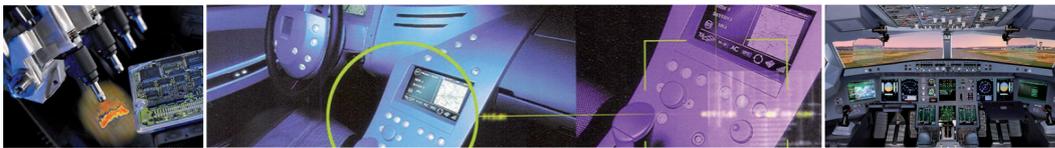




## PROJECT RESULTS

# Speeding embedded system development

### Model-driven engineering cuts coding costs for safety-critical systems



***The Gene-Auto project developed an open-source code generator which enables automatic transformation from high-level industry-standard models to executable program code. This cuts development costs for real-time embedded systems in safety critical domains and was evaluated successfully in industrial case studies. The toolset is intended to be qualified according to aerospace industry standards.***

Embedded systems are responsible for innovation in many industries, particularly in safety-critical aeronautic, aerospace and automotive domains. However, they have a major impact on final product cost – 25% in automotive and 35% in aeronautics. Moreover, there is a demand for higher levels of integration with lower costs, while the intrinsic complexity of these systems is exploding.

Some industries are compensating by outsourcing much software development to low-cost countries as these activities require a significant workforce. However, outsourcing can create extra loops and costs, while leading to loss of know-how and competences.

#### **Model-driven engineering shows the way**

Model-driven engineering now offers a way to reduce workforce needs and shorten the development loop for embedded systems.

It is widely applied for highly complex and critical systems as application-specific solutions can be described using high-level graphical modelling rather than a computer programming language.

Abstraction of implementation details makes it possible to verify and validate system properties very early in the design. Subsequent model refinements add all the necessary details and, finally, a code generator helps to convert the model to working software code.

Increased productivity in specification and design coupled with early verification and validation are a major advance – and there is even more to gain. The goal of Gene-Auto was a certifiable automatic code generator allowing conversion of high-level functional models to ‘correct-by-construction’ software code guaranteeing lossless conversion from model to software code – eliminating verification at code level.

#### **Developing open market-standard approach**

Gene-Auto implemented an open-source solution for automatic code generation based on the *de-facto* industrial standard Simulink/ Stateflow modelling suite and its open-source counterpart Scicos. These graphical modelling and simulation tools enable the user to create block diagrams to model and simulate the dynamics of hybrid systems and compile models into

## GENE-AUTO (ITEA 05018)



#### **Partners**

- Airbus France
- Alyotech
- EADS-Astrium
- Barco
- Continental
- FeRIA/IRIT
- IB Krates
- INRIA
- Israel Aircraft Industries
- Tallinn University of Technology
- Thales Alenia Space

#### **Countries involved**

- Belgium
- Estonia
- France
- Israel

#### **Start of the project**

January 2006

#### **End of the project**

December 2008



## PROJECT RESULTS

executable code.

While several proprietary tools exist to convert such models to embedded code, Gene Auto allows more freedom for development organisation and toolset customisation. This enables the toolset to be certified and, through that, suppress code-level verification.

The resulting open-source toolset facilitates long-term support, maintenance and tool qualification based on publicly available and well-defined meta-models for system and code modelling. It supports multiple input formalisms and fully automatic transformation from input model to embedded code, supports qualification through open architecture and suitable development processes within the DO178B aviation standard, and optimises coding.

### Impacting costs and performance

The initial impact of the toolset is on cost of ownership as no purchase is required and maintenance costs can be reduced by 20 to 30%. A more important effect is a marked increase in performance and efficiency of embedded software development. A benchmarking exercise comparing two similar software developments – one using traditional methods, the other based on automatic code generation for 75% of the code –

showed an overall cost reduction by a factor of three and a shortening of the development cycle by a factor of four.

Good co-operation between industrial partners from safety-critical domains, SMEs and academia ensured that common requirements were worked out from several key industries. It has also resulted in the creation of an embedded systems community based on aeronautics excellence and maintaining Europe's leading position in these industries.

Furthermore, the open-source strategy deployed has shown a satisfactory scheme for ensuring the openness of the tools, end-user influence on the development roadmap and the required durability in line with industry standards – such as the 80-year lifetime demanded in the avionics industry – with the possibility of different uses and contributions.

### Tested and validated by industry leaders

The toolset has been tested and validated by project partners including Airbus, Barco Avionics, EADS-Astrium, Thales Alenia Space and Continental that are leaders in their industries. A first public release was made under the GPL licence in early 2009. Work is continuing in an open community to extend the tool.

### Major project outcomes

#### Dissemination

- 14 papers (including conference presentations)
- 20 presentations/demos at events
- 2 articles
- Other activities: more than 50 internal company presentations, 1 public webinar, project website at [www.geneauto.org](http://www.geneauto.org), display at ITEA symposium (2006-2008) and Research Connection 2009 (Prague, 7-8 May 2009)

#### Exploitation

- 1 new product (the Gene-Auto Code Generator)
- 3 new services (Gene-Auto Pro support service by IB Krates, support services by Alyotech, qualification services from ACG Solutions)

#### Standardisation

- The GASystemModel language is considered as a common metamodel for systems modelling in several other open-source projects (Topcased, Spacify, Memvatex, OPEES, EDONA)

#### Spin-offs

- 1 spin-off (ACG Solutions)

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