Social Software for Coordination of Collaborative Process Activities

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Abstract. Recently, a trend toward collaborative, on-line business process modeling can be observed that is also emphasized by several initiatives. Social software has the potential satisfying such a collaborative modeling. It provides tools to collaboratively exchange and share information resources among peers. Despite of the potential that social software has, it is insufficiently used as work resource (e.g., for help requests or partner search) due to a low integration of social software into the workflow management system. The aim of this paper is to exploit Wikis and social networks for the coordination of collaborative process activities. Wikis are suggested in order to reduce the model design phase. A technique will be introduced that allows visualizing a process model from Wiki pages. The connection of process activities with social networks supports browsing for suitable process collaborators. A coordination model will be introduced that governs the collaboration.

1 Introduction

Social software is still gaining high popularity and has attracted a significant amount of users. Social software has been differently exploited and identified as suitable, e.g. for knowledge management [1] and recommender systems [2].

Activities that may highly benefit of further exploitation of social software are business process modeling and process coordination. In particular, a Wiki can accelerate the model design phase. A Wiki stores how-tos and best practices (activities of users for a special task). Consequently, the evaluation of the as-is state (and finally the process model creation) can be facilitated when analyzing Wiki pages. Social networks might help to find appropriate partners and collaborators, respectively. Process activities (e.g., booking, notifying) requiring at least two peers can be performed when browsing user profiles (skills, experiences) in social networks and getting in contact with the appropriate persons.

However, the usage of social software within business process activities also requires coordination mechanisms. Wiki pages that serve as input for the visualization of process models need to be consistently updated (in case of insertion of new process activities). Cooperatively performed activities (with the support of social networks) need to be supervised and managed. In case of missing coordination support, it is left to the user to perform the corresponding tasks.

In this paper we exploit a Wiki and social networks for the coordination of cooperatively performed activities. The information stored in Wikis and social networks is used to find appropriate collaborators (from internal and external organizations). Changes made in the process model (e.g., insertion of an activity) will be communicated to the Wiki implicating an update of corresponding pages. The approach presented in this paper has the following advantages:

- available best practices are reused facilitating process model creation,
- synchronization between Wikis and the process model facilitates modifications and reduces redundancies,
- parallel existence of textual (Wiki) and graphical (process model) content representation enables users to select the favored style. Validation techniques (for process models) can be used to investigate the reachability of activities,
- controlled coordination of collaborative process activities.

Given this background the remainder of the paper is structured as follows. The following section illustrates our approach and summarizes background we will work upon. In particular the generation of process models from Wiki pages is explained and a model for coordinating process activities based on social networks. Section 3 describes the continuous modeling and coordination of collaborative processes based on social networks and case-based reasoning and the synchronization of the process model with the Wiki. Our approach is applied to a use case in Section 4. Section 5 discusses related work. Eventually, Section 6 concludes the paper and gives an outlook on future research.

2 Coordination of Processes using Social Software

The next subsection presents a scenario for our approach and motivates the need for coordination mechanism. Subsection 2.2 sketches the foundations of our approach.

2.1 Scenario

Assume somebody has an innovative idea for a third-party founded project and intends to write a project proposal to get fundings (e.g., from the EU). Since he has never written a project proposal before, he has to get familiar with the existing processes and regulations in his department concerning project proposals. Research departments widely use Wiki pages to describe the corresponding processes and best practice approaches. Initially, the researcher invokes the proposal writing page and also remembers colleagues talking about EU projects and project partners. On the Wiki page he finds a set of hints for writing project proposals but no information how to initiate a collaboration. The researcher has specific research departments and companies in mind working in different areas that are relevant for his proposal idea. He looks in his contact lists and finds the address of a person working for one of the companies he has in mind. He contacts her and both agree on writing a proposal. She works for a company, which has their own regulations about collaboration, which means that a non-disclosure agreement (NDA) has to be signed. The process of signing an NDA is new to the researcher and he has not found any note about this on the Wiki pages. Thus, he decides to make a note about this. After the proposal has been accepted for the hearings, the researcher has to organize the trip to attend the hearings. This process is explained on a Wiki page again. The researcher has to contact the travel agency in order to book train and flight tickets. Finally, he has to book a hotel room. If he is aware of other future project partners that will attend the hearing, he might arrange the hotel booking with additional persons.

This use case requires coordination effort. Wiki pages need to be updated, third-party organizations need to be contacted, collaboration needs to be arranged and managed. In case of no integrated coordination tool support, it is left to the researcher to perform the corresponding tasks and to solely coordinate the activities.

