PROCESS-ORIENTED COORDINATION OF COLLABORATIONS IN SOCIAL NETWORKS

Agnes Koschmider, Andreas Oberweis and Huayu Zhang
Institute of Applied Informatics and Formal Description Methods (AIFB), Karlsruhe Institute of Technology (KIT)
Kaiserstrasse 89, 76133 Karlsruhe, Germany

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Abstract: Social networks are known to stimulate the exchange and sharing of information among peers. Even more social networks can initiate a cooperation (e.g., people sharing music) and a collaboration (e.g., searching for collaborators for research works). However, social networks are not widely used as work resources (e.g., for help or support request) mostly due to missing coordination mechanisms. This paper describes how collaboration can be coordinated in social networks. The proposed way to achieve this is based on the usage of a set of activity lists of social network members. An activity list specifies all personal activities required to reach a collaborative output. Based on the activity lists a process model can be generated that controls and analyzes the coordination. Activities requiring collaboration are performed using social network. The approach is illustrated with a use case.

1 INTRODUCTION

Social networks such as Facebook, MySpace, LinkedIn and XING have attracted millions of users over the past few years. The platforms are mainly used for private purposes such as the initiation and maintenance of personal contacts, but also for business purposes, for example, job placement or marketing.

Although there are functionalities available in social networks for (research) collaboration (e.g., entry of interests), social networks are not widely used as work resources (e.g., for help or support requests). One reason for this is an insufficient coordination support for collaborations. Ineffective communication mechanisms in social networks also hamper the activation of collaboration (e.g., there is no support for analysis of interpersonal relationships). Particularly, there is a lack of coordination of geographically distributed collaboration among different organizations (e.g., writing an EU proposal) where geographical, language or technical barriers exist. Coordination mechanisms can be used to analyze the existing relationships, help to overcome communication barriers regarding the output of collaboration and may efficiently organize collaborative activities.

Let the following scenario be given as shown in Figure 1. Member B1 from the social network on the right hand side intends to write a research paper (preferably with people of complementary knowledge). New in the department, she is not aware of the paper writing process. Assume a source is given that describes the writing process (e.g., a wiki page) or the user specifies by herself the activities required to write the paper. Based on this source, respectively activity list, a process model is generated including her own activities. Some of these activities might require collaborators who can be found in social networks, for example, the collaborators A3 and B9. Subsequently, the initial process model of B1 can be extended with activities of these two collaborators.

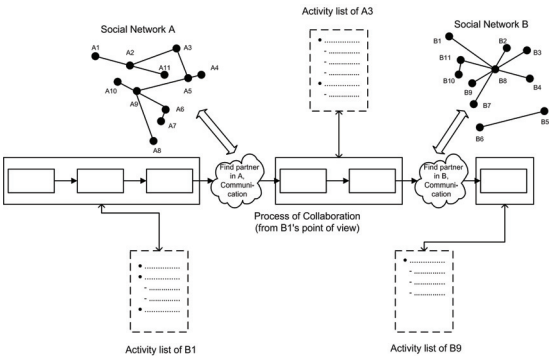

Figure 1: Coordinating the paper writing process.

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This paper describes a model for the coordination of collaborations in social networks. Particularly, the focus lies on geographically distributed collaborations, which are difficult to handle. The approach presented in this paper can be used to enhance existing social networks supporting the coordination of (research) collaborations.

The paper is structured as follows. Section 2 describes the properties of geographically distributed research collaborations in social networks and the activities to be coordinated. Section 3 provides a process-oriented approach to coordinate such collaborations. The modeling process is explained in Section 4. The approach is illustrated with a use case in Section 5. Related work is discussed in Section 6. The paper concludes with a summary and an outlook on future research in Section 7.

2 RESEARCH COLLABORATION IN SOCIAL NETWORKS

2.1 Fundamentals of Social Networks

A social network is a network whose nodes are social actors (individuals or groups) and whose edges represent the relationships of actors to each other (Barnes, 1972). This paper will refer to research collaborations in online social networks where social actors (network members) are research groups, scientists, technical staff, doctoral or postdoctoral researchers. Each edge is weighted with a positive value, which indicates the frequency of communication between two network members. Collaboration starts in a social network as soon as the first two stages of network development (Potential and Coalescing, see Figure 2) are completed. After reaching the end of the third stage (Active) the network members stay only occasionally in contact. Figure 2 also provides an overview about the activities of each stage, to which we will refer in the following sections.

