Management of Model Relations Using Semantic Wikis

Michael Fellmann  
Chair for Information Management and Information Systems  
University of Osnabrueck  
michael.fellmann@uni-osnabrueck.de

Oliver Thomas  
Chair for Information Management and Information Systems  
University of Osnabrueck  
oliver.thomas@uni-osnabrueck.de

Thorsten Dollmann  
Institute for Information Systems at the German Research Center for Artificial Intelligence (DFKI)  
thorsten.dollmann@iwi.dfki.de

Abstract

The unified documentation of models and their relations, which vary greatly concerning the description view, the abstraction level, the language used and the purpose for which they have been built, is still challenging. The knowledge about the relations, which exist between models is usually not captured in a systematic way and hence cannot be searched and reused across different projects and stakeholders. Therefore we examine semantic wikis for the systematic collection and documentation of this knowledge. Firstly, we compare semantic wikis by means of a comparison framework, which permits the problem-adequate selection of semantic wikis. For the practical use of semantic Wikis, we secondly propose a metadata structure and demonstrate their usage based on a prototype.

1. Introduction

As a result of an increased networking of enterprises and the establishment of concepts incorporating business process orientation into the cooperative creation of products and services, there is a growing demand for adequate collaborative business process management solutions. The cooperation partners communicate with groupware and through the internet and thus are not bound to regional boundaries. Because of this networking of business processes, the business process modeling has to cope with the new requirements and has to offer an adequate support for collaboration. A key role is assigned thereby to the creation of abstract representations of reality, adequately simplified for the specifically regarded issues of interest. The use of process modeling techniques allows to put emphasis on the execution of tasks related to internal or external work orders as well as to their time and space related coordination. Current challenges to the process management in cooperation environments can be seen in particular in the distributed modeling imposed via the spatial distance of the partners, giving rise to problems related to collaborative process models and heterogeneous, distributed model data stores [30].

There is broad agreement that it is important to involve various experts, stakeholders and users in a model development cycle. Collaborative modeling can be defined as the joint creation of a shared graphical representation of a system or process [24]. Key challenges in enterprise business process modeling are to capture complex inter-departmental and organizational processes, and to integrate different perspectives on the operation of the enterprise. To support integration of different views on enterprise processes, collaborative modeling has been proven to be a useful approach. However, collaborative modeling itself is challenging, as it requires people within the business to express their views in terms of a modeling language [3].

Business process modeling is used on a large scale and supports conceptualization, communication, understanding, analysis, design and improvement of business processes and information systems [8]. Here companies must meet the requirement to incorporate both functional (e.g. organizational units, compliance with regulation) and technical aspects (e.g. service and interface descriptions). The coupling of functional and technical modeling is particularly problematic. This gap hinders a consistent conversion of business requirements into process-oriented information systems. The current situation in process management can though be characterized by language pluralism. We differ in information, application and execution models (see Figure 1). The corresponding information model to-be (representing the business perspective of the information system) has to be customized to the corresponding application system. Secondly, it can be transformed into an executable process model. In general, languages used to construct models from a business perspective (e.g. EPC, UML Activity Diagram, IDEF3, Activity Decision flow diagram) differ from those used to construct applicable and
executable models (e.g. BPMN, BPEL, XL and XPDL) for example in regard to the extent to which exceptions and failures can be represented. Corresponding to the different purposes of the modeling languages, different models on different levels of abstraction from information technology are created [20].

Figure 1. Model-based information systems design framework

Although present modeling tools allow to capture some limited relationships between models e.g. in the form of hierarchical decompositions, complex semantic relations spanning multiple modeling tools and repositories are not captured sufficiently, although this demand has already been identified in literature [4; 20]. Therefore, a uniform documentation of the models and their relations is usually not practiced. The result of this is that the knowledge around the various semantic model relations such as “is derived from”, “details” or “implements” is only implicitly contained in the mental models of individual employees of an organization. It is not explicitly represented in a central IT-based repository and therefore cannot easily be shared and reused across different individuals and projects. Moreover, it is not amenable to machine processing. This causes manifold disadvantages; one of them is for example that the analysis and search of dependencies between models is not possible.

