Institution: University of Leicester

Unit of Assessment: UoA 11 Computer Science and Informatics

Title of case study: Software companies stay innovative and win business in fast-moving and competitive market

1. Summary of the impact

Research on software architectures and reengineering helped Portuguese IT company ATX develop automated migration tools. A report by IT research company Gartner in 2009 identified the collaboration as one of the company's key strengths. The partnership allowed ATX to sustain an innovative R&D programme and win business in a competitive market.

Impact occurred via:

- New and improved methodologies and technologies provided to customers;
- Improved R&D capacity through upskilling of staff;
- Improved profile as a leading-edge IT company, leading to new business.

The same research also helped local SME Hunter Systems to redesign their products for the Web.

2. Underpinning research

Architectural models are crucial to improving efficiency and quality in software evolution. For business-critical applications, ability to adapt to new requirements is key, but traditional architectures are ill-suited to support evolution for two reasons. Firstly, they often mix fundamental business functions (computation) with more volatile business process and rules (coordination) as well as data and application logic with user interface aspects, making them sensitive to evolution of either requirements or technology. Secondly, knowledge about the system is buried in low-level code, so a large part of the effort in reengineering is spent on analysing the existing implementation.

Research at Leicester in architectural modelling and migration by model transformation addressed these challenges [1-6]. Event-based [2,6], mobile [4] and service-oriented [5] architectures as studied in [A, D] allow for computational and coordination aspects of software systems to be separated to enable independent evolution. In event-based architectures the key advantage is in allowing new functionality to be added without having to reprogram the existing software [2,6]. In service-oriented architectures, richer components support abstractions that bring the structure of applications closer to the business domain, making it easier to bind and reconfigure services [6].

Migrating to new architectures as investigated in [B, C], instead of wrapping applications by interfaces, proposed a deep restructuring approach. A methodology was developed to allow legacy applications to be decomposed first by technological and then by functional concerns, exposing the latter as services [3]. Formalising such transformations using graph-based models we improved scalability (graph-based models are often significantly smaller than abstract syntax trees [C]) while providing a high-level implementation of migration rules [1].

Software companies, such as ATX who develop and migrate software for the financial and government sector, or Hunter Systems who offer asset management solutions, regularly face the above challenges. In maintaining business-critical applications, they have to guarantee longevity. When migrating legacy applications, ATX are dealing with large undocumented systems in programming languages from the mainframe era that are too time-consuming to analyse and change manually.

ATX' relationship with Leicester began with [C] through joint research and training on methods and techniques for re-engineering legacy systems to service-oriented architectures and continued in [D]. A formal partnership was signed between ATX and UoL in 2008 after the end of [C].

Hunter Systems, migrating applications generated by out-dated GUI builders towards web-based solutions, have to document the existing architecture to support the migration to new platforms. They contacted the University for expertise in software architectures and migration in 2011 leading to an Innovation Partnership (a form of sKTP) supporting consulting, training and joint supervision of students' projects.

Key personnel

Leicester: J Fiadeiro, (Professor, 2002-2012), R Heckel, (Professor, 2004-), S Reiff-Marganiec (Senior Lecturer, 2003-), M El-Ramly (Lecturer, 2003-07), A Boronat (Lecturer, 2007-), K Ehrig (PDRA, 2006-08), L Bocchi (PDRA, 2006-), C Matos (PhD student/RA, 2006-2011)

ATX: L Andrade, R Correia, S Gorton, J Gouveia, G Koutsoukos, C Matos.

Hunter Systems: N Hunter (CEO), J Iqbal (seconded to Leicester for training in 2011-12)

3. References to the research

Grants:

A. "AGILE: Architectures for Mobility", FP5-IST-2005-16004; €1,377,000 (Leicester: €125,494); January 2002 – April 2005. Grant holder for UoL: J Fiadeiro.

B. "SEGRAVIS: Syntactic and Semantic Integration of Visual Modelling Techniques", FP5-HPRN-CT-2002-00275; Leicester budget: €50,000); October 2002 – September 2006. Grant holder for UoL: R. Heckel.

C. "Leg2Net: From Legacy Systems to Services in the Net", Marie Curie Transfer-of-Knowledge Industry-Academia Partnership 003169; €417,775; June 04 – May 08. Grant holders: J Fiadeiro, R Heckel, S Reiff-Marganiec (for UoL) and L Andrade (for ATX). PhD Students: C Matos, R Correia.

D. "Sensoria: Software Engineering for Service-Oriented Overlay Computers", FP6-IST-2005-16004; €8,158,000 (Leicester: €742,380); September 05 – February 10. Grant holders for UoL: J Fiadeiro, R Heckel, S Reiff-Marganiec. PDRAs: L Bocchi, K Ehrig, P Torrini. PhD Students: D Biztray, J Abreu.