2.2 Properties of Geographically Distributed Research Collaborations

A collaboration can be described with the following four properties (Schramm-Klein, 2005): *direction of collaboration* (vertical, horizontal, lateral), *number of partners* (bilateral, multilateral), *formalization of collaboration* ("strong ties", "weak ties") and *binding intensity* (formal, informal collaboration). In addition to these properties, a research collaboration can be characterized by the *type of collaboration*:

- Reading and writing: The collaboration artefact is a result of a knowledge creation process, such as a model, a project proposal or program code.
- Organizational: The collaboration artefact is a result of an organizational process, such as a joint workshop or a business trip.

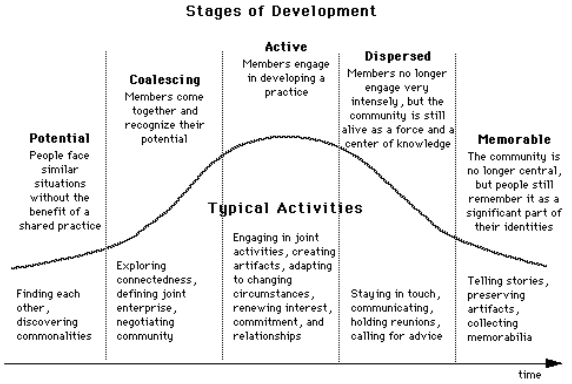


Figure 2: Stages of social network development (Wenger, 1998).

In this paper a geographically distributed research collaboration in social networks is considered as a not by contract regulated teamwork performed on the two types of collaboration. We assume that two or more network members are involved in the collaboration, who have weak relationships with each other. These network members have either the same or complementary research interests.

To support a collaboration according to the social network development, different activities in the first three development stages should be coordinated with respect to the above-mentioned properties. Table 1 summarizes the corresponding activities.

Table 1: Summary of activities and collaboration properties for each development stage.

Stage	Activity to be carried out	Property
Potential	Finding partners	horizontal vertical bilateral multilateral
Coalescing	Building relationship (establishment of contacts and communication), specifying collaboration outputs	bilateral multilateral informal „weak ties“
Active	Executing collaboration (e.g. writing a publication, joint assessment of a proposal, development of a prototype and organisation of a joint workshop)	bilateral multilateral informal „weak ties“ reading and writing organizational

3 MODEL FOR COORDINATION OF COLLABORATION IN SOCIAL NETWORKS

To coordinate a research collaboration in social networks a process-oriented approach has been chosen. The advantage of this approach is a controlled coordination and analysis of the collaboration. In the following we will define a model that includes all activities of social network members in order to reach a collaboration output. The model supports the consultation of a social network in case of a collaboration. The process model that is generated based on the activity list of a social network member is called a “Community Process”.

The *Community Process* (CP) is a set of related activities of network members that are executed to achieve a collaboration output. The activities of a Community Process are either *Single Activities* or *Collaborative Activities*. In a Single Activity only one or no network member is involved. In a Collaborative Activity at least two network members are involved that are connected based on an explicit collaborative relationship. Social networks are used to implement Collaborative Activities, which describe the involvement of network members in social production (Benkler, 2006). The activities are performed sequentially, in parallel, iteratively or alternatively. Each Community Process has exactly one start and one end activity. A Community Process can be decomposed into several sub-processes and has at least one Collaborative Activity that refines a sequential sequence of sub-processes *Finding Partners*, *Building Relationship* and *Collaboration Execution*. Examples of a Community Process are "collaboration in an EU proposal", " collaboration in the organization of a workshop" and "idea generation process". Another example of a Community Process will be discussed in detail in Section 5.

A Community Process is associated with a set of process resources that are designated as *Community Process Objects*. A Community Process Object is either a *Flowing Object* or a *Non-flowing Object*. The Flowing Object includes all information and data that will be transferred from one activity to another so that an activity can be performed. The Non-flowing Object includes those resources that execute the activity.

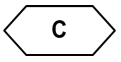
A special Non-flowing Object is *Community User* (CU) that describes exactly one network member through a user profile. A Community User has relationships to other Community Users. From these relationships the network structure can be derived. A user profile contains information about e.g., contact information, knowledge, experience and interests. A friendship and/or a relationship of knowledge may exist between two Community Users.

A type of Flowing Object is *Community Content* (CC) that is a container for a time, place or event-limited context. Examples of Community Content for research collaborations are "publication", "research project application", "workshop" and "conference".

The collaboration will be coordinated by specifying a Community Process of a network member, especially its Collaborative Activities, and assignment of Community Process Objects to the process.

