Social Software and Semantics for Business Process Management - Alternative or Synergy?

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Abstract: *Business Process Management (BPM) provides support for managing organizations' processes and facilitates their adaptation to changing market conditions. Although various BPM solutions have been successfully applied in industry, there are still many open issues to be addressed, e.g., ensuring commitment of employees in process modelling and reengineering or enabling automation of business processes lifecycle.*

Researchers are currently investigating the use of Semantic Web and Social Software technologies to overcome the existing problems. Based on the conducted study, we argue that although semantics and Social Software technologies focus on different problems, they may be combined as utilized together they enable organizations to advance their processes and adapt faster to changing market conditions.

Keywords: *BPM, Social Software, Semantic Web, Semantic Business Process Management, BPM lifecycle*

1. Introduction

A process is a basic unit of business value within an organisation (Verner, 2004). As such, it may become either a root cause of inefficiency or a source of competitive advantage. Therefore, it should be well managed (Weske, 2007). To ensure a desired quality level of performed activities, much research has been devoted to investigate and advance techniques and tools supporting the Business Process Management (BPM).

BPM is a field of knowledge at the intersection of management and information technology (IT). From the management point of view, it allows to model and define the enterprise architecture of an organisation, including its structure, company vision and strategy, process landscape, business processes, data architecture or product portfolio (Schmelzer & Sesselmann, 2008; Scheer, 1999). On the other hand, BPM encompasses methods, techniques, and IT tools to design, enact, control, and analyse operational business processes involving humans, organisations, applications, documents, and other sources of information (Aalst, 2003).

The BPM area is very well supported both by the research as well as by industrial solutions. However, there are still many shortcomings that the BPM field needs to deal with. Following the applied research methodology, we have selected and analysed existing BPM lifecycles, current research projects as well as important literature on BPM, in order to extract current shortcomings of BPM. The table below summarises the findings of the conducted study.

Table 1. BPM Shortcomings

Shortcoming Area	Main Open Problems
Business-IT divide (Smith & Fingar, 2003, Dehnert & van der Aalst, 2004, Koehler et al., 2005).	• Lack of consistency among developed process models • Lack of direct mapping between business and IT languages that would allow for an automated transition between business process models and their executable versions • Limited access, from a point of view of a business analyst, to information from a business process execution

Shortcoming Area	Main Open Problems
	• Limited support for reusing of business models for IT implementation • Limited participation of a business analyst in definition of an executable process model
Compliance of business process models	• Lack of automatic compliance checking of a business process model (regarding law, regulations and organizational policy) • Limited validation of temporal constraints
Change management	• Insufficient merge capabilities in case of simultaneous concurrent model changes • Change resistance within organisations • No or broken feedback cycles regarding business process design
(Semi-) automatic retrieval and reuse	• Problems with combining incompatible notations, e.g., graph-based vs. block-based • Not enough efficient cataloguing and representing processes or services for reuse • Limited discovery of appropriate processes or services with respect to a modelling context
Collaboration	• Limited or no collaboration during process design, even in multi-national settings • Reuse of existing domain models not possible • Parameterisation and customisation of models not possible
Knowledge management	• Decentralised knowledge management in organisation not possible • Limited search and retrieval possibilities of enterprise models

To address these lacks, researchers and practitioners turn their attention to combining BPM with Social Software (e.g., van der Aalst et al., 2005; Koschmider et al., 2009) and semantic technologies (e.g., Brockmans et al., 2006, Hepp and Roman, 2007; Heinrich et al., 2008; Alves de Medeiros et al., 2008). In general, semantics is the study of meaning. In computer science, semantics reflects the meaning of all artefacts and objects the mechanisms operate on, as well as provides the meaning of the mechanisms themselves. Once the semantics is formalised, the description of mentioned artefacts and objects, becomes machine understandable. Therefore, semantics is considered to be able to help automating the BPM lifecycle and offer new functionalities to business experts contributing to a significant reduction of process modelling efforts.

In turn, the term Social Software is “software that triggers mechanisms of sociality by providing support for social practices, experiences, identity and production” (Bouman, 2007; Ullrich, 2008). The focus of Social Software tools and applications is enabling collaborative composition of more complex entities as well as inclusion of personal and social aspects (Boulos et al., 2007). From the BPM perspective, the most important feature of Social Software technologies is that they aim at enhancing sharing of information by communities within organizations as well as fostering collaboration. Thus, they are suitable to solve the problem of knowledge sharing and its application within various stages of the process lifecycle.

