

Project Results

VERDE

The iterative and incremental route to real-time embedded system development

VERDE aimed to develop and industrialise a solution for iterative, incremental development and validation of real-time embedded systems (RTES) in the domains of aerospace, software radio, railway and automotive. By integrating model-driven engineering (MDE), component-based infrastructures and verification-and-validation (V&V) techniques, rapid prototyping is facilitated through automatic mapping and execution on component-based platforms.

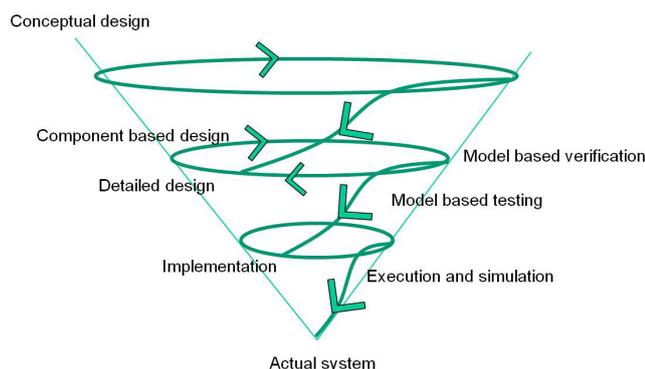
The growing complexity of software-intensive, real-time embedded systems combined with constant quality and time-to-market constraints has created new challenges for engineering. In the traditional development of these systems, the verification-and-validation cycle begins only after implementation and integration is completed. Given the financial and practical implications of this, there is a need for model-based testing and test-driven development that enables early validation of non-functional RTES properties, including performance and resource use.

RICH TECHNOLOGY MIX

The project comprised, and benefited from, a rich mix of technologies, tool providers and users in which the cooperation, particularly in terms of technologies and use cases, enhanced the realisation of the project's goals. Building on the experience and results

from other European research projects, coupled with the strong partnership between major corporations, SMEs and academics from different European countries (France, Germany and Norway), the novel approach developed by the VERDE project is being adopted and industrialised for large-scale implementation by the industry. The SMEs involved in VERDE played a key role in this by providing a combination of assets that encompass expertise, tool provision and related services in a package specifically tailored to the precise end-user needs and peculiarities. In this way, VERDE also creates new opportunities for SMEs working in the emerging market of test and analysis-driven solutions in Europe and thus promotes ready exploitation by software engineering vendors and service providers. The gains for end users involved in VERDE are lower development costs along with better overall product quality.

Productivity, predictability and cost control in the different industrial domains targeted by the VERDE project – software radio, aerospace, railway and automotive – there is a lack of integration between tools and execution platforms and no iterative validation driven strategy suitable for the software development processes used. However, the VERDE project took the component-based software engineering (CBSE) notion that intensive code generation produces significant savings in



The VERDE process

VERDE (ITEA 2 ~ 08020)

Partners

ABB Norway
Alstom Transport
CEA LIST
EADS Astrium
Fraunhofer FOKUS
FZI
GEENSYS
ICT-Norway
Infineon Technologies AG
itemis GmbH
OBOE
Robert Bosch GmbH
ScopeSET
Simula Research Lab
SINTEF
Smartesting
Thales
University of Paderborn
WesternGeco

Countries involved

France
Germany
Norway

Project start

June 2009

Project end

November 2012

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the development process to generate net improvement in productivity, predictability and cost control in the development process. The greater modularity, portability and reusability this CBSE approach offers is still incomplete since it does not integrate real-time analysis and testing strategies.

The VERDE solution stepped in to fill this gap and also produce benefits from significant complementary improvements in the development process. The combination of modelling techniques and a component-based approach enable design feasibility to be checked through the integration of various tools such as Papyrus and Diversity. Furthermore, the automatic computation of the model-based safety analysis can be adapted for hardware safety analysis.

MAKING THE RESULTS USABLE

The methodological and tool integration framework was geared to the management of use case requirements and to creating a methodological framework for the iterative, incremental design of RTES. Several versions of the VERDE Platform were built to integrate the new versions of the tools developed by the partners whose synchronised efforts to implement the transformations from the VERDE modelling language to the different execution platforms is considered key to the dissemination of results. Model-based testing focused on making the results really usable for the partners' development processes and techniques to extract component (or

sub-system) test cases from a system specification analysis were developed to drastically reduce testing complexity and identify issues at an early development stage, even if testing of the complete system is not yet possible.

EXPLOITATION PROSPECTS

The exploitation prospects of the project partners vary and mainly concern industrialising the developments made during VERDE. These include the release of more than ten open-source or commercial software products supporting the VERDE methodology. While there are too many examples of exploitation for all to be mentioned, there is one that targets all the focal domains – the Obeo Designer for System Engineering (OD4SE), developed as a commercial product. Obeo will market licences and services around OD4SE for large industrial companies or integrators in the aeronautics, train, automotive and space domains.

A number of the VERDE results are also candidates for adoption by Polarsys and three VERDE companies have made a joint response to a tender application call from a public company. Furthermore, the large project partner companies are exploiting the results of VERDE internally. All of this points to the clear market relevance inherent in VERDE that reflects the pull for reduced development and validation time. The integration focus of the project targeted the delivery of a large number of good quality, practicable results – and it delivered.

Major project outcomes

DISSEMINATION

- 68 conference papers
- 1 book chapter "Towards Accurate Source-Level Annotation of Low-Level Properties Obtained from Optimized Binary Code" in the book "System Specification and Design Languages", published by Springer in 2012
- 6 journal articles in international conferences such as M-BED, DATE, MODELS, SORT, APSEC, ISORC, Safecom, SIES, SASIMI, SHARK, ICSE, etc.
- 79 presentations in Eclipse Development Days, TOPCASED Days, Neptune, etc. and the conferences in which the papers were presented

EXPLOITATION

- 5 new products, including Yakindu CReMa (created by Itemis for requirement traceability)
- 11 improved tools, including: CertifyIt (made by Smartesting for automated functional test generation), Diversity (made by CEA for the symbolic analysis of test cases), SINTEF CVL tools (used to manage variability in systems) and Metrino (made by the Fraunhofer Institut for the validation and quality assurance of models)

STANDARDISATION

- Contributions to OMG, for example for the UML testing profile (UTP), the Common Variability Language (CVL) and MARTE

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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.



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