Editorial

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Biographical notes: Dr. Lorna Uden teaches computing in the Faculty of Computing, Engineering and Technology at Staffordshire University. Her research interests include technology learning, HCI, activity theory, knowledge management, web engineering, multimedia, e-business and problem-based learning. She has published widely in conferences, journals and chapters of books.

The first paper of this issue is 'Semantic web technologies for ubiquitous computing resource management in smart spaces' by Soldatos *et al*. Ubiquitous Computing Services consist of rich collections of hardware, software and middleware components characterised by extreme diversity and dynamism, making service deployment a challenging task. According to Soldatos *et al*., naming and directory services are a key prerequisite to accelerating and facilitating development of ubiquitous computing services. Although numerous solutions for directory services have been developed, these authors believe that none of them are appropriate for an effective representation of entities (*i.e.*, physical world entities and software/middleware components) in the scope of a ubiquitous computing environment. The authors argue that semantic web technologies are appropriate for supporting directory services, registration mechanisms and intelligent reasoning in the scope of ubiquitous computing applications. They have proposed a naming and directory mechanism based on web ontologies (OWL) and have introduced a development and deployment model for ubiquitous computing applications. The model relies on semantic web technologies (*i.e.*, ontology management) that facilitate the integration of hardware and middleware elements in the scope of ubiquitous computing applications. Based on the model and its underlying ontology management schemes, they have implemented a proof of concept application in the scope of a 'smart space' comprising numerous sensors, actuators and middleware components.

The second paper, 'Interoperable Petri net models via ontology', by Gašević and Devedžić continues on with the semantic web and ontology themes. According to Gašević and Devedžić, the main aim of this paper is to develop a suitable approach to Petri net applications on semantic web. This would enable full semantic interoperability of Petri net models. Currently, Petri net interoperability is possible at the syntax level. It would be useful to share Petri net model descriptions so that more software tools

can analyse the same model. So far, all Petri net interchange attempts have been mainly tool-specific with very low general acceptance. In order to reuse Petri nets more effectively on semantic web, a Petri net ontology is needed. The Petri net ontology enables describing a Petri net using semantic web languages (*e.g.*, RDFS and OWL). Petri nets described in this way can be inserted into other non-Petri net XML-based format, such as scalable vector graphics (SVG, the XML-based WWW Consortium (W3C) standard for 2D Vector graphics) that makes it possible to reconstruct Petri net models using metadata and annotations according to Petri net ontology.

In this paper, Gašević and Devedžić present a Petri net infrastructure that provides sharing Petri nets on the semantic web. They believe that ontology can be used for formal description of Petri net semantics. According to Gašević and Devedžić, Petri net ontology overcame validation problems, but it does not exclude current Petri net formats (especially PNML).

With Petri net ontology, these authors believe that they can use ontology development tools for validation of Petri net models (*e.g.*, Protégé). Using Petri net ontology also enables them to use semantic web languages for representing Petri net models. Gašević and Devedžić also show how PNML can be used as a guideline for Petri net ontology. They developed the Petri net ontology using both UML and Protégé tools, and used RDF and OWL to present the ontology. A Petri net software tool – P3 – was used to convert the Petri net ontology compliant models to formats of current Petri net tools using Extensible Stylesheet Language Transfunctions (XSLT). In order to show how the ontology can be used, Gašević and Devedžić have developed a simple educational web application that uses RDF-annotated ontology-based Petri net learning materials.

From web technologies we move on to web requirements. Requirements engineering is the process of transforming the operational needs of an organisation into a complete, consistent and unambiguous systems specification through an iterative process of definition and validation. Several approaches to Web Requirements Engineering (WRE) have been developed by researchers. The recommendations of these researchers to web requirements methods is to utilise a general web requirements engineering framework for developing web applications to be in line with business needs and future vision. The objective of WRE is to incorporate the elicitation/analysis of business strategy as part of a requirements engineering process.

Paper three, 'Strategy-focused requirements engineering method for web applications' by Al-Salem and Abu-Samaha is the first of the three WRE papers. Al-Salem and Abu-Samaha present an extended Web Application Requirements Engineering (eWARE) method. This method focuses on aligning requirements to business strategy and to elicit legal, technological, business, marketing and content requirements. The eWARE is an adaptation of two methods: the VORD to elicit web applications requirements and BCS to aid in planning/analysing a business strategy.

According to Al-Salem and Abu-Samaha, the eWARE method deploys the concept of requirements alignment to business strategy in order to attain business objectives during the requirements discovery, elicitation and formalisation process. It enables organisations to identify the services of the web application that will achieve the business objectives in order to become more profitable and achieve a competitive edge.