Taking into account recent initiatives, the question appears whether semantic technologies and Social Software can indeed bring added value to the BPM field. Can semantics and Social Software concepts be both applied to the BPM field and offer efficient and cost-cutting solutions to the currently existing problems like evolution or semi-automatic construction of business processes, automation of the BPM lifecycle, closing the gap between business and IT? In this paper, we discuss these issues showing and comparing the current and possible applications of semantics and Social Software. We also try to answer the question whether there is any convergence between these concepts and what the flaws of their applications are.

To achieve our aim, the article is structured as follows. First, initiatives applying semantics in the BPM field are discussed in Section 2. Next in Section 3, we shift our focus to examples of applications of Social Software concepts in BPM. Section 4 discusses the pros and cons of merging semantics and

Social Software in BPM. The paper concludes with a summary and an outlook on further (open) research questions.

2. BPM Supported by Semantics

The approach of using ontologies, reasoners, and semantically annotated web services within BPM is called Semantic Business Process Management (SBPM), as introduced by Hepp et al. (2005). If we would perceive SBPM as a modelling method as defined by Karagiannis and Kühn (2002), then, SBPM should provide a modelling technique consisting of a modelling language (in this case an appropriate set of ontologies), a modelling procedure (i.e. scenarios supported and methodology) as well as a set of supporting tools. The following subsections discuss each of these elements.

2.1 Ontologies

The main goal of applying semantic technologies to the BPM lifecycle is to increase the level of automation by providing a common description of process elements that disambiguates their meaning throughout the entire lifecycle. This should allow addressing many deficiencies identified in the previous section including efficient categorization of models, discovery and analysis of artefacts, easier transition between BPM phases (see Hepp et al., 2005; Hepp and Roman, 2007; Wetzstein et al., 2007; Abramowicz et al., 2009) as well as the business-IT divide.

SBPM is based on the assumption that main aspects of an enterprise model can be captured semantically. Therefore, a set of ontologies needs to be defined to represent different aspects of an enterprise model. A very early ontology that could be potentially used within SBPM is the Enterprise Ontology presented by (Uschold et al., 1998). It provides concepts for organisational modelling, strategy modelling, process modelling, and resource modelling. Although being quite comprehensive, the ontology in question neither provides appropriate support for current modelling languages used in industry nor is extensible, i.e. it does not allow replacing or extending parts of it with other ontologies. Thus other approaches were proposed, e.g., TOVE project (Fox, 1992), REA ontologies (Lampe, 2002) or e3-value (Gordijn, 2002).

One of latest initiatives concerns the ontology stack developed within the SUPER project, where the required semantic process representation is divided into three main groups, namely: process, organisation-related and domain-specific ontologies (Hepp & Roman, 2007; Pedrinaci et al., 2008, Filipowska et al., 2009). Process ontologies are created in order to describe the structure of a process, whereas organisation related ontologies provide a description of artefacts or actors that are utilised or involved in the process. The domain ontologies provide additional information specific to an organisation from a given domain.

Another issue is ontologising business process modelling notations. In this area, most of the research efforts focus on providing new meta-models for description of business processes. Among these efforts are e.g. annotations of Petri Nets (Brockmans et al., 2006), formal framework for process description (Greco et al., 2004), annotations of UML activity diagrams (Lautenbacher & Bauer, 2006). There are also a couple of initiatives trying to provide ontologised versions of already existing modelling notations e.g. EPC or BPMN. EPML (Event driven Process Chain Mark-up Language) proposed by (Mendling & Nüttgens, 2005) is a vendor neutral XML-based exchange format and provides a serialization format for the EPC diagrams. First efforts towards ontologisation of EPC were presented by (Aalst, 1999; Kindler, 2006) who proposed meta-model-based semantics of the EPC models. A comprehensive approach to this issue was presented also by (Thomas & Fellmann, 2007) and may be considered as a starting point for further initiatives in this direction e.g. sEPC developed by (Filipowska et al., 2008). Ontologisation of Business Process Modelling Notation may be found in (Abramowicz et al, 2007). The examples of the process ontologies not directly related to any particular notations are recently developed GPO (General Process Ontology) (Lin, 2008) and BPMO (Business Process Modelling Ontology) (Cabral et al., 2009) developed within the already mentioned SUPER project.

