Institution: University of Surrey

Unit of Assessment: UOA 11 Computer Science and Informatics

Title of case study:
Adaptive Information Systems

1. Summary of the impact (indicative maximum 100 words)

The University of Surrey has developed a set of tools that is enabling us to develop innovative web-based information systems with much lower resources than has formerly been possible.

These tools and techniques are being exploited by a University of Surrey spinout, *Rulemotion*.

The underlying platform has now been used to develop eight distinct business systems. A key feature of our approach is that it enables the business domain to be modelled in structured natural language (using the Object Management Group (OMG) supported standard SBVR [for Semantics of Business Vocabularies and Rules]). The server side functionality is then generated from the business model. *Rulemotion* is the first organisation to offer such extensive support of SBVR. This is a key fusion of the Business Analysis (Business Rules) and Information Technology domains – the gulf between these two communities has been an area of tension for the past 30 years.

2. Underpinning research (indicative maximum 500 words)

The terms "Digital Ecosystem" and more specifically "Digital Business Ecosystem" were coined in 2002 at the beginning of an EU funded programme to open up the on-line (business) communities that were becoming an important catalyst for economic growth. The concern was that with the high costs and specialist skills needed to build and maintain information systems, the increasing reliance of commerce in IT would lead to a channelling of value into a closed community of keystone businesses. Instead, the European Commission wanted to see Information and Communication Technology evolve to support the growth of networks of SMEs and local innovation systems.

We have been actively involved in the Digital Ecosystem community since November 2003. Our main focus has been on building techniques to (1) enable small enterprises to build and publish on the Web (business) information systems that are closely fitted to their needs, and (2) to support robust execution of business transactions that may involve collaborations of SMEs without the need for a governing portal [1]. A classic scenario for the latter would be a facility to book complete holiday solutions without needing to go through an aggregator such as Expedia (which can be prohibitively expensive for smaller enterprises, e.g. source 7) [3].

The way we have achieved this is to build a tool stack, and underpinning theory, that enables us to generate information systems from structured natural language specifications [2]. These specifications are expressed as Business Rules using a vocabulary that is defined for a specific domain. The specific language we use is SBVR, which is an OMG supported standard. Business Rules, and SBVR specifically, are typically used by Business Analysts with the mapping to the implementation efforts of information technologists typically being rather imprecisely linked to the work of Analysts (if at all). What we have done is to define mappings that enable us to generate information systems directly from the Business Rules (expressed using SBVR) [5], [6].

We use the term "adaptive" because the above approach provides us with an important quality. As understanding of a business domain evolves we can update the business rules that constrain that domain, and the underlying business system will adapt to our changed understanding of the

domain.

We can provide significant added value by making it easy to publish the resulting (business) information systems on the World Wide Web. This has two major benefits. Firstly it enables a business enterprise to access a wider mark, or an information resource to be accessed or contributed to by a wider community. Secondly, it opens the possibility for two or more SMEs to engage in B2B transactions to enable them to collectively publish a higher value offering to a customer base than either party would be able to in isolation [3], [4].

The facilitation of such B2B transactions was promised by the technology stacks associated with Service-Oriented Computing (SOC). However, these technologies fit much better to intra-enterprise collaboration than they do to inter-enterprise collaboration – essentially, they mandate a tighter coupling between services than is usually acceptable to SMEs. What we have done is to develop a light-weight approach to publishing services, and executing cross-business transactions that respects the local autonomy of the participants. This has both a practical implementation and a strong theoretical foundation.

Key Researchers and positions at Surrey University:

Prof. Paul Krause (2001 – present)

Dr. Sotiris Moschoyiannis (PhD Student; RA 2006-2009; Lecturer 2010 – Present)

Dr. Alexandros Marinos (PhD Student; RA 2010-2011)

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

[1] Marinos A. and Krause P. An SBVR Framework for RESTful web applications, *Rule Interchange and Applications, Springer*, 144-158, 2009.

[2] Marinos A. and Krause P. Using SBVR, REST and relational databases to develop information systems native to the digital ecosystem, *Proc. 3rd IEEE International Conference on Digital Ecosystems and Technologies (DEST '09)*, 109-114, 2009 (*Best Paper Award*).