Semantic wikis provide a potential solution to this problem as they allow representing such relations in an explicit and formal way and yet provide an easy to use platform for documentation. In general, semantic wikis extend wiki systems for collaborative content management with semantic technologies aiming at enhanced navigation, search, and retrieval possibilities [17]. Whereas regular wikis are a collection of structured text and hyperlinks, semantic wikis allow for classifying page contents and links between pages by annotating them with concepts of a formal model such as an ontology.

In this paper, we examine the suitability of semantic wikis to manage the documentation of models and to capture the relations between models in an explicit and machine processable representation. The paper is organized as follows. At first, we give a short overview over related work. Then a comparison framework for semantic wikis is introduced and applied to a selection of wiki engines. For the practical application of the semantic wikis a semantic metadata structure is developed. The usage of this metadata structure is demonstrated based on a prototypical implementation. The contribution closes with a discussion and outlook.

2. Related Work

Approaches to modeling often deal with the question, how specific models can be derived from existing models [23; 29]. The authors in this field regard both version relations between models [5; 28] and variant relations, which results in the characterization of special construction techniques [32]. Especially the configuration plays a large role as a special technique due to its great potential for IT-support [25]. However, in these works relations between models are regarded only fixed on one description level, i.e. if a reference model exists on the business level or on the implementation level, then also the model derived from this model is assigned to the respective level. These works accordingly lack the consideration of relations spanning descriptions of process on the business level as well as on the implementation level that are necessary in implementation projects. In contrast, our contribution proposes to support the documentation of these relations spanning all description levels.

The formal description and semantic annotation of models in general are advanced in the field of “Semantic Business Process Management” [11; 12]. The capturing of relations between models with technologies of the Semantic Web is described in regard to product models by Hahn [10], in regard to reference models and the models derived from them by Hinkelmann, Thönssen and Probst [13]. These approaches focus in contrast to this contribution...
mainly on the formalization of the semantics of models on the level of language-based meta models or – in the context of annotation – that of individual model elements.

The semantics of modeling languages is also addressed in the context of the ontological analysis [34]. Here the so called Bunge-Wand-Weber-model is of importance [35]. Further work regarding the semantics of modeling languages can be found in the field of enterprise model integration and from meta modeling platforms [15; 19]. Besides, tools exist such as METIS [14] in order to express relations between language constructs and language based meta models.

While these works investigate the semantics and the management of relations between modeling language constructs, our contribution investigates the management of the relations between models with the help of semantic wikis. We have chosen semantic wikis as documenting models and their relationships naturally matches the purpose wikis are built for – documenting information objects and linking between information objects. Also, the functionality offered by semantic wikis is somewhat orthogonal to what (collaborative) modeling tools and methods provide. Whereas the latter focus mainly on creation phase, the former focus on the tool-independent documentation and hence on the usage phase of models as knowledge artifacts.

3. Comparison of Semantic Wikis

3.1. Setting up the Comparison Framework

Criteria for the comparison of semantic wikis regarding the documentation of models and the management of their relations can be identified in various areas. These are derived using the analogy of a library where books correspond to models. Basically, it must be possible to physically include a book in a library (place it on the shelf) or to remove it when it is obsolete which in respect to models refers to model management. When a book is included in the library, an entry in the library catalogue has to be made which corresponds to the area of model documentation: When a user wants to find a book, there have to be browsing and searching functionalities which correspond to browsing and searching models. Finally, it may even be interesting to see how a particular book is rated by other users or to have a space for discussion which in respect to using models corresponds to the area of collaboration. In the next sections, criteria pertaining to these areas are discussed in more detail.