Using semantics within BPM promises machine processability and rich description of process content and involved resources. It should ensure that the developed process models are consistent and are described using the same terminology what facilitates their reuse and common understandability. Although quite promising, the main challenge here lays in the availability and existence of the common domain description that would be accepted by the process participants. Not only obtaining process participants' acceptance to use the proposed ontology constitutes a problem, but also development of domain ontologies that would be a specialization of already delivered solutions is a challenging and time consuming task. It requires from a knowledge engineer not only a good domain knowledge regarding the concepts, relations etc. but also a good command of Semantic web technologies and tools. The concern about the manageability of the proposed ontologies and their interoperability also arises.

2.2 SBPM Methodology

Besides providing the necessary ontologies and supported scenarios, it is also important to provide guidance on how to apply them. Most of the initiatives in the SBPM field, however, focus only on selected phases of process lifecycle and do not provide the overall methodology that should be followed. The exception seems to be the already mentioned SUPER project that proposes the most comprehensive approach, one that encompasses the entire lifecycle consisting of four phases (Wetzstein et al., 2007): Semantic Business Process Modelling, Semantic Business Process Configuration, Semantic Business Process Execution, and Semantic Business Process Analysis..

The first phase is the Semantic Business Process Modelling where the main actor is a business analyst modelling a business process. The results of the Semantic Business Process Modelling phase are semantically annotated business process models. The goal of the semantic annotation within is to explicitly specify the functionality of tasks and decisions in the process flow as well as actors, roles, resources etc. involved in the process (i.e. process content). At this stage not only modelling, with support of ontologies, takes place, but also the already mentioned additional functionalities taking advantage of the ontological process descriptions may be implemented (e.g., ontology-based searching for process fragments matching business criteria, auto-completion, process fragments discovery or compliance checking).

Within the Semantic Business Process Configuration phase, semantically annotated business process models are translated into executable process descriptions. Mentioned transformation is automated and is realised by the already mentioned task composition functionality. After composition, the model is validated, transformed to semantically enhanced BPEL process representation and only then, after adequate serialisation, finally deployed in order to be executed.

After a semantic business process model is deployed to the process engine, it becomes ready for instantiation (i.e. execution) within the Semantic Business Process Execution phase. An executable process model created within the previous phase is externalised as semantic web services and made available to clients. The semantic business process is executed on a semantic execution engine. This execution engine supports the discovery of semantic web services during runtime if requested

The last phase, Semantic Business Process Analysis, involves the monitoring of processes aiming at providing relevant information on running process instances within the process execution phase as well as process mining analysing already executed process instances in order to enable improvement of existing process models.

It may be concluded, the usage of the semantic technologies does not affect the main stages of BPM, but rather increases the level of their automation as well as provides new functionalities to business analysts as well as IT experts.

2.3 Tools

SBPM is still an object of ongoing research. Therefore, only few tools supporting it are available. For instance, Born et al. (2008a) provide an extension of SAP's BPMN modelling tool Maestro, which allows creating BPMN processes and initiating semantic process composition. Maestro is not yet publicly available, but instead it is a research prototype used at SAP to evaluate new semantic technologies. In turn, Dimitrov et al. (2007) provide an extension of WSMO Studio. This extension allows modelling of ontologised processes in a visual manner using a BPMN-like notation. Stein et al. (2008a) extend the commercial business process modelling tool ARIS allowing semantic annotation of EPC process models and transforming them into BPEL.

A prototype of a semantic BPEL execution engine also has been created. Lassen et al. (2007) describe the architecture of such an execution environment. The important element is having access to reasoning capabilities to invoke semantic web services. Here, existing environments like WSMX (Haller et al., 2005) and IRS III (Domingue et al., 2004) can be used. Stamber et al. (2008) demonstrate the integration of WSMX with the professional BPEL execution engine Oracle BPEL Process Server.

In the area of semantic process mining, Alves de Medeiros et al. (2008) describe the architecture of tools based on the ProM platform.

2.4 Supported Scenarios

Reviewing the existing initiatives within the SBPM field, two main groups of use cases (Hepp et al., 2005) of applying semantic technologies to BPM can be distinguished, namely:

- applying semantic technologies (especially reasoning) to analyse enterprise models and
- applying semantic technologies to create entirely new models or to create new parts of enterprise models.