To graphically describe a Community Process, an extension of Petri nets (Reisig, 1986) is used. Petri nets are well known and are well suited for modeling, analyzing and verifying process and data flows. However, additional graphical elements are required to describe human-centric activities especially communication behavior such as the behavior in a Community Process. The graphical symbols of the notation are listed in Table 2.

Table 2: Notation for Community Process modeling.

Symbol	Description	Meaning / Remarks
	place	Temporary storage for Flowing Objects
	transition	Single Activity
	directed arc	Arcs running from a place to a transition or vice versa
U	label	Collaborative relationship; A Collaborative Activity is identified by a label on a transition.
	F-block	Representation of an abstract Finding Partner sub-process
	B-block	Representation of an abstract Building Relationship sub-process
	C-block	Representation of an abstract Collaboration Execution sub-process
	block arc	Block arc runing from F-block to B-block or from B-block to C-block
	connection	Assignment of a Community User to a Single Activity; connections may only exist between unlabeled transitions and members
	member	Representation of a Community User with a name

Besides these graphical extensions, a special refinement rule must be applied to labeled transitions (Collaborative Activities) that is defined as follows. In case of refinement of a labeled transition a se-

quence of F-block, B-block and C-block will be created.

Figure 3 shows an example of a simple Community Process that involves two network members (with Name1 and Name2). Collaboration starts with the Collaborative Activity CA.

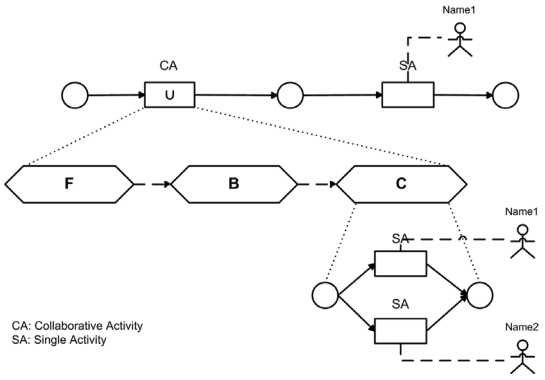


Figure 3: Coordination of a research collaboration using a Community Process.

For the modeling of Community Process Objects UML class diagrams are used here. Figure 4 shows the structure of the Community Process Object.

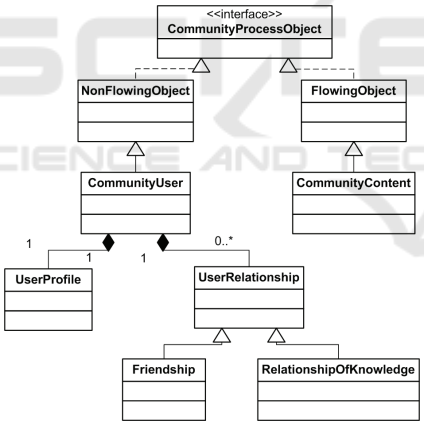


Figure 4: Structure of Community Process Object.

4 THE PROCESS OF MODELING

This section describes the process of modeling a Community Process. The modeling process consists of five steps.

1 First, Community Users have to be obtained from e.g., the analysis of data from "event logs" (van der Aalst and Song, 2004) or e-mails from information and communication systems (Yamakami, 1998). Alternatively, user data from existing social networks such as Facebook or XING can beused. Based on the user's relationships the structure of the network can be represented with a Sociogram given by Social Network Analysis (Wasserman and Faust, 1994). Subsequently, statistical analysis methods of the network structure can be used to determine some important metrics for collaboration such as *centrality* (a network member has a lot of relationships to other network members*)*, *indegree/outdegree* (number of incoming/outgoing connections in the role of requestor and responder) and *transitivity* (two network members who are both connected to a given network member can be considered as directly connected). These metrics are suitable to filter contact persons or collaboration partners.

2 In the next step, all data objects describing Community Content have to be specified such as publication, collaboration agreement and appointment.

3 Generation of the Community Process based on an activity list of a network member starting from the first abstraction level. (Dengler et al., 2009) suggested an approach how to automatically generate a process model based on wiki pages describing activities of an organizational process.

4 Assignment of data objects from Community Content to places and if necessary assignment of Community Users to Single Activities.

5 Refinement of the Community Process using the elements presented in Table 2 and modeling more concretely the abstract Finding Partners, Building Relationship and Collaboration Execution sub-processes.

The modeling steps 4-5, and possibly steps 1 and 2 are to be repeated until all Collaborative Activities are defined and the Community Process is described accurately enough.

