Collaborative Process Development using Semantic MediaWiki

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Abstract: Often organizational processes are rather informal, subject to frequent changes, and involve roles with unclear responsibilities. Nevertheless it can be beneficial for efficient organizational knowledge management to document and communicate such processes. In this context, current state-of-the-art methods and tools for process engineering do not provide the most appropriate instruments. In this paper we address this issue by combining traditional process engineering techniques with a collaborative, wiki-based approach. As a result we present an extension to Semantic MediaWiki featuring collaborative creation of a process description and the automated generation of its structured, graphical representation.

1 Introduction

In order to enable efficient collaborations within companies structured representations of the organizational processes are needed. Nevertheless, as practical experience has shown, the processes are often poorly documented; even if they are documented, the formal representations are often not enacted correctly, consistently, and homogenously as they do not sufficiently reflect the reality of daily work. This is mainly due to the fact that processes are subject to frequent changes and that a significant effort is required to create and update the process descriptions. As traditional process management methods apply interview- and workshop-based techniques to capture structured knowledge about organizational processes, they tend to be time-consuming and inefficient. In contrast, we suggest a collaborative approach to process design where process descriptions are gradually improved by different contributors.

In order to support such a collaborative, distributed, and iterative process documentation by a modelling tool, we extended the Semantic MediaWiki (SMW) wiki software with process modelling and visualization functionalities. Thereby, we are able to capitalize on the fact that process activities, people, and organizational roles (at least in our case-study environments) do already exist in the corporate wiki and only have to be arranged in a meaningful manner. The suggested approach relies on the collaborative aspect of wikis [LC01] allowing collaborative modelling of business processes in an iterative way. By

leveraging existing, well-known wiki syntax for modelling processes, we reduce the barrier for manipulating process descriptions. By relying on widespread and well-accepted wiki technology, we enable users to model and update organizational processes in a familiar environment by reusing externalized knowledge already stored in wikis.

Other expected advantages for modelling business processes with SMW are less maintenance costs of the system and improved interoperability through RDF export functionality which is already provided by SMW. Thus implicit process knowledge is made explicit in RDF format and can easily be used by other applications.

This paper is structured as follows: In the Section 2, we briefly describe the methodological approach for decentralized and collaborative development of process models. Section 3 sketches our Semantic MediaWiki extension, introduces properties for annotating processes and means for the graphical visualisation of processes within the Semantic MediaWiki. Section 4 presents two use cases where we have documented first practical experiences while implementing the proposed solution. Related work is discussed in Section 5. The paper concludes with a summary and some ideas for future extensions of our approach (Section 6).

2 Methodological Approach

Our methodology for collaboratively creating business processes is based on the Knowledge Maturing Process Model [SHL+08], shown in Figure 1. The model structures five phases for the maturation of knowledge building upon each other: the expression of ideas, the distribution in communities, formalization, ad-hoc learning and standardization. In addition to being used for the maturation of content objects, the model can also be applied to other knowledge representations like process models or ontologies for knowledge organization. Regarding the maturation of business process models, the conceptual model proposes to start with individual task lists and routines. Task patterns can be distilled for recurring tasks and shared between individuals. In a next step, a wider community of people is allowed to discuss, refine, enhance and complete these procedures in a social and collaborative manner. Eventually, this evolutionary process results in business process models which are adequate standardizations of real-world practice. Even though we concentrate on the more informel and less formal phases of the proposed model.

3 Process Extension for SMW

To support this method for formalising processes, we developed a process extension[1] for Semantic MediaWiki. This extension builds on the capability to query for semantic properties which is provided by Semantic MediaWiki [VKV+07], and displays these query results as a process graph. It adds a special query printer to SMW which transforms the result of a special process-property query into the GraphViz DOT language [KN02] and

[1] A demonstration of the extension can be found at `https://km.aifb.uni-karlsruhe.de/projects/process`