The two distinguished groups of scenarios are discussed further on within this section with the special focus of shortcomings described previously.

Within the first scenario, semantic technologies are used to discover previously unknown facts relevant to an enterprise and its models. This is possible as the ontologies mentioned within the previous subsection are used to describe the content of the model, thus, making it processable by machines. Indeed, having the semantically annotated models offers entirely new possibilities for querying the model space (Celino et al., 2007; Markovic et al., 2008). Therefore, a manual task of analysing existing process models may be substituted by querying semantically enabled enterprise models. A business expert defines a query based on a domain ontology used in a company and then a reasoner computes the query as well as the content of the enterprise model to discover relevant facts.

One of the supported use cases is therefore semantic compliance management or compliance checking (El Kharbili et al., 2008; Alves de Medeiros et al., 2007). Thus, a business expert may automatically discover all business processes and other elements of the enterprise affected by a new regulation or changed business rules.

The other use cases address enriched pre- or post-execution process analysis. Using semantic description, it is possible to reason before execution and answer questions as those on dimensions included in Zachman Framework (Zachman, 1987). Enhancing business process models with semantic descriptions enables also reasoning on the process execution results in order to optimise processes (Celino et al., 2007). In addition, semantic process mining techniques are used to extract so far unknown process models from semantically annotated execution logs (Alves de Medeiros et al., 2007, Pedrinaci et al., 2007). A clear representation of process content allows for constant monitoring of the workload of employees, level of resources etc.

Within the second scenario, semantic technologies are used to generate or partially define new elements of an enterprise model. This scenario encompasses a semiautomatic construction of business processes, supporting the evolution of a process, and semiautomatic retrieval and reuse of process artefacts.

Describing process models using one common terminology allows for their effective categorization and cataloguing. This facilitates discovery of processes or process fragments and allows for efficient reuse of already modelled processes (Markovic et al., 2008). The semantic annotations allow not only for efficient process discovery but also auto-completion of processes as during modelling similar already existing process models can be identified with respect to a modelling context (e.g. goals, process builder’s intentions and requirements) (Born et al., 2008).

Based on description created in the modelling phase, a semantically annotated process model may be further translated into executable process descriptions thus, bridging the business-IT divide (Karastoyanova et al., 2008). This requires transformation of the process and linking the process model to the available IT infrastructure. Mentioned transformation is automated and is realised by the task composition functionality that assigns to each task within a process model a composition of semantic web services able to fulfil the task’s goal (Weber et al., 2007). If two interacting web services use different data structures, a mediator may be applied to moderate between the different data formats. This will be possible, if the data formats of the web services are defined using semantics and an appropriate mediator exists.

A similar approach known as semantic enterprise application integration is using semantics to generate the application logic to integrate IT systems (Bouras et al., 2007a). For example, the Enterprise Interoperability Ontology (EnIO) (Bouras et al., 2007b) is proposed to represent the common understanding of data, services, and processes within enterprise application integration scenarios. This work enables assisted composition for web services (Alexakis et al., 2007) so that developing an integration solution is accelerated and quality of the found solution is improved.

2.5 Conclusions

This overview shows that SBPM is an active research area focusing on defining the necessary languages, providing some preliminary tools or outlining approaches and methodologies as indicated in this section. Introducing semantics into BPM creates new possibilities (especially with regard to additional software tools' functionalities) and allows solving some of the problems described in the previous section. However, an empirical evaluation of the proposed technologies to validate the practical relevance of SBPM and the effort invested in the ontology development or the complexity of semantic reasoning is mostly missing. Only Stein et al. (2008b) conducted a first empirical case study investigating some aspects of introducing semantics in BPM.

Moreover, semantic technology suffers from the following problems that need to be addressed before successful adoption on a larger scale:

- efficient reasoners – reasoning on ontologies is a complex, time as well as resource consuming task what makes utilisation of ontologies in time-critical scenarios impossible;
- effort required to create an ontology, especially by non-expert users;
- abstraction layers – proper description requires all users to agree on a common terminology as well as granularity level of an organisation description and they need to follow only this approach;
- ontology mapping and merging – various enterprises (or even different branches of the same company) may use different ontologies for process description which need to be merged e.g., prior to collaboration;
- ontology evolution – changing environment imposes also changes in an organisational model, so a change management methodology needs to be applied to the ontology stack.