In the area of the model management it is an important criterion, to what extent the representations of semiformal models can be imported in a wiki. Here, fundamentally two scenarios can be differentiated. First, a model can be imported as diagram, which has been produced by a modeling tool (indirect import). Second, the model can be read in by means of a standardized exchange format for models, like e.g. EPML, XPDL or XMI (direct import), which implies that the wiki is able to generate a graphic representation from the input data for displaying the models. In order to be able to set different authorizations for the use of the wikis e.g. in the intranet, extranet or the internet, the wiki should have an administration tool to restrict the access rights.

The model documentation can be implemented fundamentally by wiki pages, which contain a natural-language documentation of the model. In order to keep the training costs in regard to the wiki usage as small as possible, the support of the users by a WYSIWYG editor is desirable. With this, a user does not have to learn a special syntax for formatting the wiki page.

Semantic wikis usually have functionalities to annotate a wiki page with a term or concept of a metadata structure such as an ontology. Similarly, links between wiki pages can be typed. Analogous to the support concerning the creation of wiki pages, the wiki should support the user also in annotating wiki pages and links, e.g. by an auto completion functionality or a WYSIWYG editor for annotation. Further criteria regarding the annotation are whether metadata structure, e.g. in the form of an ontology, can be imported in order to facilitate the initial use of a semantic wiki. In addition, the export of semantic data is relevant in order to be able to use and analyze it by external applications. Furthermore, for the adjustment of the wiki to the changing requirements of the model documentation it is relevant whether the metadata structure can be changed within the graphical user interface of a wiki. Besides annotation, of special importance is also a versioning mechanism for the wiki pages as well concerning the semantic metadata attributed to them, so that changes of the documented models and the metadata remain at any time traceable.

In the area of browsing and search, apart from a full text search for the fast finding of contents, the implementation of a feature for faceted browsing is important. A facet here is understood as a property defined in the metadata structure of the semantic wiki which is used to describe relations between models (e.g. ‘is derived from’) or models itself (e.g. ‘provision date’). The values of these facets can be used for an effective and multi-perspective-based selection of models and to create complex filters (e.g. ‘show me all process models that have been derived from ‘rental process’ after 2008–08–01’ and that are on implementation level).
Table 1. Overview of semantic wiki engines