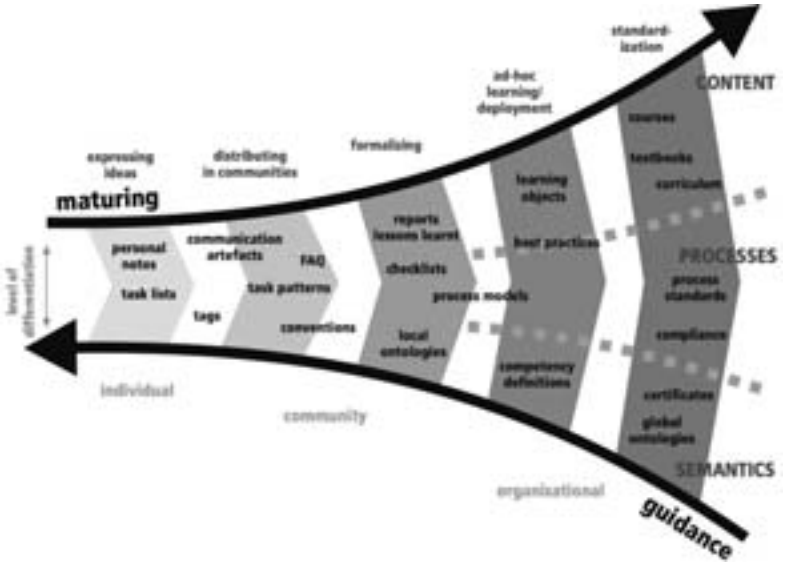

Figure 1: The Knowledge Maturing Process (Source: [SHL+08])

returns the corresponding process graph created with DOT.
After introducing the semantic relation required for describing processes in SMW, we discuss parameters used in the semantic query.

3.1 Process Properties

The process extension supports most of the *Basic Control-Flow Patterns* introduced in [RvdAM06]. In our approach every single process step (activity) is represented as a wiki page belonging to categories *Process* and the corresponding process name.
To express the sequence of the process, we use special predefined process properties. If an activity has one successor (sequence pattern) or more successors executed in parallel (parallel-split pattern), the property `has Successor` is used. An activity can have several successors, but only one has to be selected and executed (multi-choice pattern). Therefore we use the property `has OrSuccessor`. To express conditions (exclusive-choice pattern), the properties `has Condition`, `has ConTrueSuccessor` and `has ConFalseSuccessor` are used. At the moment, there is no distinction between the synchronization pattern and the simple-merge pattern.

- `has Successor`: This property links to a standard proximate activity. If there exists more than one successor activity, a conjunction is displayed in the graph.
- `has OrSuccessor`: If several successor activities exist, this property is used to link to them. A disjunction is displayed in the graph.
- `has Condition`: This property declares the condition that is used for selecting

the successor activity. The condition must be answerable with true or false and can only be used with properties *has ConTrueSuccessor* and *has ConFalseSuccessor*.

- `has ConTrueSuccessor`: This property links to the successor activity which should be executed if the condition is true. In the graph, the edge to this activity is labeled with *true*.
- `has ConFalseSuccessor`: This property links to the successor activity which should be executed, if the condition is false. In the graph, the edge to this activity is labeled with *false*.

In addition to these properties which control the sequence of the processes, it is essential that other properties are introduced which describe the activities in detail. In our first version, we have implemented `has Role` and `uses Resource`. These activity description properties can be extended by the users themselves.

- `has Role`: This property links to the corresponding role, which is responsible for the activity. In the graph the role is displayed in red and is assigned to the activity. It can be switched off, so it is not shown in the graph.
- `uses Resource`: This property links to the corresponding resources, which is used in the activity. In the graph the resource is displayed as a blue folder and is assigned to the activity. It can be switched off, so it is not shown in the graph.

To display process activity properties in a clearer way on the corresponding wiki page, we suggest to use a process wiki template[2]. In this template, an additional property *belongs to process* is used to specify the corresponding process and to set the page category which is the differentiator in the semantic query.

3.2 Semantic Query

With the deployment of this process extension, the SMW is enhanced with a new query format *process*. A query format in SMW allows to define the formatting of the results of a query. SMW already allows for a number of different query formats, like tables, timelines, or maps, from which the query author can choose from. The semantic query retrieves all properties presented in section 3.1 and can be controlled by additional parameters to switch off displaying of description properties.

- `showroles`: If this parameter is set to *yes*, the assigned roles will be displayed in the graph.
- `showresources`: If this parameter is set to *yes*, the assigned resources will be displayed in the graph.

[2] `http://www.mediawiki.org/wiki/Help:Templates`

Figure 2: Example process graph in the wiki

An example semantic process query which can create the graph in Figure 2, can look like this:

```
{{#ask: [[Category:Process]] [[Category:{{PAGENAME}}]]
| ?has OrSuccessor=hasorsuccessor
| ?has Successor=hassuccessor
| ?has ConTrueSuccessor=hascontruesuccessor
| ?has ConFalseSuccessor=hasconfalsesuccessor
| ?has Condition=hascondition | ?has Role=hasrole
| ?uses Resource=usesresource | format=process
| graphvalidation=no | showroles=yes | showresources=yes
}}
```

It is also possible to do some process validation by using parameter *graphvalidation*. If this parameter is set to *yes*, every node which does not have a *has Role* property, will be displayed red in the graph.

