

# A Workflow-supported Social Network Model

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**Abstract.** The purpose of this paper<sup>4</sup> is to build a fundamental theory, which is called workflow-supported social network model, for representing workflow-supported social networking knowledge formed through workflow-supported organizational operations. The proposed model can be used not only for discovering workflow-supported social networking knowledge but also for eventually analyzing the discovered knowledge. Consequently, the crucial implication of the proposed model is in quantifying the degree of work-intimacy among performers who are involved in enacting the corresponding workflow procedures.

**Keywords:** workflow-supported social networking knowledge, ICN-based workflow model, social network analysis, knowledge discovery

## 1 Introduction

Recently, the workflow literature just starts being focused on "People" [3]. It starts from the strong belief that social relationships and collaborative behaviors among people who are involved in enacting the specific workflow models affect the overall performance and being crowned with great successes in the real businesses and the working productivity as well. Consequently, research and development issues of applying the concept of social network and its analysis methods to workflow models have been emerging in the literature; there

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have been existing two main branches of research approaches in adopting social network techniques onto workflow-supported organizations. One is so-called workflow-supported social network *discovery* issues, the other has something to do with so-called workflow-supported social network *rediscovery* issues. The latter is concerned with mining social networking knowledge from workflow event logs, which was firstly issued by [2]; the former is to discover social network knowledge through exploring the human perspective of a group of workflow models, which was issued at first by [7]. More specifically we would differentiate the former from the latter; the former is to explore a defined social network (social definition aspect) embedded in the underlying workflow model itself, but on the other hand the latter is to explore an enacted social network (social enactment aspect) from the execution logs of the model. Consequently, the workflow-supported social network model proposed in the paper is directly related with both the social network discovery issues and the social network rediscovery issues.

## 2 Workflow-supported Social Network Model

There are two kinds of social perspectives on workflow models: Role and Actor(Performer). That is, for any activity  $a$ ,  $e_p(a)$

$$= \{r_1, r_2, \dots, r_n\}, \text{ where } n$$

is the number of roles,  $\forall n \in P$ , involved in the activity, means that an activity  $a$  is performed by one of the roles; Also,  $s_{or}(ii) = \{a_1, a_2, \dots, a_m\}$ , where  $m$  is the number of activities performed by the role, means that a role  $r_n$  is associated with several activities in a workflow procedure. Typically one or more participants are associated with each activity via roles. A role is a named designator for one or more participants which conveniently acts as the basis for partitioning of work skills, access controls, execution controls, and authority / responsibility. An actor is a person, program, or entity that can fulfill roles to execute, to be responsible for, or to be associated in some way with activities and procedures. The workflow-supported social network model proposed in this paper can eventually be used for visualizing various shapes of social perspectives embedded in workflow models, and particularly we focus on the actor-based social perspective in this paper.

### 2.1 Formal Definition

In this subsection, we start from introducing the basic concept and definition of workflow-supported social network model that can be used for a knowledge representation theory for workflow-supported social networking knowledge, not only that can be discovered from workflow models, but also that can be rediscovered from workflow execution logs. Basically, the origin of the workflow-supported social network model is the actor-based workflow model[1], and its rationale is on where it represents the behaviors of acquisitioning activities among actors in a workflow model, which we would call workflow-supported social relationships that form this special type of social networks. As given in the formal definition,

**[Definition 1]**, of the workflow-supported social network model, the behaviors of the model are revealed through incoming and outgoing directed arcs labeled with activities associated with each of actors. The directed arcs imply two kinds of behaviors—workflow-supported social relationships and activity acquisition of actors —through which we are able to get precedence (candidate-predecessor knowledge/candidate-successor knowledge) knowledge among actors as well as activity acquisition of each actor in a workflow model. In terms of defining actor's predecessors and successors, we would use the prepositional word, "candidate", because a role-actor mapping is an one-to-many relationship knowledge, and the actor selection mechanism will choose one actor out of the assigned actors mapped to the corresponding role during the underlying workflow model's runtime.

The activities on the incoming directed arcs are the previously performed activities by the predecessors of the actor, and the activities on the outgoing directed arcs are the activities acquired by the actor, itself. And besides, the activity on the transitive directed arc implies not only the acquisition activities of the actor but also the previously performed activities by the actor, itself.