5 USE CASE

In this Section, a use case of a Community Process for the coordination of research collaboration will be presented. The corresponding process on "collaboration on writing a scientific paper" can be found in (Klink et al., 2006). Figure 5 shows an example of the network structure after the Community Process Objects have been modeled. Note that this figure shows only some of the edges with weights (communication frequency of peers).

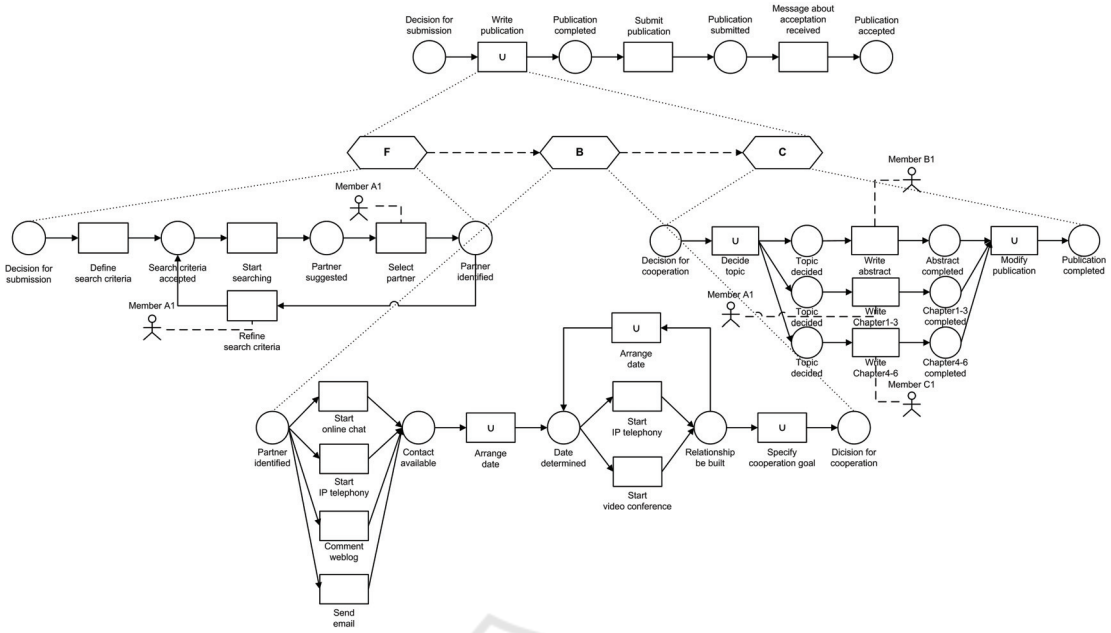


Figure 6: Creation of a Community Process model.

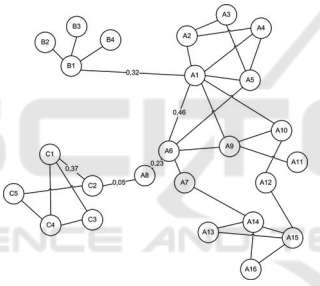


Figure 5: The network structure before the execution of collaboration.

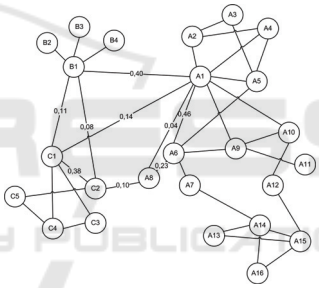


Figure 7: The network structure after the execution of collaboration.

The next step is the generation of the first abstraction level of the Community Process. Subsequently, the modeling steps 4-5, as explained in Section 4, and possibly also steps 1 and 2 must be repeated. A network member can either model the activities by himself or use a modeling support tool (Hornung et al., 2008). The process will be modeled top-down. Figure 6 shows the simplified Community Process.

In the execution period of the Community Process, the communication details among the network members (for example, A1, A6, A8, B1, C1 and C2), such as communication duration, frequency and media will be collected and then analyzed as mentioned in Section 4. Figure 7 shows an example of the network structure at the end of the collaboration. The structure includes some new relationships (e.g., between B1 and C1 and C2) and arcs with increased weights due to collaborative activities.

6 RELATED WORK

Related work can be found in three areas: (1) combination of process modeling with social networks, (2) Computer Supported Cooperative Work (CSCW) and (3) eCollaboration approaches for supporting scientific research.