3. BPM Supported by Social Software

Social Software is attracting high interest within academia and industry circles. Social Software supports different types of collaboration of peers and foster sharing of content and knowledge (Alexander, 2006). It can be generally categorized in the four applications wikis, social networks, social apps and blogs (Schugat. et. al., 2007).

In turn Schmidt (2006) classifies social software by the following three domains:

- Identity Management: ability to represent aspects of a person (oneself) in the Internet,
- Relationship Management: ability of sharing interests and building communities,
- Information Management: ability to find, rank, and manage online available information.

Initial applications of social software can also be found in a business context implementing Enterprise 2.0 (McAfee, 2006). However, in most of the existing cases, these applications are used mainly as information sharing frameworks (Komus & Wauch, 2008), but not as an advanced support for the BPM area. Despite the potential that Social Software applications have already demonstrated (O'Reilly, 2007), enterprises are still struggling with the challenge of how to benefit from Social Software within the BPM field. The following three subsections present the application of Social Software for the process design and execution phase, for change management and (semi-) automatic retrieval and reuse of process models. The potentials of Social Software for BPM systems are described based on available approaches (from the literature) and proprietary suggestions.

3.1 Design Support and Collaboration

Most approaches discuss the appropriateness of social features in BPM systems for the design and execution phase. Community participation and involvement improves process modelling and execution and shift the process modelling from a solely task to a group-driven task. In a group-driven design and execution of process models, applications of social software can bring several advantages. Social software, such as Wikis, can be used in order to comment and discuss about process models (Silva et. al., 2009) and to foster collaboration by exchanging and sharing workflows (Khalaf, 2009). Wikis and blogs might also be used for a commitment process e.g., on a common usage of process element names. Each actor (modeler, executor, developer) who would like to comment and share process model designs is allowed to do it. Anyone can contribute to a discussion about process models and is invited in the design and execution task, which improves a consensus on models. The activities of actors are logged to provide a history of work activities. Wikis can also be used to describe services (Paoli et. al., 2007) or to improve the design of a business system (Hussain et. al., 2009). Process modelling can also be facilitated by generating process models from wiki sides (Dengler et. al., 2009).

The community-driven extensions to BPM systems are intended for organisational use but may also be shared across organisations. First attempts can be found that establish design of models across organisational boundaries based on repositories and exploiting applications of social software [1].

In addition, during process design a socially enhanced BPM system has the advantage that tagging mechanisms can be used to annotate business processes with process policies. Alternatively, tagging mechanisms are suitable for the integration of process models into knowledge management (Prilla, 2009). Tags are especially suitable to extract the essence of policies that are defined in different languages/notations. Additionally, such an enriched BPM system may cope with roots of discrepancies between process models and really executed instances or lost innovations, which can be handled by such sharing information mechanisms (e.g., wikis, blogs). In this context, the advantage of socially enhanced BPM systems is that information is delivered to process owners without additional efforts, which eases the participation in the design of process models.

Still, it remains open if community-driven modelling and execution decreases or increases the model quality. The quality of a process model design can be regulated by the number of editors and reuses of that specific process model. The more actors worked on that model and the more a process model has been reused the better the satisfaction and the quality of the process model (comparable with Wikipedia where quality is determined by the number of edits, reuses and actors (Wilkinson, 2007).

Practical evaluations of community-driven process modelling and execution remains one direction for the future.

3.2 Change Management

Social software applications e.g., Wikis are also suitable for documenting knowledge and process models, respectively, and for project planning (Schmidt & Nurcan 2008). Community involvement and contributions generate process models enriched with more descriptions than in an individual process design. The process models are richer as more actors edit them.

A socially-enhanced BPM system might also be used for the propagation of changes as process models are subject to constant modifications. Social software will allow actors to become aware of potentially relevant updates to process models they are building themselves. Process analysts can actively inform other process builders about relevant changes in process models and they can be informed if they are affected by modifications (Koschmider et al., 2009a, Koschmider et al., 2009b). The socially-enhanced system can also be used to minimise process model changes in all modelling phases, because actors can help to achieve the necessary participants' involvement. Such a system might improve feedback cycles (Khalaf, 2009), because information is passed to responsible actors that can easily react on modifications and guarantees an efficient version control mechanism, because process models never get lost.