4 Use Cases

4.1 University

The development of the SMW-extension for collaborative process definition and refinement was driven by shortcomings observed in the group wiki of the institute AIFB at the

University of Karlsruhe. The wiki has been used by approximately 30 people to manage descriptions of how to organize certain organizational processes such as supervising student theses, setting up infrastructure for new colleagues, etc. Since basically each of these processes has been described on a single wiki page using simple plain text, over time several serious problems occurred that led to bad acceptance by the employees. These problems included: (*i*) Inconsistent descriptions due to incomplete updates by users; (*ii*) the plain text descriptions of processes tend to be very unstructured; (*iii*) pages of process descriptions are hard to find when needed which led to many inconsistent duplicates.

In order to address these problems, the need for an extension to support more sophisticated process documentation became evident and has been introduced in August 2008. Since then, 15 of the more complex organizational processes described in the wiki have been redefined by AIFB employees using the presented process extension. This involved creation of a separate wiki page for each process activity and a query on the main page that graphically displays the entire process. Up to now, each of the contained process steps has been improved four times in average. As a result of introducing the extension, a clearer process structure is provided by the graphical representation, automated updates of the process descriptions increased consistency, the use of metadata improved the search mechanism and consequently increased reusability of the process descriptions.

4.2 Research Center

A further application field was the research center for information technologies in Karlsruhe (FZI). At that point in time, the research department Information Process Engineering (IPE), which consists of more than 40 employees, had already implemented a Semantic MediaWiki for internal knowledge management tasks. The main concern was about supporting the following two processes: First, the employment process and second, the familiarization and training process for new employees. The processes were already modeled in the past, but experience showed that they were not lived due to not being integrated in routine tasks and underlying technical infrastructure.
Based on that experience, the basic idea was to start with a centrally designed initial process structure comprising the major activities (here: wiki pages) and sequence for both processes, the definition and assignment of role descriptions (using the property: `has Role`) and finally the assignment of roles with employees wiki-user pages (also by using the property `has Role`). Based on that initial seeding step, we continued with a decentralized extension of activities (e.g., the detailed description and linking with further relevant internal and external pages) by all involved participants of a particular process. Furthermore, relevant documents were linked to a process activity by using the property `uses Resource`.
Inline queries are used to provide automatically generated role descriptions. In this context, activities, corresponding process(es) activities and responsibilities are produced in table form. Moreover, a special wiki page has been generated for the purpose of helping new employees in becoming acquainted with organizational stuff (e.g., periodical meetings or technical infrastructure). This has been realized by allocating the role `New Employee`. The role can be used for personally greeting new employees at the top of the page and

providing them with help in order to understand activities or concrete next tasks, like, e.g., setting up a personal wiki page or configuring the email client.
Finally, it is planned to, at least, provide minimal workflow support. This can, e.g., be realized by instantiating the property `has Activity` in order to connect a new employee with a particular process activity. Using an SMW extension, such a property instantiation can be automatically changed to the subsequent process activity, when a responsible role (i.e. person) has confirmed the successful accomplishment of a process activity. Based on that, responsible employees can, e.g., automatically be informed about necessary tasks at the right time. Process monitoring (e.g., identifying the current process status) can also be realized by simply querying for the process activity, a new employee is assigned to.

5 Related Work

By far the most well-known and widespread methods and tools for acquiring business-process knowledge are based on the idea of centrally planned, managed, and run, interview- and workshop-based sessions between process modellers or consultants on one hand and process-knowledge owners on the other hand. In this spirit, an abundance of modelling methods and tools has been developed, like BPMS [KJS96], ARIS [SJ02], IDEF3 [MMP+95], or CommonKADS [SAA+99]. Such methods are especially useful and appropriate for highly repetitive, high-volume, so-called production workflows or administrative workflows[3] where a central process definition can be created and optimized, and then serve as a normative, pre-scriptive model for process enactors, and as the basis for standardization and automation.