<table>
<thead>
<tr>
<th>Name</th>
<th>Short Profile</th>
<th>Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td>COW</td>
<td>Supports the collaborative construction and evolution of ontologies. The wiki supports versioning, transactions and the management of concurrent modifications of wiki pages. Ontology information can be used inside wiki pages to generate dynamic contents and for question answering. [<a href="http://www.informatik.uni-freiburg.de/cgnm/software/cow/">http://www.informatik.uni-freiburg.de/cgnm/software/cow/</a>]</td>
<td>[9]</td>
</tr>
<tr>
<td>IkeWiki</td>
<td>It supports different levels of formalization from plain texts to ontologies. The wiki supports the W3C-standards RDF and OWL and provides reasoning capabilities. A WYSIWYG-editor offers support in editing wiki pages, which can also be generated by embedding SPARQL-queries into a wiki page. [<a href="http://ikewiki.salzburgesearch.at/">http://ikewiki.salzburgesearch.at/</a>]</td>
<td>[26]</td>
</tr>
<tr>
<td>Kaukolu</td>
<td>The annotation technique of wiki pages with semantic concepts provides a high degree of flexibility as it is possible to e.g. annotate texts on the basis of paragraphs and smaller units than a page. An example of this would be legal texts which can be annotated with existing ontologies and then the annotations can be used for querying. It is possible to switch between a page-oriented and an annotation-oriented view of the contents. [<a href="http://kaukoluwiki.opendfki.de/">http://kaukoluwiki.opendfki.de/</a>]</td>
<td>[16]</td>
</tr>
<tr>
<td>Makna</td>
<td>One strength of this wiki is hat predefined OWL-ontologies can be imported into the wiki and subsequently can be used to create instance data. The editing and annotation of wiki pages is assisted by numerous interactive tools e.g. to find classes or properties of the ontology by keywords etc. It also provides templates for searching the wiki contents. [<a href="http://www.apps.ag-nbi.de/makna/">http://www.apps.ag-nbi.de/makna/</a>]</td>
<td>[18]</td>
</tr>
<tr>
<td>OntoWiki</td>
<td>OntoWiki focuses agile and distributed knowledge processes. It supports numerous visualizations and views on a knowledge base, most notably a faceted search which can be used to narrow down the search space or the integration of geographical information such as maps. Collaboration is supported by the possibility to discuss each part of the knowledge base, to rate the popularity of contents and to reward the user contribution. [<a href="http://ontowiki.net/">http://ontowiki.net/</a>]</td>
<td>[1]</td>
</tr>
<tr>
<td>PlatypusWiki</td>
<td>A simple wiki which has been extended with a user interface in order to support the annotation of wiki pages with metadata. It supports RDF, RDF-Schema and OWL. [<a href="http://platypuswiki.sourceforge.net/">http://platypuswiki.sourceforge.net/</a>]</td>
<td>–</td>
</tr>
<tr>
<td>Rhizome</td>
<td>This wiki is a wiki-like content management system. Entire pages, i.e. their structure and content, can be edited as RDF-data. Rhizome supports the editing of pages by means of a text formatting language which is able to produce arbitrary descriptions of XML- and RDF-data. [<a href="http://rs4rdf.liminalzone.org/Rhizome">http://rs4rdf.liminalzone.org/Rhizome</a>]</td>
<td>[27]</td>
</tr>
<tr>
<td>SemanticMediaWiki</td>
<td>As an extension of MediaWiki, the software which is used e.g. by Wikipedia, SemanticMediaWiki focuses on simple usage and scalability in order to make semantic technologies available to a great user community. A major project which is based on SemanticMediaWiki is the creation of a “Semantic Wikipedia”. [<a href="http://semantic-mediawiki.org">http://semantic-mediawiki.org</a>]</td>
<td>[18]</td>
</tr>
<tr>
<td>SweetWiki</td>
<td>At the core of this wiki there is a web server extended with semantic technologies. The web server supports the direct embedding of tags into wiki pages. The relations between tags can be defined by means of an ontology which is defined and maintained by the administrators of the wiki. A search engine embedded into the web server allows search and navigation in the wiki pages. [<a href="http://www-sop.inria.fr/teams/edelweiss/wiki/wakka.php?wiki=SweetWiki">http://www-sop.inria.fr/teams/edelweiss/wiki/wakka.php?wiki=SweetWiki</a>]</td>
<td>[6]</td>
</tr>
<tr>
<td>WikSAR</td>
<td>This wiki provides a simple semantic annotation and search. By embedding queries into wiki pages, collections of wiki pages can be retrieved and displayed. A graph-visualization provides an overview of the contents of the wiki. [<a href="http://wiki.navigable.info">http://wiki.navigable.info</a>]</td>
<td>[2]</td>
</tr>
</tbody>
</table>

Additionally the browsing in the set of models documented in the wiki can be facilitated by summary pages which list the models according to various (user defined) criteria. The maintenance of such wiki pages can be a very labor intensive task provided that a big set of models exist. The wiki should therefore provide a functionality to generate such pages “on the fly” using embedded queries. That is, queries which work behind the scenes to retrieve the desired information when the wiki page is accessed. Whereas these queries are useful for the automated processing of the metadata stored about the models in the wiki, the wiki should provide also features to conduct manual searches. Criteria to the manual search are the support of a query language such as SPARQL [22] and assistance for the production of correct queries, e.g. in form of a query template or a search form, which facilitate the input of correct queries. In order to leverage the full potential of machine processable metadata which is collected about models in the semantic wiki, the use of an inference machine is an important criterion allowing new facts to be inferred, which have not explicitly (i.e. manually) been stated in the metadata about a model.