2.2 Background

The approach presented in this paper builds on Semantic MediaWiki (SMW) providing process modeling and visualization functionalities [3]. Additionally, our approach uses a model for the coordination of collaborative process activities.

The SMW allows users to express their knowledge with their natural language combined with formal annotations allowing machines to process and export this knowledge using RDF. Users can connect Wiki pages by using semantic annotations and thus defining associations between pages. In the process visualization a Wiki page is represented by an activity. The flow between activities is built based on semantic annotations and using special predefined process properties[1]. The advantages of using SMW for process development are:

- *Collaboration*: All users have access to the corporate Wiki and thus everybody can contribute in process development and browse existing processes.
- *Versioning*: SMW provides the history of all edits. Old versions can be viewed and compared as well as changes can be undone.
- *Reuse of Process Knowledge*: SMW can be used as a process knowledge repository. The stored knowledge can be reused in other Wiki pages using queries or by other applications using RDF export.

Figure 1 visualizes our scenario and shows where SMW is used in the scenario. SMW describes best practices of an organization (how to write a proposal, how to get in contact) and serves as input for visualization of the process as-is state. In our approach we take the formalized processes in RDF, transform them into simple Petri Nets and use them in a process execution engine. Users can modify either Wiki pages or the process model. The coordination of updates will be explained in Section 3.2.

After the generation of a process model based on SMW, coordination mechanisms are needed to ensure the execution of separate activities, which may be performed by different users in different collaboration contexts. Koschmider et

[1] For further information we refer to [3].

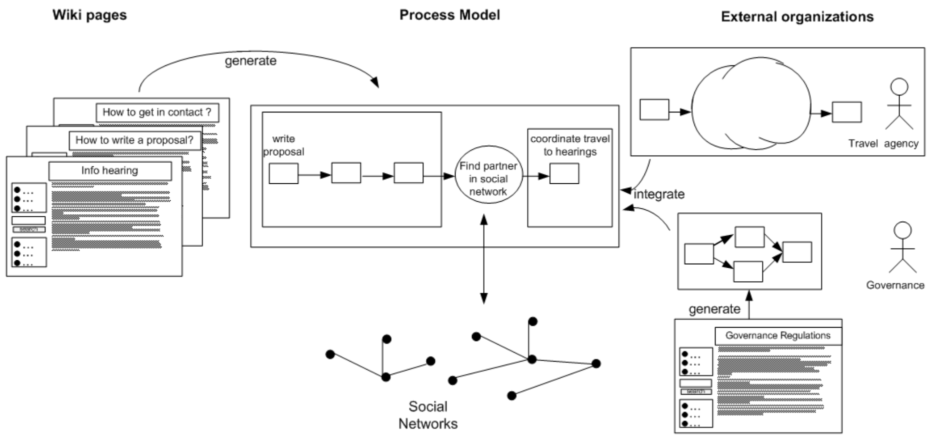

Fig. 1. Proposed approach

al. [4] have suggested a model called *Community Process* for the coordination of collaborations in social networks. The Community Process is a set of related activities of network members that are executed to achieve a collaboration output. The concept of Community Process considers different development stages of social networks (*finding partners*, *building relationships*, *executing collaboration*) and uses results of the analysis of interpersonal relationships, so that the activities and human resources can be more easily and purposefully applied for the initiation and execution of a collaboration. It is a user-driven approach and provides flexibility and extensibility in collaborative modeling due to the adoption of lazy and late modeling [5]. The modeling notation of Community Processes is derived from Petri Nets. Figure 2 shows an example of a simple Community Process model related to the scenario in Section 2 that involves two collaborators (Name1 and Name2).

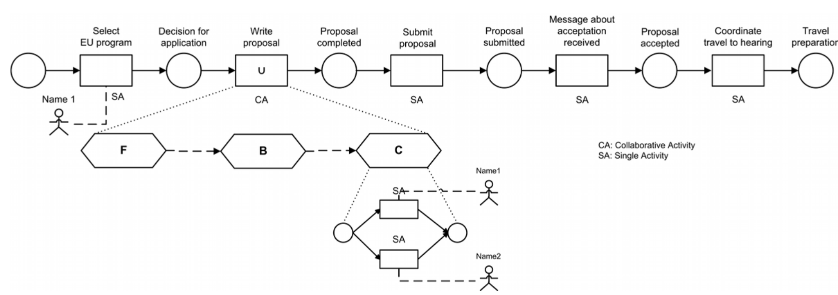

Fig. 2. An example of a simple Community Process - Writing an EU proposal.