The modelling of such production / administrative workflows is not necessarily the most important point of application for our approach, as a top-down, centralized analysis and optimization approach may for them be feasible and useful. Nevertheless, even in this case, we see three potential advantages:

- our knowledge maturation process which starts de-centrally with lightweight technology and lightweight user involvement may be more "seductive" for end users to bring in their process knowledge into the seeding phase in a simple and effortless manner—compared to formal, time-consuming, interviews or workshops;
- the ongoing, collaborative process-knowledge evolution, may be a very simple, yet powerful, instrument to keep up-to-date the process documentation with respect to changes in real-world process enactment—without having to repeat process analysis efforts again and again; practical experience shows that the organizational benefits of business-process re-engineering are often very limited because a single, "one-shot" BPM/BPR project cannot keep pace with the speed of the changes in the organizational work procedures;
- the low-barrier wiki approach may also be a very suitable means for collecting more and better continuous improvement suggestions—currently, the systematic collec-

[3] See http://www.chips.navy.mil/archives/00_oct/workflow.html

tion of lessons learned in business processes and their analysis for continuous process improvement is hardly done—or it is realized in expensive additional software and organizational overhead [DANT01].

However, in order to have clearer insights on this, more long-term field studies are required with our approach.

More interesting for our approach may be the more knowledge-intensive processes, typically realized through weakly-structured workflows [SAMS01]. Like for the strongly-structured processes mentioned above, also here manifold modelling methods and tools have been devised, for instance PROMOTE [WK05], GPO-WM [Hei05], DECOR [Abe04], or KMDL [GMK05]. These approaches extend process modelling by means for describing knowledge-related process perspectives (e.g., knowledge required to enact an activity, or knowledge flows between activities), by means for integrating knowledge-management oriented activities or sub-processes (like information retrieval activities or editorial sub-processes for lessons-learned documentation), or even by means for fine-grained description of knowledge-creation, knowledge-retrieval, or knowledge-transfer activities. They also use knowledge-oriented process analysis for designing organizational knowledge infrastructures [ST05].

However, although some of these approaches significantly extend the process-modelling paradigm, they nevertheless stick to top-down, interview-based, ”one-shot” process-knowledge acquisition and ”traditional”, centralized modelling tools used by the KM consultant. So, neither the decentralized collection of process knowledge nor its wiki-based evolution with lightweight technologies is foreseen in these scenarios—although many modelling tools create Intranet representations of process models linked to other information resources (e.g., [HB06]).

There is one further thread of work, stemming from the analysis of ad-hoc processes for knowledge-intensive tasks, which led to the idea of personal task-knowledge management which can be evolved into reusable and shareable task patterns [vEAB+03, RRMvdA05, OGR07]. The idea of individually created, but later shared task patterns conceptually fits well with our wiki-based approach; however, the task-pattern approach is technologically and conceptually much more sophisticated—which may mean more powerful, or may mean more unrealistic; the combination of both ideas may be subject to future work.

Altogether, the consequent exploitation of wiki technology as well as wiki philosophy turns out to be our approach’s ”unique selling proposition”—although there are first attempts to investigate the combination of social software and business process modelling and management, there is still not much work done in this area: see, for instance the workshop [NS08]: here, the only contribution with some relation to our work is [KSR08] which proposes to support a process modeller by exploiting collective knowledge in the form of a model library and the automated recommendation of known model parts for a specific modelling goal.

6 Conclusion and Future Work

In this paper, we addressed the problem of business process modelling by introducing a collaborative approach using SMW. In order to enable visualization of processes, we extended SMW with a new query-printer format using the graph-visualization application *DOT*. In detail, the implemented method supports the process designers in developing and formalizing business processes, including knowledge-intensive processes in enterprises, by giving the opportunity to connect by semantic annotations wiki pages with activity knowledge to process chains. The advantages of this approach are a high process flexibility, the integration in existing and already used infrastructure, and thus the immediate usability for the users without spending too much effort, because existing wiki pages, like how-to's or work descriptions, as well as information about users from user pages, can be reused. Furthermore, decentral creation and extension of processes is possible. In addition to that, standard wiki features can be used, like versioning, watchlist, reverting etc.
In the future we will perform a further validation of our approach by collaboratively constructing additional business and knowledge processes. Furthermore, we are interested in evaluating our methodology by, e.g., examining the number of process activity modifications subject to a specific time period (vitality of changes). Moreover, it is planned to technically realize at least minimal workflow support. This can, e.g., be done by providing technical means for marking and identifying activities as completed. This information can then be used for switching from one activity to its successor and informing the associated role about current tasks to be done. Another option could be to provide an import/export interface or remote access to process models. Besides achieving the possibility of standardized process interchange, workflow support could based on that be outsourced to external workflow management systems. In addition, several monitoring features are planned in order to identify the current process status or even check the consistency and operability of collaboratively modeled processes.

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