3.3 (Semi) automatic Retrieval and Reuse

Business process models can be designed from scratch or reusing already available model fragments from a repository. A recently implemented support system for business process modelling (Hornung et al., 2008) assists business analysts in an effective cataloguing and reusing of process models and model fragments. An extension of the modelling support system with social networks enables new forms of information sharing and exploitation of social relationships (Koschmider et al., 2009a, Koschmider et. al., 2009b). Especially a socially-enhanced BPM system supports encouragement of business analyst's trust and participation by those business analysts who are unskilled in process modelling. Business analysts gain insight who (e.g., well-known people) already edited and reused specific process models and model fragments. The system is aware of an automatic tagging mechanism that facilitates an efficient cataloguing and retrieval of process models and unveils the business analysts modelling objective at process modelling time (Koschmider et al., 2008). Additionally, social bookmarking and tagging improve access to process knowledge. Heymann et al. (2008) found that tags chosen by users seem to have considerable redundancy when compared to the text and domains of pages they annotate. This favours an automatic generation of tags. Taxonomy

[1] http://www.alignspace.com/, http://www.ariscommunity.com/

libraries such as WordNet (2010) can be used to bridge the gap between different modelling terminologies and abstraction levels.

3.4 Conclusions

To summarise, BPM can gain many benefits if it applies social software applications appropriately. Floridi (2009) is convinced that Web 2.0 will gain high success because "it leverages the only semantic engines available so far in nature, us".

Besides these advantages of socially enhanced BPM systems, social software copes with some problems, such as:

- Learning Effort: applications such as wikis are usually not intuitive to use and require training effort. Benefits of social software correlate with the number of actors using this software. Launching of new features should be clearly communicated to actors and the features should be intuitive to use.
- Security: social software applications are said to be unsecure. The registration process is available for anybody who is interested in participation and also the access to information is open for everybody. Social software is not appropriate for managing critical/private business process models.
- Quality: the quality of commonly designed process models can be determined by the number of edits, reuses and actors like it is done for Wikipedia (Wilkinson, 2007). However, quality measures are required that ensure model quality in community-driven, collaborative modelling projects.

This list ends with problems that are not unique to social software but also to the World Wide Web or Software Engineering (e.g., trust, version control or data integrity). Thus, coping with social software problems also means coping with more general ones.

4. Merging Semantics and Social Software in BPM - Discussion

Previous sections provided a number of ideas how semantics and social software may address the BPM shortcomings. The table below summarises these ideas showing how each of them addresses shortcomings and problems of BPM identified in the introduction section.

Table 2. Semantics' and Social Software' Support of BPM Shortcomings.

Shortcoming	Support	Semantics	Social Software
Business IT-divide	Mapping between business and IT languages, allowing for reuse of business process models	X	
	Assuring consistency between developed process models via machine translation as well as user annotation	X	X
	Definition of executable processes based on semantic translation or data shared by other users	X	X
Compliance of business process models	Business models can automatically be checked for compliance	X	
	Tagging processes with information on business policies, etc.		X
Change management	Full feedback on process lifecycle regarding business process design via logs and change notifications		X
	Overcome change resistance in organisations as people are aware of changes and often actively participate in the creation of the solution		X

Shortcoming	Support	Semantics	Social Software
(Semi-) automatic retrieval and reuse	Previously incompatible notations can be switched if necessary by translation mechanisms based on ontology stacks	X	
	Annotation provided by users (e.g., folksonomy) facilitates sharing of processes and allows more precise retrieval		X
	Discovery of processes or services profits from better formal descriptions as well as from context subtly influencing the reuse	X	X
Collaboration	Reuse of existing domain models is possible thanks to formal specifications and easy retrieval; customization may be achieved via reasoning	X	
	Full support for collaborative design of processes		X
Knowledge management	Social web-inspired knowledge management, including such features as decentralization and search		X

Analysing the table, we may note that semantic technologies focus on provision of shared vocabulary, formalised, and machine processable metadata and their main aim is to provide automation. In turn, social software conversely describes an overall approach of incorporating users into design and implementation of IT systems, where the focus is on knowledge sharing and collaboration. Indeed, looking at the origins of the Semantic Web and social software concepts, we note several differences. The most important one is that while the Semantic Web focuses on machines by providing machine processable information, social software focuses on humans mostly by providing efficient frameworks for information sharing, thus, also providing understanding but between people, not machines. If we analyse them in detail, they may be considered as two sides of the same coin and thus, both of them may support BPM neither competing nor excluding each other.