The special feature of a Community Process model is the labeling of activities with “U”. Such a labeling represents collaborative behavior that is performed by a sequence of abstract sub-processes *Finding Partners (F)*, *Building Relationship*

(B) and *Collaboration Execution (C)*. The first two sub-processes (F and B) focus on the preparation of a collaboration, while the third sub-process (C) refers to the actual execution of assigned tasks. A Community Process is associated with a set of Community Process Objects that include e.g., Community Users (which describe network members through their user profiles) and Community Contents (that are data objects transferred from one activity to another). Based on user relationships (e.g. obtained through analyzing outgoing Emails or Chats [6]), that are stored and continuously updated in Community Users, social network structure can be created. Upon this structure, analysis methods can be applied to recommend collaborators in one's personal network while executing the sub-process F, or to suggest how to contact potential collaborators in sub-process B. Referring to our scenario, label "U" can be put on the transition *write proposal* in Figure 1, which triggers the Community Process.

3 Coordination of Business Processes

Although the Community Process approach supports an effective utilization of personal resources in social networks, it remains unsolved how resources such as processes or services of conventional business information systems can be integrated into Community Processes. For this reason an extension based on case-based reasoning (CBR) [7] will be suggested and described in the next section. Some ideas how to use CBR in process management can be found in [8, 9]. The goal of the integration is to ease an uninterrupted execution of activities in and outside social networks, for example, tickets booking by travel agency and signing an NDA in a company. On the opposite side, a Community Process can also be integrated into business processes to enable self-organized collaborations using social networks, which will be elaborated in a separate paper.

3.1 Integration of Business Processes into Community Process using CBR

In this section, we describe a CBR-solution for integration of business processes (internal and external) into Community Processes in detail. This rises some challenges. Firstly, it is difficult to identify and select the most appropriate process or service from several providers whose functional and non-functional properties match users' requirements. Secondly, the Community Process may change in case that it is performed each time with different external resources. Thus, a flexible and not fixed connection between a Community Process and a business process or service is desirable.

The goal of using CBR is reuse (sharing) of user experiences obtained during the interaction with business processes of external organizations. Without deep modeling or technical knowledge users will be guided by a reasoning system to easily choose a support provider (just at the moment when they request one). After the execution of a Community Process, including the integrated business processes, the user experiences will be stored as a new or in an existing case. The process owner can finally decide whether the case details should be reconverted to Wiki pages or not, which would be seen as a best practice by other users.

In our approach we treat a business process as a case that will be completely executed to fulfill a support request without revealing process details such as process logic. Each instance of the case has an owner who acts as support responder (provider). A solution to a case (business process) consists of the following three components: (I) description of the support provider. (II) communication details (e.g., contact methods) with the support provider and (III) interface for using the case, such as input and output parameters. Case solutions will be integrated into Community Processes to specify and implement *Collaborative Activities*. In other words, a collaboration behavior between a peer and a business support provider, which also requires the integration of process data, will be recognized and handled in the Community Process.

In this paper we focus on business processes of external organizations (e.g., see Figure 1), which may deliver services to individual peers, so that firstly the subject domains of the cases are restricted. Knowledge of these domains can then be collected and stored in the case database to enable better understanding of the cases. A possible decomposition of business process cases based on the approach of [10] is shown in Figure 3. There are five main subject domains, which relate to different business areas from the tertiary industrial sector and three main subject sub-domains that relate to different function areas.

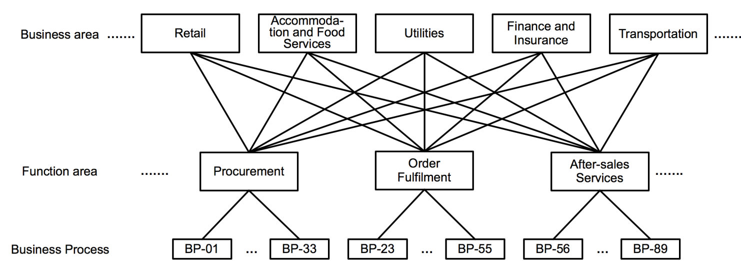

Fig. 3. Subject domains of cases

Within a domain a case can further be refined using, for example, a dynamic memory model [11] or category and exemplar model [12]. For case retrieval, we introduce here our own method, which considers existing information of social relationships of users (e.g., stored in Community Users) in social software systems (Wikis and social networks). We call this method *Network-based Two-way Case Retrieval*. It is two-way in the sense that it supports retrieval both in the network-of-person (i.e. social network structure) and network-of-data (as shown in Figure 3). The method works as follows: Firstly, we define a *personal similarity (PS)* as a concept whereby each node in a network-of-person is assigned a degree as a positive integer based on the number of nodes between the user and his relationships. A *data similarity (DS)* is either a syntactical or a semantic similarity in the network-of-data that is mentioned in [7]. To select the right way for case retrieval, the following decision models can be used.