Publications (Leicester authors underlined)

1. C Matos, R Heckel: Annotate, Abstract, Redesign, Transform: Reengineering Java Applications into Services, Proc. 4th Intl. Symposium on Graph Transformations with Industrial Relevance, AGTIVE, 2011

2. J Fiadeiro, A Lopes: An algebraic semantics of event-based architectures. Mathematical Structures in Computer Science 17(5): 1029-1073 (2007)

3. R Correia, C Matos, R Heckel, M El-Ramly: Architecture Migration Driven by Code Categorization. ECSA 2007, LNCS , Springer, 115-122 (2007)

4. A Lopes, J Fiadeiro: Adding mobility to software architectures. Sci. Comput. Program. 61(2): 114- 135 (2006)

5. L Andrade, J Fiadeiro: Composition Contracts for Service Interaction. Journal of Universal Computer Science 10(4): 375-390 (2004)

6. A Lopes, M Wermelinger, J Fiadeiro: High-order architectural connectors. ACM Trans. Softw. Eng. Methodol. 12(1): 64-104 (2003)

4. Details of the impact

Both ATX Software and Hunter Systems face challenges of maintaining and reengineering substantial applications, either as part of bespoke client project or to update their own products. Accessing research and expertise at Leicester has helped them to

- *Inform company strategies* toward developing products and/or processes
- *Improve the skills and knowledge* of their staff to enable them to perform these developments
- *Innovate products and processes*, making them more effective and opening up new markets

ATX Software specialises in architectural modernisation and migration of software systems to event-based and service-oriented architectures. The company, established in 1996, with headquarters in Lisbon maintains subsidiaries in Spain and Brazil. ATX has a wide portfolio of clients in the private sector, finance and government, including [text removed for publication]. Key technogy partners include MS, HP and IBM. Turnover in 2012 was [text removed for publication].

In a go-to-market strategy report produced in September 2009 by IT research company Gartner, the partnership between ATX and UoL was identified as one of its key strengths.

The collaboration helped to *inform company strategy* in order to

- adopt event-based and service-oriented architectures as target platforms for their client's systems.
- reinforce more flexible (higher level) reengineering/migration processes and supporting tools based on the approach in 2.

The cooperation *significantly improved skills and knowledge* through training by UoA researchers. Two ATX staff went on to earn PhDs. ATX HR manager Fernando Ramalho said: "The partnership provided a valuable source of information and learning... enhancing the company's ability in terms of highly qualified human resources.'' This has enabled "difficult issues to be addressed collectively and from different viewpoints, leading to innovation as a result of the partnership's work'', as demonstrated by the following examples.

Innovation in products and processes was helped as follows.

- The approach adopted for ATX's reengineering process is based on pattern-matching and transformation rules, developed and accumulated through past projects. Scientific evaluation [1] confirming superior scalability and effectiveness of the approach has contributed to the decision to move the core tool set from a code-based to a more high-level platform. This has been (and is being) applied in tools automating migration from Delphi to .NET, Powerbuilder to .NET or Java.

- Two products derived from technical contributions in [1,3] are a port of CARE (ATX's main program analysis tool) to Eclipse in [D] and contributions to PL\SQL extraction from Oracle Forms to database stored procedures, using pattern matching developed in [C, D]. These were used in significant client projects, such as a mid-sized migration from Oracle Forms to Microsoft .NET (USA) and a large migration from Oracle Forms to Java (Brazil).

These innovations led to increased competiveness, enhancing the company's profile as capable of resolving complex migration problems across a variety of platforms and helped securing new clients and business in Brazil and USA.

The collaboration opened doors to partnerships and sources of expertise, such as academic and business partners in the Sensoria project [D]. Mr Ramalho said: “These relationships and connections with several partners were seen to be valuable for a number of reasons, not least because it brought people together with organisations they previously had not worked with and would never had a reason to meet with.’’

Hunter Systems are originally a reseller of CRM software who started to market an in-house asset management solution to their clients in services and manufacturing. At their initiation, this desktop-based solution had to be replaced by a web-based one in order to remain effective in situations where the workforce is increasingly mobile and distributed.

Through consulting with the UoA, the company was able to adopt the methodology defined in [1,3] and apply it to define target architecture and platforms for their products. By conducting feasibility studies, training a developer on a reduced version of the product, and supporting a graduate intern at the company, the UoA has enabled them to execute their migration and expand the company’s knowledge- and skills base.

The product is undergoing testing within the company and is being extended by a CRM integration to meet further client demands. Early indications are that 80% of clients want to switch to the web-based product. Especially through cloud-based hosting, the solution is also attractive to small companies. Based on these predictions by CEO N Hunter, significant resources are being committed to finalise the development and testing of the product.

5. Sources to corroborate the impact

Corroborating source: HR Manager, ATX Software

Corroborating source: Former Developer, ATX Software

Go-To-Market Strategy, A Report for ATX Technologies Ltd., Gartner, Sept. 2009, confidential but available to the University.

Factual statement from managing director of Hunter Systems Ltd (SAM Software Solutions Ltd) on September 10th, 2013.