In (Hornung et al., 2008) a recommendation-based modeling support system for business processes is described. To support the selection of appropriate process models social networks are used (Koschmider et al., 2009). (Khalaf et al., 2009) and (Silva et al., 2009) are not using a recommendation system based on social networks, but use social networks for an active exchange of process patterns. The approaches above could be adapted in the modeling of Community Processes in order to capture target-specific process fragments.

Approaches in the areas of CSCW and eCollaboration focus on the use of information and communication technologies to support collaboration. For example in (Lubich, 1995), a CSCW framework for scientific collaborations in Europe was described. (Harrer et al., 2007) describes an approach in eCollaboration enabling researchers to detect interaction patterns by utilizing logfiles of user actions captured by system. (Luzón, 2009) considers the possibility of using academic weblogs as tools for eCollaboration to enable better communication among researchers. The main innovation of the presented approach, in contrast to the results from CSCW and eCollaboration, is the flexibility and extensibility of the coordination of collaborations in social networks.

7 CONCLUSIONS AND OUTLOOK

This paper proposes a process-oriented model for the coordination of research collaborations in social networks. Other available process-oriented approaches do not take into account the network (relationship) development appropriately, so that the coordination of collaboration cannot take place efficiently.

Coordination on the basis of the network development in combination with Social Network Analysis has the advantage that the activities and human resources can be applied in an easier and more targeted way for the initiation and execution of a collaboration. To organize collaboration the concept of Community Process was introduced, which coordinates both the individual and collaborative activities of network members. The collaboration can be effectively controlled by a network member through a Community Process because the communication behavior with partners and the status of execution are transparent.

Next steps of this work include the formalization of all concepts of the Community Process in order to obtain a system-supported execution of Community Processes. An evaluation will be conducted investigating the system's effectiveness and usability.

REFERENCES

Barnes, J. A., 1972. *Social Networks*, Addison-Wesley Professional Press.

Benkler, Y., 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*, Yale University Press.

Dengler, F. et al., 2009. Collaborative Process Development using Semantic MediaWiki. In *WM'09: 5th International Conference of Professional Knowledge Management.* Köllen Verlag.

Harrer, A., Hever, R., Ziebarth, S., 2007. Empowering researchers to detect interaction patterns in e-collaboration. In *AIED'07 International Conference on Artificial Intelligence in Education.* IOS Press.

Hornung, T. et al., 2008. Recommendation Based Process Modeling Support: Method and User Experience. In *ER'08, 27th International Conference on Conceptual Modeling*. Springer-Verlag.

Khalaf, R. et al., 2009. Enabling Community Participation for Workflows through Extensibility and Sharing. In *BPMS2'09, 2th International Workshop on Business Process Management and Social Software*.

Klink, S. et al., 2006. A Service-oriented Information System for Collaborativ Research and Doctoral Education. In *ICEBE'06, IEEE International Conference on e-Business Engineering*. IEEE Computer Society Press.

Koschmider, A., Song, M., Reijers, H.A., 2009. Advanced Social Features in a Recommendation System for Process Modeling. In *BIS'09, 12th International Conference on Business Information Systems*. Springer-Verlag.

Lubich, H.P., 1995. *Towards a CSCW Framework for Scientific Cooperation in Europe*, Springer-Verlag.

Luzón, M.J., 2009. Academic Weblogs as Tools for E-Collaboration Among Researchers. In: *E-Collaboration: Concepts, Methodologies, Tools, and Applications*, Idea Group Publishing Press.

Reisig, W., 1986: *Petrinetze: Eine Einführung*, Springer-Verlag. Berlin, 2nd edition.

Schramm-Klein, H., 2005. Wettbewerb und Kooperation in regionalen Branchenclustern. In *Kooperationen, Allianzen und Netzwerke: Grundlagen - Ansätze – Perspektiven*, Gabler-Verlag.

Silva, A.R. et al., 2009. AGILIPO: Embedding Social Software Features into Business Process Tools. In *BPMS2'09 2th International Workshop on Business Process Management and Social Software*.

van der Aalst, W., Song, M., 2004. Mining social networks: uncovering interaction patterns in business processes. In *BPM'04, 2th International Conference on Business Process Management*. Springer-Verlag.

Wasserman, S., Faust, K., 1994. *Social Network Analysis: Methods and Applications*, Cambridge University Press.

Wenger, E., 1998. *Communities of practice: learning, meaning and identity*, Cambridge University Press.

Yamakami, T., 1998. Social Process Visualization in Regional Community Network Users. In *APCHI 98, 3th Asia Pacific Conference on Computer Human Interaction*. IEEE Computer Society Press.