The idea of combining semantics and social software is of course not new. The potential for combining semantic technologies and social approaches emerged even before social software concept was actually coined. For example, Sure et al (2002) proposed an editor for collaborative ontology development. Similarly, Handschuh and Staab (2003) proposed OntoMat, a component-based, ontology-driven Web-page authoring and annotation tool.

Due to specifics of wikis, first applications of semantics were observed in this most prominent phenomenon of social software (Völkel & Schaffert, 2006). First approaches based on extension of existing wiki platforms with semantics, e.g. Kroetzsch et al (2006) extended MediaWiki. Later on, separate platforms emerged that were targeted at more general social software, e.g., KiWi by Schaffert et al 2009.

In turn, Passant (2007) considers how existing social software tools can be part of the Semantic Web, and distinguishes two areas: population of domain ontologies and sharing a common model for better information description and retrieval. He also considers approaches to integrate folksonomies with Semantic Web.

A more general approach is also presented by Ankolekar et al (2007). They are convinced that both technologies will retain in the future as they have supplementing strengths: social software focus on community and usability and Semantic Web infrastructure to facilitate mashup-like information sharing. They present a scenario that illustrates the potential for combining Web 2.0 and Semantic Web technologies.

Not only social software may benefit from semantics but also the other way round. One has also to mention applications that leverage user involvement and move the focus from social software towards development of the Semantic Web, e.g. ontology games (Siorpaes et al., 2007). The idea is to masquerade collaborative ontology engineering behind on-line, multi-player game scenarios. Wiki may also be used to develop comprehensive, informal definitions of terms, each one identified by a URI

(Hepp et al., 2007b). Social software increases the change that ontologies will be developed and understood by majority of potential users instead of by single individuals or small groups.

The table below provides a comparison of semantics and social software with regard to ease of application and maintenance of these concepts in BPM.

Table 3. Semantics and Social Software in BPM

	Semantics	**Social Software**
Implementation	Preliminary work is required in order to benefit from this technology	Easier to introduce, because of significant experience of users as well as web designers (e.g., AJAX).
Level of acceptance	Training and paradigm shift needed. More user-friendly tools/interfaces necessary	Smooth integration, because users are familiar and experienced with social software technologies
Application areas	Semi-automated implementation of processes (service discovery and composition); integration of IT systems	Design of models; introduction of new processes, policies; knowledge management.
Updating	Time-consuming	By users, less effort required
Tools	Several tools available although most of them are rather scientific prototypes with limited usability	Many generic tools are available but few of them are related to business process modelling; this however means a high potential for development

Semantics offers a comprehensive approach for the entire process lifecycle. However, its application requires additional effort from the BPM actors, e.g. annotation of tasks or subprocesses, formal specification of pre-conditions and post-conditions. Social software is most successfully applied whenever the user involvement is considered and no additional training is needed. However, it offers support only for selected phases of BPM. Thus, the combination of semantics and social software may offer many advantages as while semantics may be responsible for support of back-office and smooth transitions between various phases, social software is predestined for front-office and interactions with BPM actors.

However, the technologies in question are still not mature enough. User acceptance is the biggest risk factor. While enterprises are still struggling with the challenge of how to benefit from social software, it is hard to expect that they will quickly accept socially-enhanced Semantic Business Process Management. Nevertheless, users should appreciate ease of participation in the design of process models. All this supplemented with a solid semantic backbone should open new perspectives for enterprises.

5. Summary

The emergence of new technologies inspires visions of advancing a field of practice by adopting these technologies. As discussed in this article, such visions exist in case of BPM, too. Currently, the adoption of semantics and social software technologies is discussed by many researchers. However, as of today it is unclear if the research efforts try to tackle similar problems, or if they are unrelated.

Our analysis shows that semantics and social software technologies mostly address different BPM shortcomings and that only few overlaps exist. This seems to be a consequence of the different technologies' natures. For example, semantic technologies are mostly used to enable machines processing content, whereas social software technologies are used to enable better integration between human individuals. Also, semantics must be introduced in a top-down approach, whereas semantics are often adopted in a bottom-up movement.

Our analysis also shows that in most cases only initial research prototypes are available, preventing any professional adoption of this technologies in BPM. Therefore, additional research is needed bringing semantics and social software technologies to businesses.

6. References

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