Apart from the criteria listed so far it has to be considered in addition that changes on models in modeling projects are carried out usually not exclusively on a centralized or global model. Instead, they are performed rather distributed by project teams at detail models and united afterwards to an improved construction. This is due to the trend for division of labor in the model development [33]. Therefore, collaboration functionalities supporting the cooperation of the stakeholders are highly important. As relevant criteria functionalities for collaborative indexing (tagging), discussion and for the assessment of quality (rating) of models should be provided.
3.2. Applying the Comparison Framework

Already, numerous implementations of semantic Wikis exist; for an overview see [31], for comparisons see [7] or [21]. In the context of this contribution, the compared wikis are selected on the basis of (a) the completeness of the implementation regarding the criteria specified in the previous section, (b) on the extent and the quality of their documentation and (c) how frequently they are cited and thus how much impact they already created in the scientific community. As the documentation of models is inherently a collaborative task, wikis which predominantly focus personal knowledge management have not been selected. Likewise wikis were not considered, which were developed exclusively for specific contents, as e.g. mathematical formulas or encyclopedias. Table 1 shortly introduces each selected wiki engine.

Table 2 “Comparison of semantic wikis” shows the results of the comparison of the semantic wikis which have been selected according to the mentioned criteria. If a criterion or a functionality is implemented by a Wiki, this is indicated by a filled out circle ●. The contrary case is indicated by an empty circle ○. Table 2 reveals a relatively high implementation rate of the compared wikis regarding to functionalities in the area of model documentation. Most wikis supports the import of metadata structures in the form of RDF or OWL ontologies, a support of annotation mechanisms by the majority of the regarded wikis is likewise available.

<table>
<thead>
<tr>
<th>Model management</th>
<th>COW</th>
<th>IkeWiki</th>
<th>Kaukolu</th>
<th>Makna</th>
<th>OntoWiki</th>
<th>Platypus Wiki</th>
<th>Rhizome</th>
<th>Semantic Media Wiki</th>
<th>Sweet Wiki</th>
<th>WikSAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import of models as images</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Import of models based on exchange format</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>User roles, access rights</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model documentation</th>
<th>COW</th>
<th>IkeWiki</th>
<th>Kaukolu</th>
<th>Makna</th>
<th>OntoWiki</th>
<th>Platypus Wiki</th>
<th>Rhizome</th>
<th>Semantic Media Wiki</th>
<th>Sweet Wiki</th>
<th>WikSAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>WYSIWYG-Editor</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Annotation support</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Import of metadata/ontologies</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Export of metadata/ontologies</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Editing of metadata schema/ontologies within wiki pages</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Versioning of wiki pages</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Versioning of Metadata</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Browsing and search</th>
<th>COW</th>
<th>IkeWiki</th>
<th>Kaukolu</th>
<th>Makna</th>
<th>OntoWiki</th>
<th>Platypus Wiki</th>
<th>Rhizome</th>
<th>Semantic Media Wiki</th>
<th>Sweet Wiki</th>
<th>WikSAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faceted browsing</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Embedded queries</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Support of a query language</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>□</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Assistance in query formulation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Query with inference</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Full text search</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

In contrast to this the other areas exhibit clearly smaller implementation rates in this comparison. In the area of model management for example, it has to be stated that no wiki permits the import of models in a standard exchange format. Also functionalities in the area of collaboration are to be found still relatively rarely. As a serious issue affecting the usefulness of the compared wikis is the lack in the area of browsing and search. Only few of the compared wikis permit a faceted browsing and embedded queries, which facilitate navigation in large sets of models and the generation of summary pages (e.g. listing of all models, which are one the same description level constructed with the same modeling language etc.).

In addition, queries with inference are rarely supported (e.g. find all models that are connected to the given model via a transitive “isDerivedFrom”-relation). It is to be expected, however, that the
addressed problems regarding the use of the semantic metadata will be solved in the medium term by improved implementations of the wiki engines. When the mentioned shortcomings diminish, semantic wikis may well serve the documentation, search, evaluation, discussion and analysis of models and their relations.

