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SABUMO: Towards a collaborative and semantic framework for knowledge sharing

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ABSTRACT

Knowledge is one the most valuable assets in todays companies. Artificial Intelligence (AI) techniques aim to represent the knowledge in a way that can be applied to solving complex problems or supporting decision making processes. During the last years the semantic web techniques have supported the share of knowledge by means of ontologies. Ontologies have been used for both annotating resources and reasoning. Business Process Management is one of the specific fields in which the use of ontologies has been widely applied. This paper presents SABUMO, a framework based on ontologies that allows experts to represent and share their knowledge with other experts by means of shared and controlled vocabularies. The framework also allows the execution of business processes represented by experts. The execution of this knowledge does not require the installation of complex AI programs. Initial results of the evaluation setup show promising results both in usability and recommendation.

1. Introduction

In a Knowledge Society, knowledge must present a tacit structure for sustainable advantage (Sharma, Ng, Dharmawirya, & Samuel, 2010). The power of knowledge is a very important resource for preserving valuable heritage, learning new things, solving problems, creating core competences, and initiating new situations for both individuals and organizations today and in the future (Liao, 2003). In this scenario, knowledge workers perform their duties in knowledge-intensive organizations (Soto-Acosta, Casado-Lumbreras, & Cabezas-Isla, 2010), with a high interest in keeping the actual knowledge and expanding it via innovation (O'Sullivan & Dooley, 2010).

Knowledge management is a field that has been addressed by researchers from many different angles, but industry, too, has reacted with a large variety of specialized tools for different approaches (Rus & Lindvall, 2002). According to Jeon, Kim, and Koh (2011), knowledge management emerges as the core management of paradigm future survival strategy of the 21st century. There are two main strategies in knowledge management (Jahn & Nielsen, 2011): personalization and codification. While personalization focuses on people and provides possibilities to share their knowledge (person to person), the codification strategy focuses on documents and provides possibilities to write down and store information and for others to access it (people to documents to people).

Knowledge codification can be defined as a software and human agent-driven process by which organizations extract, transform, and store knowledge for codification and embodiment in organizational routines (Datta & Acar, 2010). Knowledge codification presents several limitations as depicted in Michailova and Gupta (2005) that, in many cases, influence the ultimate goal of knowledge management – knowledge sharing.

Semantic technologies have impacted in the last few years on knowledge codification and knowledge management, presenting a solution to knowledge codification. Semantic technologies and more precisely, ontologies provide us with organization, communication and reusability (Blanco, Lasheras, Fernandez-Medina, Valencia-Garcia, & Toval, 2011). This paper presents a framework for Semantic Anotation and BUsiness processes MOdelling (SABUMO), based on semantic technologies, that allows experts to represent and share their knowledge with other experts by means of shared and controlled vocabularies. The framework also permits the execution of business processes represented by experts. Moreover, SABUMO enables the execution of these processes through its own platform in an easy and scalable way.

The remainder of this paper is organized as follows. Section 2 reviews the state of the art related to technologies and processes present in SABUMO. Section 3 describes the architecture of the solution. Section 4 shows the results of the validation conducted. Finally Section 5 presents the conclusions and the future research.

2. Related work

This section presents relevant works related to the technologies applied in SABUMO. First business process modelling techniques and trends are described. Second, the relevant literature about

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semantic technologies is outlined and, finally, semantic annotation trends are depicted.

2.1. Business process modelling

The roots of process modelling can be traced back to the early 20th century as a tool for organizational design (Mendling, Reijers, & van der Aalst, 2010). A business process model captures elements, typically in some graphical form, such as the activities that constitute the business process; the performers of these activities; the time, location, and modus of their execution; and the information that is processed (Giaglis, 2001). In plain words, according to Fernandez-Fernandez et al. (2010), business process modelling is a group of techniques that allow modelling those business aspects necessary for correct performance of the business process applications.

Many organizations have, over time, built repositories of business process models that serve as a knowledge base for their ongoing Business Process Management (BPM) efforts (Dijkman, Dumas, van Dongen, Kaarik, & Mendling, 2011) and these companies design and maintain several thousand process models (Reijers & Medling, 2011). Business process modelling is, thus, widely used within and across organizations as a method to increase awareness and knowledge of business processes (Recker, Indulska, Rosemann, & Green, 2010). Not in vain do business process modelling and its automation improve the performance of business activities and enables enterprise-wide monitoring and coordination (Nikolaidou, Anagnostopoulos, & Tsalgatidou, 2001).

