and universities. It was co-ordinated by ICT-Norway, the trade association representing the ICT industry in Norway with over 350 members.

It was set up as an ITEA 2 project because of the intention to meet market needs and to exploit the technology commercially as quickly as possible. This benefits both the companies involved in the project and software engineering in general by working with real problems and demonstrating real solutions.

Industrial partners were particularly keen to improve their engineering work. For example, ABB wanted to develop new product lines for railway signalling, while NSN wanted to describe the features of its systems better. And tool vendors such as MetaCase and @-portunity were interested in developing domain-specific modelling languages and saw the value of modelling variability.

All partners were convinced of the opportunities offered by MDE and realised that a joint effort was necessary since no single company was able to create and evolve the MoSiS results on its own. The consortium was also keen to make an impact through standardisation. An approach to the Object Management Group (OMG) for standardisation of modelling variability was a key element of the project from the initial proposal.

The overall goals of the project 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.

MODELLING VARIABILITY

The most important achievement of MoSiS is a language for modelling variability – the Common Variability Language (CVL). 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.

For example, a range of mobile phones can offer the same facilities while having different screen sizes, types of interface – keyboard or touch screen – or user language. In the same way, signalling systems for railways will have to provide the same main functions for any size of station – from simple to very complex; and one station may be very like another, so there would be no need to produce a new model from scratch.

CVL is not totally new. MoSiS built on the work on product lines and variability in earlier ITEA projects such as FAMILIES. However, no-one had really developed a language to model all the aspects of variability, separate from the base model of the system, and with tool support to automate part of the engineering processes.

As a result, MoSiS is expected to have a major impact on both products and product-development processes. In terms of engineering, use of CVL will lead to more cost-efficient production of products. Case studies within the project indicate a ten-times improvement in efficiency. And such automation means that what took weeks or months before can now be achieved in hours.

On the product side, well-defined models allow for more complex systems – and such complexity can be achieved in a more reliable manner. Moreover, this is generic technology, so it can be used in all domains across the whole embedded systems sector with applications already seen in automotive development, communications, defence, energy, health and transportation. It can also be used outside of the embedded systems sector.

EXPLOITATION AND STANDARDISATION UNDERWAY

Several companies have started to use the MoSiS technology, including NSN, engineering consultant Combitech, which has applied the results to the development of a system for a fighter aircraft, and tool vendor MetaCase, which has started to apply it in its tools. These tools make it possible to define the language for a specific domain – for example for NSN in the development of base stations for mobile communications networks.

ABB has used the results to develop the Train Control Language (TCL) which allows modelling of railway stations. This is a graphical language employing 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. This language has been presented at several conferences in the railway sector.

Good results have also been obtained in the area of MDE for specific domains, particularly modelling non-functional requirements (NFRs), such as performance. MoSiS has provided tool support for the NFR+ Framework developed by VTT. Results of this work show that it is possible to bridge what has been gap between requirements engineering work and implementation in systems. Until now, these have been two separate worlds to a certain extent. Now there is a method for modelling requirements and breaking these requirements into more low-level functions that can be measured and checked that they are met.

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 OMG with a call for proposals. MoSiS is heading a submission team which includes IBM. Submissions are expected in late 2010 with OMG selecting the best approach.

More information: http://itea-mosis.org