

Impact case study (REF3b)

Institution: Bournemouth University
Unit of Assessment: UOA15
Title of case study: Enhancement of 'Upstream' Software Development Methods.
1. Summary of the impact (indicative maximum 100 words)

BU's software engineering research has focused on the improvement of software development methods with a particular emphasis on the 'upstream' or requirements phases. The benefits include improved development processes as well as considerable financial savings, as evidenced in this case study. The research has been used locally in projects with medium sized enterprises (SME's) and in collaboration with international partners including National ICT Australia (NICTA) to enhance business and IT alignment (Australia and Japan); the European Commission funded *Visualise all moDel drivEn programming* (VIDE) project to impact commercial tools (France and Germany); and with Bosch Automotive (Germany) to enhance model driven development.

2. Underpinning research (indicative maximum 500 words)
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BU research in software engineering methods has focussed on what are typically regarded as requirements phases. The consistent theme within this work has been the need to provide models or approaches, which are accessible to users, whilst also allowing rigour of analysis.

These ideas have been manifested in a variety of our modelling approaches. From 1997-2000 research focused on process models that were mapped to formal and enactable notations (P1), to enhance understanding of client business processes. This work evolved to provide Business and IT alignment methods described in P2 and P3. These concepts were then incorporated into model driven approaches and tools through BU's involvement with the European funded VIDE project.

Latterly, researchers have continued to enhance software engineering methods using process approaches within the requirements phase of model driven methods (P5). This has provided improved merging for distributed model driven development through a PhD funded by Bosch (P6), (completed in 2012) and application of software engineering expertise to enhance methods for SMEs (e.g.Morning Data).

The following outlines specific 'upstream' software engineering research output from BU which has been applied to these projects.

- **Accessibility of Process Models and Process Modelling Tools:** This involves building accessible tool-sets that take account of their varied audiences. This can be seen in early work by Phalp (BU 1997 to present) (P1), which describes how 'user-facing' process models can be mapped through families of models, to allow rigorous analysis of process issues, whilst still allowing end users to validate notations which are accessible to them.
- **Business and IT Alignment:** Work on mapping through families of models was revised when Phalp and PhD student Cox (completion 2002) incorporated problem frames. These ideas were presented at conferences in 2003, including ProSim (International Workshop on Software Process Simulation Modelling at ICSE 2003) and REFSQ (Working Conference on Requirements Engineering: Foundation for Software Quality). Cox subsequently took these ideas to NICTA and the collaboration was continued with journal papers on the extended methods (P2 and P3). These papers were widely publicised.
- **Enhancing Model Driven Methods and Tools:** Later work from 2005 onwards was driven by the need to provide notations and tools that were accessible to a range of stakeholders, including non-IT specialists. This work drew on BU specification tools expertise (P4) and was key to BU's successful contribution to the VIDE project. This work has continued in the group, with a PhD completion by Fouad (2011) and further published outputs describing how requirements should be incorporated fully within the initial, or Computationally Independent Modelling (CIM), phase of model driven development (P5).

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In parallel, researchers have addressed other practical development issues, notably work at Bosch on how merging of models can be enhanced within the context of distributed software development (P6), again suggesting mechanisms and providing prototype tools.

3. References to the research (indicative maximum of six references)

- P1.** Phalp, K.T. (1998). The CAP Framework for Business Process Modelling. *Information and Software Technology*, 40(13), 731–744. DOI: 10.1016/S0950-5849(98)00058-5. **P2.** Bleistein, S., Cox, K., Verner, J. and Phalp, K. (2006). B-SCP: a requirements analysis framework for validating strategic alignment of organizational IT based on strategy, context, and process. *Information and Software Technology*, 48(9), 846–868. DOI: 10.1016/j.infsof.2005.12.001. **P3.** Cox, K., Phalp, K., Bleistein, S. and Verner, J. (2005). Deriving Requirements from Process Models via the Problem Frames Approach. *Information and Software Technology*, 47(5), 319–337. Available from: <http://dec.bournemouth.ac.uk/ESERG/kphalp/ist05.pdf> [accessed 20 November 2013]. **P4.** Kanyaru, J.M. and Phalp, K. (2009). Validating software requirements with enactable use case descriptions. *Requirements Engineering Journal*, 14(1), 1–14. DOI: 10.1007/s00766-008-0070-8. **P5.** Fouad, A., Phalp, K., Kanyaru, J.M. and Jeary, S. (2011). Embedding Requirements within the Model Driven Architecture. *Software Quality Journal*, 19(2), 411–430. DOI: 10.1007/s11219-010-9122-7. **P6.** Grimm, F., Phalp, K. and Vincent, J. (2008). *Enabling multi-stakeholder cooperative modelling in automotive software development and implications for model driven software development*. First International Workshop on Business Support and MDA (MDABIZ) – a Tools 2008 Workshop, Zurich, July 2008.

4. Details of the impact (indicative maximum 750 words)

BU's research in enhancing software engineering methods and tools has been applied in a range of contexts across the world. Much of the international impact was delivered through collaboration, including through the VIDE project, with NICTA, and with Bosch, but also on a local scale through BU's knowledge transfer partnerships (KTPs).

VIDE project: Developing a model-driven tool set for organisations across the globe

VIDE was a European Commission funded project that began in 2005. It brought together ten institutions and industry partners from five European countries. The project aim was to develop an enhanced model driven tool-set.

BU joined the project team because of their researcher's extensive 'upstream' expertise. Without this background, BU would not have gained entry to the consortium, nor had the successful bid, nor been a successful consortium partner.

