

INNOVATION REPORT

An iterative and incremental approach to real-time embedded system development



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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 are completed. Given the financial and practical implications of this, there is a need for model-based testing and test-driven development that enable early validation of non-functional RTES properties, including performance and resource use.

The aim of the ITEA 2 VERDE project was 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.

A rich interdisciplinary mix

The VERDE consortium offered an opportunity for close collaboration between mature technology providers and end users from different sectors of the industry, with the ultimate goal of investigating new directions for the next generation of engineering tools. The novel approach developed by the VERDE project is ready for large-scale deployment by industry. The SMEs involved in VERDE played a key role in this by

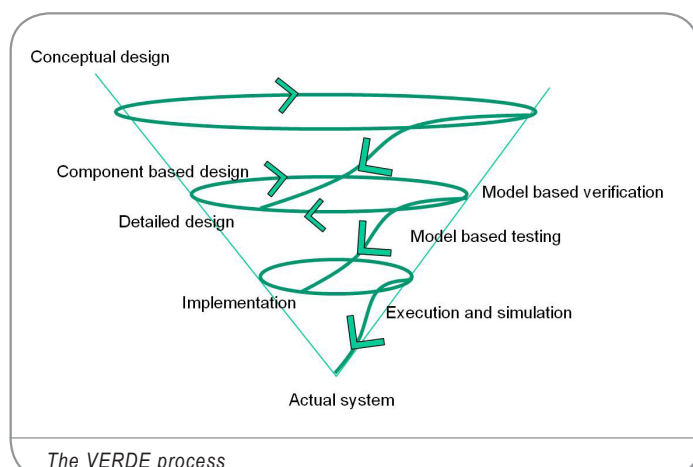
providing a combination of assets that encompass expertise, tool provision and related services in a package specifically tailored to the precise end-user needs and peculiarities. In this way, VERDE not only creates new opportunities for SMEs working in the emerging market of test and analysis-driven solutions in Europe but also promotes ready exploitation by software engineering vendors and service providers. The end users involved in VERDE gain from lower development costs along with better overall product quality.

Bridging the gap

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, with no iterative validation driven strategy being suitable for the software development processes used in the targeted domains. The net improvement of productivity, predictability and cost control in the development process generated by the VERDE project is based on the component-based software engineering (CBSE) notion that intensive code generation produces significant savings in the development process. This is true of automotive with AUTOSAR and, more recently, in several domains that use lwCCM-based frameworks, such as satellite and software-defined radio.

Extending the possibilities

In VERDE the key innovations concern the way in which modelling techniques and a component-based approach have been combined to enable design feasibility to be checked through the integration of various tools such as Papyrus, which aims to provide an integrated and user-consumable environment for editing any kind of Eclipse Modeling Framework (EMF) model and particularly supporting UML and related modelling languages like MARTE. This standard UML profile for Modelling and Analysis of Real-Time and Embedded systems completes UML with key notions for the RTE domain (non-functional properties, time, resources). Providing a language that can be used to design and analyse a system with a number of different tools and techniques, in a way that is standard and easier to automate, represents a significant step in the field. The technologies that have been developed in the VERDE project are innovative in both the



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state-of-the-art and the state-of-the-practice in terms of being able to create and manipulate models for component-based embedded software engineering, in a number of aspects.

The combination of model-driven engineering, a component-based development strategy, testing and non-functional properties analysis techniques, and standardised open-source tools tailored for a small but representative number of target business domains and platforms, has led to tangible success. VERDE has also driven the UML test profile evolution to 1.2 as well as the revised version of the common variability language (CVL). These actions were undertaken by CEA, the Fraunhofer Institute, Thales, SINTEF and Smartesting while Astrium has also evaluated the possibilities for addressing shortcomings for data modelling in UML at OMG.

Exploitation prospects

From the real-time and embedded systems research community perspective VERDE constitutes a means of effectively exploiting the capabilities of prevailing analysis and verification techniques geared to solutions in actual industrial domains. These include the release of more than ten open-source or commercial software products supporting the VERDE methodology, such as the focus on RMF by Itemis to provide open-source implementation of both the ReqIF standard under the umbrella of Eclipse foundation (eclipse.org/rmf) and a traceability solution (CReMa). Bosch, meanwhile, is exploiting the VERDE methodology and early validation for the development of future products while Astrium will focus on system engineering process improvement (converging

gradually to full-scale model-based system engineering) and functional simulation development.

While there are too many examples of exploitation for all to be mentioned, it is worth referring to one that targets all the focal domains. This is 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. Obeo will also improve SPEM Designer (SPEM meta-model and viewpoint) and provide the SPEM Designer free of charge to researchers and R&D projects. By providing the SPEM Designer to ten R&D projects, it is hoped that new users will be encouraged to discover the Obeo Designer platform.

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.

More information:
www.itea-verde.org