However, a fundamental adjustment of the wikis necessary for this endeavor concerns the metadata structure, which is necessary for the annotation of models and the relations existing between them. Such a structure can be imported into the wiki; the import e.g. in the form of RDF- or OWL-ontologies is already supported by most wikis (see Table 1, row “import of metadata/ontologies”). If that is not possible, another way would be to use an internal editor of a wiki (if provided) to create or adapt the metadata structure. In the following, we show such a metadata structure in form of an ontology.

4. Metadata Structure for Managing Model Relationships

Data providing semantic, structural, administrative and technical data about other data are commonly referred to as metadata. In this context, a metadata structure for managing model relationships is a structure specifying how semantic data for representing model relationships have to be structured. On the one hand, data representing the relationships of models among themselves is considered (model relations). On the other hand, data representing the relationships between models and other characterizing information objects (model attributes) is considered. Figure 2 shows the metadata in terms of an UML metadata ontology (an OWL version of the ontology can be accessed via http://www.semantic-business.org/ontologies/2008/08/sbpmwiki.owl). The classes of the ontology are visualized as UML classes, relations as UML association classes. Arcs in the labels of the association classes show specific properties of the relations such as transitivity or symmetry.

Model relations are often divided into a whole-part-relationship partOf and a further relationship isRelatedTo representing related content, linking or connection. The partOf relationship also expresses that a model can be considered as part of another model. In this general sense a partial model can be both a model fragment and an independent, self-contained model.

Examples of partOf-relationships are constructs provided by almost all modeling languages for disaggregation of detailed models which are to be considered as part of a parent model. The relationship type isRelatedTo is further specialized in a implementing relation isImplementationModelOf, a detailing relation isDetailedModelOf, a linking relation isConnectedTo und a derivation relation isDerivedFrom. The implementing relation isImplementationModelOf expresses that a model is
the computer aided executable conversion of the structures of another model. An example of this relation is a BPEL model which is an implementation model of the corresponding BPMN model. The detailing relation the referenced model also contains more particulars than the model referenced with the isDetailedModelOf relation. In contrast to the implementation relation the additional details primarily conduce to a more detailed representation of the modeling domain. The linking relation isConnectedTo allows for the representation of arbitrary connections between models linked with process interfaces. The derivation relation isDerivedFrom can represent the issue of a model being constructed by means of an adaptation process from another model. This relationship type can further be specialized into the relationship types containsModel, isAnalogousTo, isConfigurationOf, isInstantiationOf and isSpecializationOf which correspond with the commonly used reference modeling techniques aggregation, configuration, instantiation and specialization.

Basic model attributes are the description view (e.g. processes and data), the description layer (e.g. business requirements), the language (e.g. BPEL) and the visibility of the model within the boundaries of an organization (e.g. public or private). The attributes mentioned can be represented with corresponding relationship types between the class Model and the classes DescriptionView, DescriptionLevel, Language and Visibility.

The user interface as part of a prototypical implementation clarifies the practical use of the metadata structure developed above (see Figure 3). In the upper left part of the user interface, a user can alternatively use the search function or the selection of facets, which prunes the set of the models showed in the upper items part, to retrieve relevant models. The central main part of the user interface shows a wiki site documenting a model which includes its relationships to other models. After the description of the model, the
model relations specified by means of the metadata structure in Figure 2 are displayed. The model relations displayed in the example are the relationship types defined in the metadata structure: isRelatedTo, partOf and derivations of them. The relationship types are displayed as links. Noted behind every link is the number of models being related with the considered model via the corresponding relationship type. When a user follows such a link, a list of affected models is displayed from which a user can select a model he is interested in. Hence, a wiki user can easily navigate within the net-like linking arising out of the metadata structure. To improve the clarity the display of the model relation is further assorted by ingoing and outgoing links.