The report describes BU's major strength as “synthesising work from different communities in order to provide effective and innovative approaches to the wider software systems development context.” The report goes on to state: “This integration of systems methods and models with novel computational approaches provides solutions to problems that are intractable using traditional or single paradigm methods” (R1, p.44-5).

Subsequently BU's research informed the VIDE project on various levels, including:

- The process and specification of tools.
- General requirements and Business and IT and Alignment, as described in P2.

In the model driven context BU provided an accessible tool-set, which allowed greater involvement of stakeholders in the CIM phase of model driven development. These ideas also facilitated developments by VIDE's collaborating industrial partners. These developments are evidenced in the VIDE Dissemination and Exploitation Deliverable report (R1). Examples include:

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Softteam, a software tools vendor, based in Paris, has subsidiaries in Saint Quentin en Yvelines, Rennes, Nantes and Sophia Antipolis. The company used code generation capabilities introduced during VIDE to add capability to their tool 'Objecteering'. They have now created a new modelling tool, Modelio, which uses the results of the VIDE project in its development. Modelio has many advantages over the tool that it replaces, including the superior usability that was an anticipated impact of the VIDE work. The analysis on VIDE's impact on Softteam concludes: "It is expected that the number of code generator licenses will increase between 1% and 8% in 2009" (R1, p.57).

Altec are a major enterprise resource planning (ERP) producer in Greece. Altec used the VIDE toolkit as an add-on to their existing ONAR tool-set (Ontologies based ENterprise Application IntegRation) (R2, p.60). The report states: "ALTEC has an exploitation strategy which features further investigation of the pre-CIM and CIM level tools provided by BU and iWi which provide a natural business domain entry level to their tooling." (R1. P42).

Altec's sales forecast for the relevant revenue streams in a 5-year period were calculated with a 14% annual growth (R2, p.60). The company said: "All our expectations from VIDE project ... still hold ... ONAR is now in its full commercial phase ... and is offered on the cloud for our customers – mainly companies using our ERP systems and also public sector authorities" (R2, p.42).

NICTA – Australia and Japan

The Business and IT Alignment methods, which fed into VIDE, were directly rolled out via NICTA consultancy work in Australia and Japan. These alignment methods were used extensively by NICTA for internal projects and for consultancy and were used by a wide range of commercial organisations within Australia and Japan. A clear indicator of the success of these approaches was the significant financial savings that were claimed as a result of their use (R3).

Bosch automotive: Model merging in distributed model driven development

Bosch automotive needed to develop models in parallel, as part of a software product line suite, across two sites. The unified modelling language models (UML) are revised at different sites, and variants need to be merged. BU researchers observed that existing approaches to merging preserved syntax often lost meaning to the modeller. This was a critical issue as the engineers used layout to convey meaning in a number of distinct ways, and that these tactics were outside the normal unified modelling language (UML) rules.

As a solution researchers invented a novel, semi-automatic model merge, which preserved layout choices, thereby preserving meaning for the modeller. A prototype tool was built and used by the development team, who were extremely supportive. One of Bosch's Senior Engineers praised the graphical layout and dynamic adjustment of the model tree view's column width, as well as usability of the tool. These comments are included in the PhD thesis (R4 and R5).

Software engineering with small to medium sized enterprises (SMEs)

Researchers have worked on six knowledge transfer partnerships (KTP) to conduct requirements engineering for software systems organisations. A specific example is the KTP with Morning Data Ltd, which took place between 2009 and 2012.

Morning Data Ltd is a leading supplier of world-class software and service solutions for the global insurance industry. The project centred on software maintenance and evolution with an emphasis on introducing rigorous software engineering methods.

Through this project the BU research team used their 'upstream' expertise to discover and document requirements, ensuring that the new generation of product aligned with Morning Data's business strategy and would meet the needs of their clients.

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The company identified the project as having been of vital strategic importance and quantified financial gains, stating in their report to the Technology Strategy Board (TSB) that: "Through the meetings with the University we learnt and adopted a new development process and methodology which allowed us to drastically improve the quality of the software we were producing." They also stated a direct projected increase in turnover of £200K and an increase in pre-tax profit from £36k to £175k (R6 and R7).

In a public blog, the Development Director at Morning Data states: "Over the duration of the project we have learnt so much and introduced so many valuable new tools to our development team – we simply would not be working the way we are now without having had the involvement and the knowledge of the staff at BU." (R8).

The project was rated as very good by the TSB and added to the short list from which KTP case studies will be developed as an example of best practice (R9).

This measurable financial gain demonstrated through the Morning Data project is an example of how BU's research into process modelling; business and IT alignment and enhancing model driven methods can be applied to deliver substantial financial savings.

5. Sources to corroborate the impact (indicative maximum of 10 references)

R1. VIDE Dissemination and Exploitation Deliverable 10.2 (available on request).

R2. Formerly Agile Technologies and IT Innovation, Research Programmes Division, ALTEC Software S.A. (was Altec PI for the project). Contact details available.

R3. Former Director of Promise Point Boutique and former NICTA researcher. Contact details available.

R4. PhD thesis, completed 2012, describes the work with Bosch, and the development of merging methods and prototype tool (available on request).

R5. Former BU PhD student, now a Lecturer at University of Zwickau, Germany. Contact details available.

R6. Final KTP Report on Morning Data to TSB (available on request).

R7. Development Director at Morning Data. Contact details available.

R8. Public blog from KTP Development Manager on the Experience of KTP.

R9. Feedback from TSB on Morning Data project (available on request).