

INNOVATION REPORT

Early verification and validation speeds development of right product at right time



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The ITEA 2 EVOLVE project has created a high-level methodology for early verification and validation of evolutionary products through the accredited and certified integration of each component. It provides an iterative and incremental framework based on agile and model-driven engineering paradigms, fostering accredited and certified component reusability. Novel toolsets, methods and guidelines reduce development costs and time.

High quality software plays a key role in the digital revolution and is an integral part of most products from global high-technology companies. Moreover, continuous time and cost pressures mean that the right products must be brought to market at the right time – neither too early nor too late.

Reliable, accurate, fast and low-cost validation and verification of products is therefore a cornerstone of modern high-tech industry. However, many software organisations clearly lack efficient verification and validation technologies that would support rapid, high quality software development in a volatile business environment.

EVOLVE set out to create an iterative and incremental methodological framework for early verification and validation of evolutionary products. The methodology is oriented by the agile and model-driven development paradigms, fostering accredited and certified component reusability in a broad sense. The target domain is the construction of software for real-time embedded systems which may be subject to legal certification or internal company accreditation.

Agile and model-driven design

Much effort has been put into agile and model-driven design to ensure products are made in the right way – for example looking at processes to ensure good quality and good reliability. This ITEA 2 project goes beyond that – focusing not just on making the product right but rather on making the right product right.

This was a very important step forward for the industrial partners in EVOLVE. Manufacturers have to ask themselves continuously during the development process if they are making the right product and at the right price. A product may be beautifully made but if nobody wants it, it is a waste of time and effort.

It should be neither under engineered nor over engineered while providing what the customer wants. This requires a continuous dialogue between the product management, sales and R&D people.

EVOLVE focused on validation of both functional and non-functional properties, from a requirements evaluation of an early architecture design to final customer acceptance. It reflected on three ways to deal with evolutionary products:

1. Dealing with evolution at an early stage and getting early feedback – so-called early verification and validation. This involves checking at a very early stage of the project if it matches the requirement from either the internal or external customer and does the concept match up in terms for example of non-functional requirements as the cost of adding any of this later on is high;
2. Agile development – this concept has been used now for several years but EVOLVE examined how to integrate early verification and validation into the incremental design process; and
3. Model-driven design.

Combining these three elements – early verification and validation activities, agile development and model-driven design – was one of the biggest challenges and biggest innovations in the project. In practice, proper definition of the agile design process allows early verification and validation.

Work resulted in novel toolsets, methods and guidelines to reduce development cost and time. These included techniques for architecture modelling, model analysis, analysis-based design decisions and model transformations, such as schedulability, variability and fit-for-function analysis as well as integrating novel modelling techniques, such as aspect-oriented modelling and domain-specific modelling languages. Test flow was also studied for iterative and incremental integration with a model based testing framework, configuration and build management, and test automation

Incremental certification process

Another major problem that was overcome involved a certification process which allows incremental advances once a product is launched in a safety-critical domain so that certification does not have to start from scratch each time.

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Effectively, EVOLVE had created an incremental process which makes it possible to handle different levels of certification – this could be in terms of functionality or different markets such as use of an automotive product in avionics or space – without having to restart from scratch each time.

There are big overlaps between certification in different sectors. The need is to check what has been achieved already for example, for certification for automotive market – this has been done, and this and this. If the same product is now being launched for use in the aerospace sector, what can simply be reused – that is where evidence already available – and what has to be redone. This approach can also be used to assess what would be needed to launch a product in a totally new domain.

Positive benefits already

Project partners have already obtained positive benefits from use of the framework developed. For example, Barco had been developing a new product and showing it to customers. Every demonstration resulted in a lot of new requirements and features that had to be incorporated. The scope of the product kept expanding and got out of control.

By introducing a sort of agile approach, it was possible to prioritise features and implement them based on the highest business value. It was then decided that the scope was defined for certain iteration and at that point that the product was

complete. Barco stopped adding new features – having covered the features it wanted to supply its customers. This may have lost one or two potential customers but it is necessary to make a hard commercial choice.

A second partner – Melexis – was looking at expanding its portfolio of products with embedded software from the automotive industry into the aerospace domain. The certification framework assessment approach allowed comparison of standards and encouraged the company to expand.

Another positive outcome from the project has been two spin-off companies, both tool vendors:

- The Open License Society developed a tool – originally called an open cook book and now GoedelWorks systems engineering cloud service – being commercialised by a spin-off called Altreonic; and
- Critical Software has made tools and frameworks which are going to be commercialised in a spin-off called Educad.

Products exactly fit for purpose

As the Barco example demonstrated, a major benefit of the EVOLVE approach is that it allows a manufacturer to make the right product right. The final product is fit for purpose; no more, no less with the right cost for the effort involved. It also enables companies to change direction from time to time in a controlled way to focus on interesting parts of the market.

Use of these results will enhance the competitive nature of European industry – especially for the partners in EVOLVE but also more globally as there was extensive dissemination of results – as it shows that it is possible to bring the right product to the market faster. An added advantage is that a company can quickly change and adapt itself to evolving technology horizons particularly with the ever-growing importance of embedded software.

This ITEA 2 project not only enhanced the state of the art but also the state of the practice – formalising requirements management, clarification and model verification. This was also linked to excellent knowledge transfer from the academic partners who were continually challenging their industrial partners. Some parts of the project related to state of practice had been known in universities but had not been adapted or used in a real industrial environment before.

More information:
www.evolve-itea.org