Further metadata on a model are displayed in an info box “model profile”. The respective headlines, e.g. “description level”, correspond to the model attributes defined in the metadata structure (see Figure 2). The attribute values are each displayed a link. If a user follows such a link, he is directed to an illustrative wiki site commenting this attribute value. All information parts are directly editable. Therefore all contents can be enhanced form the users at any time. The flag “discussion” in the upper part of the user interface can support the interchange of the users and the flag “version/history” displays older versions of the model to be able to relate to the enhancement processes.

5. Discussion

So far, wikis have been proposed to manage the relationships between models and to provide a means to document models. However, wikis may also easily be used to document the design rationales for creating a model. Moreover, the reasons for adapting a model may be documented in the wiki. This may also include the documentation of business rules and their relation to business process models. In this way, a semantic wiki can be used to manage compliance issues as it allows communicating the relevant rules among the different stakeholders in model creation and model usage. Even more advanced functionalities might be realized by extending existing wiki engines in such a way, that the derivation of specific models from reference models or the instantiations of reference models into specific processes is directly supported within the user interface of the wiki. This would also require algorithms to compute model similarity e.g. in order to find a model which is similar to a given model and which can serve as a template for the construction of a new model or detecting that a newly constructed model is in fact an instantiation of a reference model.

The use of semantic wikis for managing model relations presented in this contribution is a starting point to explore the usefulness of semantic technologies in model management. Future research will take the afore mentioned aspects into consideration and broaden the focus from managing model relations to semantic model management.

Further investigation is also required in order to determine if wiki functionalities should be added to existing model repositories, if wikis are a potential candidate to replace traditional model repositories or if the two artifacts should complement each other. This implies also organizational issues as current semantic wiki engines usually not provide a fine-grained role management and thus the wiki approach to model management seems more suitable for open or public processes. In order to investigate the combination of a well established modeling tool with a semantic wiki, a prototype is currently under development combining the modeling tool “Microsoft Visio” with the semantic wiki “Makna”. This prototype already implements most of the functionality shown in the user interface in Figure 3 and will be the basis for the evaluation of the presented approach to the management of model relations.

6. Conclusion and Outlook

A modeling task has no unique result. Every subject could arrive at a different “valid” solution. Ultimately, the construction result is a consensus about the model object, which is perceived by the involved subjects in quite different ways. To ensure the traceability of the modeling construction process, it is required to record the particular circumstances of the modelers, their objectives and the steps to be taken. Semantic wikis can be used to support the documentation of this metadata. Compared to both “conventional” wikis and tools used in process management so far, there are the following advantages that accrued using semantic wikis as described:

- Participatory and integrative approach: employees can access the semantic wiki with web browsers without installing client software and can easily edit wiki sites. This lowers the inhibition threshold for collaboration. Hence, the results of modeling projects can be discovered, discussed, rated and reused form a large number of employees.
- Incremental knowledge acquisition and sharing: Wiki pages can be created incrementally, beginning with a first idea formulated as text or incomplete models which is then gradually refined and consolidated. Hereby every step is at any time
traceable with help of discussion pages and/or versioning.

- Organic structuring: a structuring of the model supply can evolve evolutionary and is not bound to a fixed and inflexible hierarchy. Any relationships can be established between models and formally defined and controlled by way of an ontology.

- Semantic navigation and retrieval: using formal ontologies in the background of wiki sites improves the navigation and model retrieval. Hence it can be detected which models are affected when changing other models since a derivation relation between the models is stored into the wiki. In a further step, an inference engine can discover new coherences, which are in secrecy else wise.

A future integration of traditional modeling tools with semantic wikis seems to be exceedingly promising due to the potential of semantic wikis for improving the communication of the actors involved in business process management activities and for externalizing of implicit knowledge of relations between models mentioned above.

However, whether wiki functionality is to be integrated in traditional modeling tools or wikis should be extended with modeling functionality is still an open research question.

7. References


[2] D. Aumueller, "Semantic authoring and retrieval within a Wiki". In: Demo Session at the 2nd European Semantic Web Conference (ESWC 2005), May 29 - June 1, Heraklion, Greece, 2005