[3] Marinos A. and Krause P. What, not How: A generative approach to service composition, *Proc. 3rd IEEE International Conference on Digital Ecosystems and Technologies (DEST '09)*, 115-120, 2009

[4] Marinos A., Moschoyiannis S. and Krause P. Towards a RESTful infrastructure for Digital Ecosystems, *International Journal of Electronic Business Systems*, **9**, 484-498, 2011

[5] Moschoyiannis S., Marinos A. and Krause P. Generating SQL queries from SBVR rules, *Semantic Web Rules*, 128-143, 2010

[6] Marinos A., Gazzard P. and Krause P. An SBVR Editor with Highlighting and Auto-completion, Proc. 2012 RuleML Challenge. (*Overall winner of the 2012 RuleML Challenge*).

This work programme was initiated as part of the EU funded DBE project (2003-2006) and had most momentum during the OPAALS project (2006-2010).

More recent work was performed under an EPSRC funded PhD+ project (2010-2011).

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

Rulemotion was set up in October 2011. The company currently has ten full-time staff with offices in the UK and Greece. Its primary focus is two-fold: the development and usage of our SBVR

parser and editor and the associated SQL generation tools and techniques; the development of a generic platform that supports rapid development and deployment of web services. Descriptions of two projects that extensively exploit the know-how generated in our research programme follow below.

Culicoides data repository for the Institute of Animal Health (IAH). The IAH currently has a static website containing information about *Culicoides* – a genus of biting midges who are vectors for many animal diseases. Rulemotion is migrating this to a dynamic website supported by a back-end database that is evolvable as further knowledge and data about *Culicoides* is obtained. The importance of this is that it turns their currently static website into an information resource that can be searched and updated by a global community (when suitably authorised) whilst still preserving the look and feel of a well-designed web-site.

Renew (Media Metrica Ltd) is a media company building a network of digital signage screens attached to blast-proof recycling units. These are already deployed in London's financial district, and will soon be found around the world. The recycling units cost about £25,000 each, and are sponsored by Renew. The company recovers this investment through sponsorship of the content that appears on the screens. The screens display high quality news and information content, adapted for short visual contact (http://renewsolution.com/). Rulemotion's platform enables the content to be dynamically scheduled, so that content can be pre-empted by higher priority news items so long as the overall percentage of time dedicated to paid-for advertising is not compromised. The screens can also be used for emergency public information, supplied by the host city. All forms of content can be updated and displayed throughout the City in real-time.

Renew's daily audience exceeds 3m. Independent analysis details footfall per screen ranging from 10,000 to over 30,000 per day (source 4). The density of the Renew City network ensures professionals have an average of 6 to 8 engagements to consume their content each day.

The platform Rulemotion licenses to Renew is now being used by seven other clients in a broad range of domains (e.g. sources 4, 6, 7, 8). Undercurrent News, for example, is a London-based seafood business news service. The company is already a fast-growing online news service, gathering more than 1,000 users within its first month of launch.

The information system designed by Rulemotion allows Undercurrent to offer a technically sophisticated and comprehensive automatically updated database of seafood prices to its clients (www.undercurrentnews.com/prices) that helps it provide price data services that had so far not been provided by the market in an affordable or unified way.

In a different domain, Cosmorama is an award-winning travel agency in Athens, offering tours and cruises across the world to customers within and outside Greece. The 18-person company has a significant web presence (www.cosmorama.gr) and a large online database of cruises and tours. Rulemotion has provided Cosmorama with service composition technology that will allow it to offer customers an automated booking service through which users can customise their holidays and book taxis, flights and hotels simultaneously. This is enabling Cosmorama to transform itself from a traditional travel agency into an online travel retailer able to compete with leading online travel companies, such as lastminute.com.

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

1. Details of Rulemotion: http://www.rulemotion.com/
2. For independent assessment of the potential of our approach to Service Oriented

Computing: J. vom Brocke, J. Becker, A.M. Braccini, R. Butleris, B. Hofreiter *et al.*, "Current and Future Issues in BPM Research: A European Perspective from the ERCIS Meeting 2010", Communications of the Association for Information Systems: Vol. 28, Article 25, 2011

3. As well as on the streets of the City of London, a live demonstration of the software developed for Renew Media by Rulemotion can be seen at: http://renewsolution.com/ or available on request.

4. Co-founder of Media Metric Ltd (For corroboration of claims made about the impact of our work within the context of the Renew project); Founder of Clinician Notetaker; Co-founder of Global Showcases (contact details provided)

5. Research Fellow, Institute for Animal Health: For corroboration of work on *Culicoides*. (contact details provided)

6. Founder of Undercurrent News (contact details provided)

7. Marketing & PR Manager of: Cosmarama; VforVacation project (contact details provided)

8. Creative re-director of: Re | direct; Virtual Beer Fridge project (contact details provided)