ITEA3

Project Results

REVaMP²

Extraction, verification and co-evolution in Product Line Engineering

EXECUTIVE SUMMARY

The ITEA project REVaMP² has conceived, developed and evaluated the first comprehensive automation toolchain and associated process to support the round-trip engineering of SIS Product Lines, enabling the profitable engineering of mass-customised products and services across many different domains.

PROJECT ORIGINS

Software-intensive systems and services (SIS) hold the key to mass customisation, boosting customer satisfaction and helping niche markets to become profitable. The first supplier to master this in a given market will hold a decisive competitive advantage. The current Product Line Approach (PLA) involves simultaneously engineering a set of products or services with commonalities and variants as a single coordinated process that maximises common asset and component reuse across variants. However, proactive PLA has an uncertain return-on-investment and the costs of late manual PLA are prohibitive. Many organisations are therefore missing out on the chance to maintain and expand their software-intensive product portfolios.

The REVaMP² (Round-trip Engineering and Variability Management Platform and Process) project has created the first comprehensive round-trip engineering automation platform and process to support extractive, bottom-up PLA adoption and maximise the reuse of legacy assets. An important innovation is a methodology to support Project Line Engineering (PLE), extraction, verification and co-evolution; REVaMP² is therefore able to identify core functionalities and key variation points automatically. In doing so, it reinforces the shift from one-off product sale transactions towards service subscription packages. Co-evolution ensures long-term stability: when software models are modified according to feedback from users, changes to the core are automatically propagated

REVaMP² approach

to other variants of the same type.

TECHNOLOGY APPLIED

At the heart of the REVaMP² platform is a round-trip, model-based PLE toolchain. This can be further sub-divided into a requirement engineering tool, model-based engineering tool and variability management tools, all of which already exist on the market but have been adapted to the consortium's needs. The variability management tools consist of a legacy and PL asset visualisation tool and PL asset automation tools for extraction, variation and co-evolution.

Breaking this set down further, there are currently eight tools, five research Proof-of-Concept (PoC) demonstrators developed by academic partners and three commercial tool prototypes developed

by industrial partners. Two tools focus on formal verification while one analyses product line variability models. The others analyse reusable product line artefacts such as requirements models, hardware models, source code and test sets, as well as the relationships between the artefacts themselves and the artefacts and the variability models. Several open-source elements have also been developed, including a unified framework for mining software artefact variants and a dashboard for tracing features in a codebase to their location in the code.

Validation has been finalised through 12 use-cases in various domains, including system-on-chip design flow (Magillem), automotive suspension design variants (Siemens) and defence product family coordination (Saab).
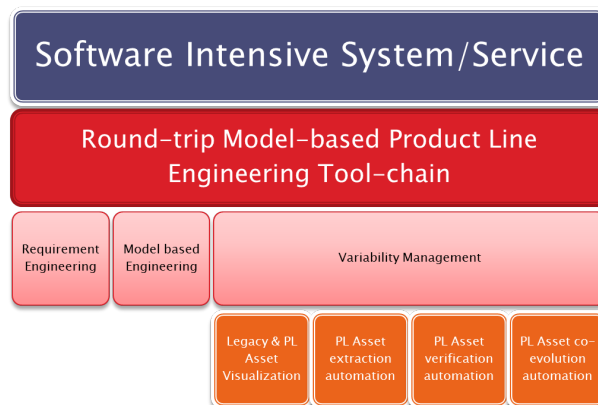
As variability tools cannot work in isolation, the REVaMP² consortium is also being joined by external partners to pursue the standardisation of Variability Exchange Language (VEL) within OASIS. This will enable the exchange of variability information across tools and help to spread the project's innovations.

MAKING THE DIFFERENCE

According to a 2015 study, PLE has the capacity to increase software engineering productivity and quality by a factor of ten. Promising technology results have already been seen by the consortium, including a 15% increase in the coverage of correctly-parsed variation points in C code for KernelHaven and a reduction of Softeam's time-to-market for custom bundles from six weeks to three. ABB expects a 69% decrease in identification and extraction effort and a 15.72% time reduction in the migration of legacy code; as a result, they reported 108% satisfaction with the project (indicating that it exceeded their baseline expectations).

While PLE is already the norm for large players, REVaMP² opens up its possibilities to companies of all sizes at a time when digitalisation will potentially add EUR 1 trillion to Europe's GDP. As new types of SIS PLE spread across key economic sectors like manufacturing, transportation and healthcare, so too will the demand for toolchains like REVaMP². This has already resulted in 24 new or enhanced products, services and systems. Siemens, for instance, has been able to fast-track the technology readiness level of product-line engineering support, while MES has extended their M-XRAY to automatically extract architectural assets from analysed models. In terms of human capital, 14 new positions were created across the consortium.

From a long-term perspective, REVaMP² has generated co-marketing and co-distribution agreements which will sustain the results and have a multiplier effect for companies (such as Softeam and PureSystems, who are offering their Modelio Variability Designer and Asset Variability Framework alongside one another). The project was also highlighted to 133 participants at SPLC 2019 and 35 students at an industry-driven hackathon; it has subsequently formed a basis for 16 academic examinations and three training programmes. As REVaMP²'s results are domain-independent, this dissemination will help the toolchain to spread to virtually any economic sector. In turn, this will herald a new era of automatic development for variable products, allowing organisations to affordably cater to niche markets and minorities in ways that were previously unimaginable.

MAJOR PROJECT OUTCOMES

Dissemination
- 91 publications, more than 5 Q1 papers
- 2 Software Product Lines Conferences organised with more than 200 participants

Exploitation (so far)
- 3 bilateral co-marketing, co-distribution agreements Softeam-Magillem-pure:systems
- 24 new products including:
    - Feature Dependency Visualisation (FeDeV)
    - VariaMos Web Front-End PL Model Editor
    - BUT4Reuse: C/C++ adapter
    - Modelio Variability Designer
    - FeatureDashboard for Feature Location

Standardisation
- Contribution to 2 standardisation committees:
    - INCOSE standards on Requirements Engineering
    - OMG standard on System Engineering modelling

Partners

Belgium
(Un)manned
dotOcean
Macq
Siemens
Sirris
Sony Depthsensing Solutions
University of Antwerp Nexor

France
Magillem Design Services
Softeam
Sorbonne Université
Thales Research & Technology
Université Paris 1 Panthéon

Germany
ABB
AVL Software ad Functions
FZI Forschungszentrum Informatik
Model Engineering Solutions
pure-systems
Robert Bosch
ScopeSET
University of Hildesheim

Spain
Hiberus Tecnologías de la Información
Knowledge Centric Solutions
Universidad San Jorge

Sweden
ABB
Altran
Karlstad University
KTH Royal Institute of Technology
SAAB
Scania
University of Gothenburg

Project start
November 2016

Project end
December 2019

Project leader
Andrey Sadovykh, Softeam

Project email
andrey.sadovykh@softeam.fr

Project website
http://www.revamp2-project.eu/