1. *Match(DS)*: Cases will be returned whose data similarity compared to a new case indicates a significant threshold.

2. *Match(PS)*: Cases used by users in a social network will be listed for selection whose personal similarity to the owner of Community Process have a specific threshold and then matched with the new case by using the first model Match(DS).

The main advantage of this two-way method is that the accuracy of system reasoning can be increased because personal similarity is considered in the case of low data similarity.

Case reuse means in our context that a Collaborative Activity will be refined including the sub-processes *Finding Partners (F)*, *Building Relationship (B)* and *Collaboration Execution (C)*, which will be automatically constructed based on a case solution. The output of the F-sub-process is generated according to Component (I); The B- and C-sub-processes can be built according to Component (II) and (III), respectively.

Case revision will be applied during runtime of a Community Process. If errors occur (e.g., an external service is no more available) a repair process will be triggered that provides necessary general and case-specific knowledge for compensation purpose, such as modifying process details, suggesting other cases and adjusting conditions and constrains on the Collaborative Activity that are given by other process activities.

After the completion of a Community Process, according to the modified process details either a new solution will be generated or existing solutions will be updated in case database. These new solutions can consequently be reused and integrated into other Community Processes.

3.2 Wiki Update Methods

In addition to the reuse of process execution data we also propose to update the process information in the Wiki, because the acceptance of a Wiki depends on the degree to which a person can truly benefit personally from it. Therefore it is important that a certain quantity and quality of content is available in the Wiki [13] and we want to guarantee this by updating the Wiki with executed process information. Updating and storing each case in the Wiki will result in an information overload and make it hard for the users to find the information relevant for their case. Therefore smart update mechanisms have to be applied that only the common relevant information is updated in the Wiki. In a Wiki update process different commands can be executed: New pages can be created, if new process activities are required, information on existing pages can be inserted or deleted and pages can be deleted, if the process activity is no longer required. The Wiki can be updated in different ways. On the one hand a *semi-automated update* can be performed by giving the user a list of the process activities from the process execution engine and let him choose what should be written into the Wiki. On the other hand an *automated* update can be performed by writing information directly into the Wiki applying the following update rules.

- *Counting repetitions*: A simple filter for updating process information is counting the same instances executed by the users. When a specific threshold is achieved, the process has reached a mature level and will be updated in the Wiki.

– *Abstracting similar cases*: Similar cases can be derived and abstracted. Therefore approaches to process mining like producing a taxonomy of workflow models [14] providing an abstraction method and taxonomy of patterns [15] can be used. Then the abstracted patterns can be updated in the Wiki.
– *Skill level*: Users have different levels of skills. If a user with a high skill level has executed the process, the Wiki will be updated with this new process instance.

4 Use Case

In this section our approach is applied to the scenario described in Section 2. A *Proposal Writing* process can be displayed in a Wiki as illustrated in Figure 4. This approach of collaborative process development using SMW including import and export of process activities into/from SMW has been validated and used within the ACTIVE project[2]. One of the findings was that people more likely reuse and refine processes instead of model them from scratch in the Wiki.

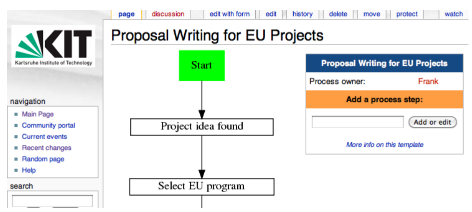

Fig. 4. EU Proposal Writing process in SMW

The process skeleton from the Wiki is exported to the process execution engine by transforming RDF format into Petri Nets (as explained in Section 2.2) and is further refined during runtime. During runtime, the users will be guided to fulfill a collaboration starting with the activation of a Collaborative Activity (through labeling with "U"). Subsequently, the abstract sub-processes *Finding Partners*, *Building Relationship* and *Collaboration Execution* will be created and concretized. In the sub-process *Finding Partners*, search criteria muss be defined, such as place of work, working area, interests, skills and experience. Additional search criteria, such as available time in calendar, total number of publications related to a certain topic, may also be included. The defined search criteria will be sent to one or more social networks in order to retrieve a list of suitable collaborators. A keyword retrieval based on user profiles (stored in Community Users) that also considers social relationships (by calculating the centrality[3], indegree/outdegree[4] and transitivity[5] of the network members [16] according

[2] This work has been funded as part of the IST-2007-215040 EU project ACTIVE (`http://active-project.eu/`).
[3] A network member has a lot of relationships to other network members.
[4] Number of incoming/outgoing connections in the role of requester and responder.
[5] Two network members A and C who are both connected to network member B can be considered as directly connected in a transitive network.

to a logged set of their related actions, such as write, tag and comment, in social networks) may provide a more precise rating. Because of the different data structures in the process and social networks, adapters have to be implemented to mediate the data transfers.