The VORD method was proposed by Kotonya and Sommerville as a software RE approach to organise both the elicitation process and the requirements themselves, using Viewpoints (VPS). A viewpoint is anyone who may have some direct or indirect

influence on the system requirements. The VORD RE process includes activities concerned with VP identification, VP service description, cross-viewpoint analysis to discover inconsistencies, omissions and conflicts, and developing an object-oriented model of the system from the VP analysis.

Although VORD is useful for eliciting web application requirements, it needs to be modified and extended to meet the particularities of sub-applications. BCS was introduced by Kaplan and Norton as an approach to performance measurement. It has evolved into a strategic communication and performance measurement framework that helps organisations articulate, communicate and monitor the implementation of a strategy as well as direct attention to drivers of financial success. Kaplan and Norton define BCS as a multidimensional framework for describing, implementing and managing strategy at all levels of an enterprise by linking objectives, initiatives and measures to an organisation's strategy.

Within web engineering, BCS has been used for evaluating the strategic importance of organisational web presence, for measuring and managing e-business projects and for the strategic management of e-commerce. Despite its usefulness, BCS has not aligned business applications requirements to organisations' business strategy. eWARE was developed to overcome the respective limitations of VORD and BCS.

The eWARE process consists of a series of activities grouped into three phases: strategy articulation via BCS, Web application requirements elicitation via VORD and prototype building. The purpose of the process is to develop a Web application Requirements Specification (WRS) document that is aligned with business strategy and detailed enough to be used for contractual issues.

As stated by the previous authors, web applications should be agile enough to respond to the dynamic business and ever-changing customer needs. This has implications for web requirements. However, according to Souer *et al*., the authors of paper four, existing methods for the requirements engineering of web applications often fail to capture and specify business dynamics, and fail to implement the desired system. There is also a great need to control the unrestrained growth of instructional digital information. Content Management System (CMS)-based web applications are applications that utilise web technology and manage the instructional information. CMS-based applications are implemented to support the organisation with the creation, management and publishing of information in an efficient and effective way. According to these authors, there are no specific tools or methods existing for the development of CMS-based web applications. In their paper, 'Situational requirements engineering for the development of content management system-based web applications', Souer *et al.* have developed a method specifically for CMS-based web applications, constructed using components of two existing methods: the unified development process (UP) and UML-based web engineering (UME). These authors believe that by taking parts of proven methods, such as Unified Software Development Process (UP) and UML-based Web Engineering, a unique method can be assembled for situational development of CMS-based web applications. The method, known as Web Engineering Method (WEM) consists of the following phases: acquisition, orientation, definition, design, realisation and implementation. To include situationality to deal with the dynamic business, they have developed a route map with different routes, one route for each of the distinguishable project types that have been identified: standard project, complex projects and migration projects. The method has been successfully validated at GX, a web technology

company specialising in developing and implementing CMS-based web applications. The results indicate that WEM seems a promising approach for developing complex web applications.

The last of the requirements papers is, 'Customer experience requirements for e-commerce websites' by de Bruijn *et al*. According to de Bruijn, if businesses are to compete on the web, they need to be able to provide experiences that engage the customer. However, it is not clear what requirements considerations are for building web applications, how engagement relates to the user's overall satisfaction with a website and how this influences customer's buying behaviour. Considering customer engagement as a requirement for e-commerce web design constitutes a departure from the traditional concept of requirements engineering that focuses first on content and functionality, then usability, and finally pays lip-service to the importance of graphic design. Engagement is more likely to constitute a trade-off between the user's motivation to explore a website and the costs of this exploration in terms of usability.

Whether a user can be motivated to explore a website depends not only on the content and functionality offered, but equally on the way in which this content and functionality is presented. de Bruijn therefore believes that the requirements for content, functionality, usability and graphic design must be considered with equal importance in website development. In this paper he explores the relationships between the content, presentation and usability of websites and how these relate to the overall satisfaction of the user and their willingness to purchase goods and services. The author tested a number of high-level requirements for content, presentation and usability in the form of website heuristics. The heuristics which employ the high level requirements were applied to two websites that were considered similar in purposes and functionality, but offered different kinds of user experiences through differences in the choice of content and styles of presentation. By investigating how the heuristics apply to those websites separately and then asking users to express preferences for one site over the other he assessed the relative importance of content, presentation and usability for the relative effectiveness of those e-commerce websites.

De Bruijn concludes that both attractiveness (in content and presentation) and usability are important requirements considerations for e-commerce websites. He believes that the relative effectiveness and attractiveness of websites can be predicted using the heuristic applied in his study. The heuristics have thereby been validated to some extent as constituting important requirements considerations. According to de Bruijn, the heuristic can be used to guide the requirements gathering process by concentrating the efforts of the requirements engineering onto the factors that really make a difference for the effectiveness of the website.