There are many grammars available on the market for business process modelling purposes. The type of grammar to be used for process modelling is an important managerial decision (Rosemann, 2006). Not in vain, according to Recker et al. (2010), is the decision for a particular process modelling grammar associated with substantial investments in tool purchases, training, conventions and methodologies. The type of grammar used for modelling defines the language and its grammatical rules that can be used to articulate and communicate details about the real-world domain and, thus, determines the outcomes of the modelling process (Siau & Rossi, 2011). There are panoply of process modelling grammars including WS-BPEL, YAWL and Business Process Modelling Notation (BPMN), to cite just some of the most relevant. However, business process modelling tools on the market today are mostly "one-person tools" and, in the main, do not support an efficient reuse of process models, resulting in dissatisfaction of business users with current IT implementations (Koschmider, Song, & Reijers, 2010). On the other hand, according to Recker et al. (2010), Recker and Rosemann (2010), there are several ontological deficiencies of process modelling in practice. In this scenario, semantic technologies are expected to provide an added value to the conventional business process modelling grammars in terms of expressiveness and reuse.

2.2. Semantic web technologies

Durguin and Sherif (2008) portrays the semantic web as the future web where computer software agents can carry out sophisticated tasks for users. Semantic Technologies, based on ontologies (Fensel, 2002), provide a common framework that enables data integration, sharing and reuse from multiple sources. Ontologies (Fensel, 2002), are the technological cornerstones of the Semantic Technologies, because they provide structured vocabularies that describe a formal specification of a shared conceptualization. Ontologies were developed in the field of Artificial Intelligence to facilitate knowledge sharing and reuse (Fensel, van Harmelen, Horrocks, McGuinness, & Patel-Schneider, 2001). An ontology can be defined as "a formal and explicit specification of a shared conceptualization" (Studer, Benjamins, & Fensel, 1998). Ontologies provide a common vocabulary for a domain and define, with different levels of formality, the meaning of the terms and the relations between them. Knowledge in ontologies is mainly formalized using five kinds of components: classes, relations, functions, axioms and instances (Gruber, 1993). Languages such as Resource Description Framework (RDF) and Ontology Web Language (OWL) have been developed. These languages allow for the description of web resources, and for the representation of knowledge that will enable applications to use resources more intelligently (Horrocks, 2008). The Semantic Web consists of several hierarchical layers, where the Ontology layer, in form of the OWL Web Ontology Language (recommended by the W3C), is currently the highest layer of sufficient maturity (Lukasiewicz & Straccia, 2008).

According to Ding (2010), semantic web is fast-moving in a multidisciplinary way. Thus, Breslin, O'Sullivan, Passant, and Vasiliu (2010) state that industry has begun to watch developments with interest and a number of large companies have started to experiment with Semantic technologies to ascertain if these new technologies can be leveraged to add more value for their customers or internally within the company, while there are already several offers of vendors of Semantic solutions on the market. As a consequence, semantic web applications cover a wide range of domains including tourism (e.g. Garcia-Crespo, Lopez-Cuadrado, Colomo-Palacios, Gonzalez-Carrasco, & Ruiz-Mezcua, 2011), customer relationship management (e.g. Garcia-Crespo, Colomo-Palacios, Gomez-Berbis, & Ruiz-Mezcua, 2010), research and development activities (Colomo-Palacios, Garcia-Crespo, Soto-Acosta, Ruano-Mayoral, & Jimenez-Lopez, 2010), human development (e.g. Fernandez-Breis, Castellanos-Nieves, & Valencia-Garcia, 2009; Soto-Acosta et al. (2010)), eGovernment (e.g. Alvarez-Sabucedo, Anido-Rifon, Corradini, Polzonetti, & Re, 2010), health domain (e.g. Garcia-Sanchez, Fernandez-Breis, Valencia-Garcia, Gomez, & Martinez-Bejar, 2008), multimedia (e.g. Paniagua-Martin, Garcia-Crespo, Colomo-Palacios, & Ruiz-Mezcua, 2011), manufacturing (e.g. Garcia-Crespo, Ruiz-Mezcua, Lopez-Cuadrado, & Gomez-Berbis, 2010), financial (e.g. Rodriguez-Gonzalez, Garcia-Crespo, Colomo-Palacios, Guildris-Iglesias, & Gomez-Berbis, 2011) or media (e.g. Garcia, Perdrix, Gil, & Oliva, 2008) to cite just some of the most relevant cases.

The application of semantic technologies has been considered from various angles for process modelling (La Rosa et al., 2011). In this scenario, the work of Hepp, Leymann, Domingue, Wahler, and Fensel (2005) proposed the concept of Semantic Business Process Management (SBPM) a cornerstone of the integration of semantic technologies and BPM. The primary idea of SBPM is to combine BPM technology with semantic web services technology so that stakeholders in both the business world and the IT world can query and manipulate business processes by traversing the space bidirectionally without a great deal of manual effort (Kim & Suh, 2010). Following this line there are some relevant works devoted to this area including Thomas and Fellmann (2007), SEMPA by Heinrich, Bewernik, Henneberger, Krammer, and Lautenbacher (2008) or more recently APROMORE (La Rosa et al., 2011). In the case of SABUMO, the effects of semantics and its intrinsic expressiveness are augmented by the application of collaborative annotation.

2.3. Semantic annotation

Semantic web annotations go beyond familiar textual annotations about the content of the documents; they formally identify concepts and relations between concepts in documents, and the annotations are intended primarily for use by machines (Uren et al., 2006). In this scenario, the current focus of semantic web