If contact persons or collaborators have been selected from the result list at the end of the sub-process *Finding Partners*, the process continues to highlight the owner of the process and allows him to communicate with these persons in the social networks. A formal collaboration agreement will be prepared by system or the process owner himself, which will be again sent to the selected persons who are able to view and modify the agreement in social networks. While communicating with each other, the communication details among the collaborators, such as communication duration, frequency and media will be collected and then analyzed using Social Network Analysis [16]. According to the analysis results, suggestions can be made to foster the communication or reduce the communication overhead.

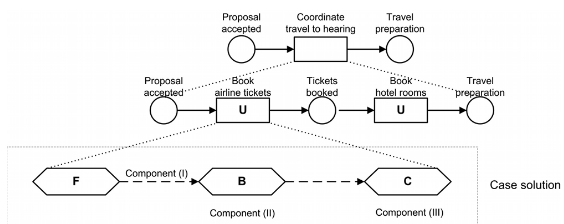

Fig. 5. Process of travel coordination.

The communication cycles end as soon as the collaboration agreement is accepted by all participants, implying the end of the sub-process *Building Relationship*. The process continues allowing a coordinated collaboration execution in the sub-process *Collaboration Execution*. Tasks will be assigned to the network members according to the agreement and each member can refine/coordinate his own activities/processes in private. In the case of integration of a business process of external organizations, such as booking airline tickets at a travel agency or signing an NDA, the CBR methods, as described in Section 3.1, will be used. Figure 5 shows for example the refinement of the *Coordinate travel to hearing* activity in Figure 2 and the components related to the solution of a retrieved case. A case revision would possibly take place if the users want to additionally book train tickets besides airline tickets at the same travel agency. From this use case we can see, that our approach takes advantages of a structured process for coordination of collaboration. Consequently, an unstructured communication is improved using social networks.

The update rules presented in Subsection 3.2 are applied to the changes made during runtime. Activities such as *booking airline tickets at a travel agency* having a high repetition are added to the Wiki.

5 Related Work

The work presented in this paper is related to the following streams (1) collaborative processes, (2) business process coordination and (3) social software for BPM. The idea of coordination support for organizational work is not new and has been early covered by action workflows [17]. The integration of social networks and Wiki with business processes allows reusing best cases and social relationships that are frequently updated. Our coordination mechanism is used only for selected information and is more flexible than works about action workflows.

Coordination can be performed with human interaction [18] or automatically. Workflow Management systems are suitable for an automatic controlled execution and coordination of tasks [19, 20, 21]. Prior to coordination the preferred work practice needs to be selected. The selection can be implemented based on process models [22] and using expert recommendations [23]. The consideration of knowledge and experiences makes our approach more flexible.

Collaborative works have been early tackled by cross-platforms such as BSCW [24] or groupware [25]. The collaboration can be modeled using several process modeling languages such as BPMN, BPEL and Petri Nets for which concrete implementations for collaborative work exist [26, 27]. The advantage of a model is its verification supporting to diagnose incompatibilities in cooperation [28]. Activities in a collaboration are not fully intended for public, therefore privacy preserving coordination was proposed [29]. Aside this, collaboration needs to tackle adequate version control [30] and access control [31]. Our approach combines advantages of conceptual models (e.g., verification) and collaborative working (tackled by BSCW).

Social software has addressed BPM to a different extend. Most approaches discuss the appropriateness of social software in BPM systems for the design and execution phase [32, 33, 34, 35]. Vendors of BPM tools have also identified the trend of social software and offer social software features in their tool suite (http://www.arisalign.com/, http://www.horus.biz/). Our approach additionally shows updates of social software resulting from process model modifications.

6 Conclusion

In this paper we presented an approach to create process models and to coordinate collaborative process activities. We described how to store process models stored in a semantic Wiki and transform them into simple Petri Nets that can be used in a process execution engine. During runtime this process activities can be coordinated and refined by using social networks and CBR. Changes made in the process model are communicated to the Wiki. One advantage of our approach is that process knowledge is acquired collaboratively in the Wiki or during runtime and made explicit. By using the presented approach available information is reused and synchronized between Wikis and the process model. Less experienced users are more effective in executing the process. The parallel existence of textual (Wiki) and graphical (process model) content representation enables users to select the favored style. In the future we plan to develop a prototype supporting our approach and evaluate it in different case studies.

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