**[Definition 1] Workflow-supported Social Network Model.** A Workflow-supported Social Network Model is formally defined as  $\mathcal{A} = (\mathbf{S}, \mathbf{E})$ , over a set  $\mathbf{C}$  of actors, and a set  $\mathbf{A}$  of activities, where

$\mathbf{S}$  is a finite set of coordinators or coordinator-groups connected from some external workflow-supported social network models;

$\mathbf{E}$  is a finite set of coordinators or coordinator-groups connected to some external workflow-supported social network models;

$\mathbf{Q} = \mathbf{Q}_i \cup a_o \text{ I}^*$  Social Relationships: successors and predecessors \*/

where,  $a_o : \mathbf{C} \rightarrow \mathcal{P}(\mathbf{C})$  is a multi-valued function mapping an actor to its sets of (immediate) candidate-successors, and  $cr_i : \mathbf{C} \rightarrow \mathcal{P}(\mathbf{C})$  is a multi-valued function mapping an actor to its sets of (immediate) candidate-predecessors;

– =  $\mathbf{U} \text{ /* Acquisition of Activities */}$

where,  $\theta_i : \mathbf{C} \rightarrow \mathcal{P}(\mathbf{C})$  is a multi-valued function returning a bag<sup>5</sup> of previously worked activities,  $(\mathbf{K} \mathbf{C} \mathbf{A})$ , on directed arcs,  $(a, (\theta), \theta), \theta \in \mathbf{C}$ ,

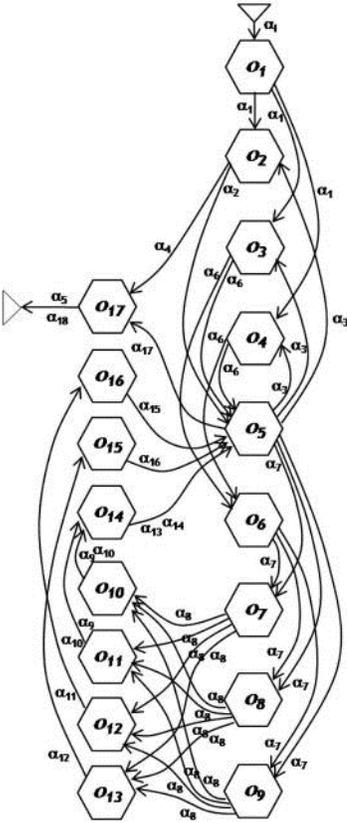
from  $\theta_i(\theta)$  to  $\theta$ ; and  $\theta_o : \mathbf{C} \rightarrow \mathcal{P}(\mathbf{C})$  is a multi-valued function returning a set of acquisition-activities,  $(\mathbf{K} \mathbf{C} \mathbf{A})$ , on directed arcs,  $(\theta, a_o(\theta)), \theta \in \mathbf{C}$  from  $\theta$  to  $\theta_o(\theta)$ ;

## 2.2 Graphical Definition

In principle, the workflow-supported social network graph is a directed graph characterized by multiple-incoming arcs, multiple-outgoing arcs, cyclic, self-transitive, and multiple-activity associations on arcs. However, it can be also transformed

<sup>5</sup> The bag theory is same to the set theory except allowing duplicated members.

to non-directed graph for analysis phases. As an example, we apply the concept to the hiring workflow procedure[5]; the graphical representation of the workflow-supported social network model is shown in Fig. 1.



**Fig. 1.** The Workflow-supported Social Network Model from the Hiring Workflow Procedure[5]

Due to the page limitation, we won't provide the details of the formal representation of the workflow-supported social network, in this paper. Unlike the activity-role mapping relationship in which an activity is mapped to just a single role (one-to-one relationship), the workflow-supported social network model based on the role-actor mapping relationships has one-to-many relationships in the mappings of activities and actors. Because of the one-to-many relationships between activities and actors, an actor node may have several outgoing directed arcs that have the same activity as their labels. On Fig. 1, for example, the actor node,  $o_1$ , has three outgoing directed arcs labeled with the same activity,  $\alpha_2$ . However, in the real enactment logs of the hiring workflow procedure during the runtime, it will be happened that  $o_1$  selects one of the neighbor actors,  $o_2, o_3, o_4$ , so as to proceed to the selected actor after performing  $\alpha_2$  during runtime. As a

result, according to the actor selection mechanisms, such as random, sequential, heuristic selection mechanism and so on, the social relationships on runtime will be differently formed with the social relationships on this discovery result. This is why we need to differentiate the workflow-supported social network discovery work from the workflow-supported social network rediscovery work.

### 3 Conclusion

In this paper, we suggested a possible way of viewing the knowledge and collaborative behaviors among workflow-supported people by converging the social network analysis techniques[4] and the workflow discovering and rediscovering techniques[2][3][6]. At this moment, it is important to emphasize that the workflow-supported social network model won't be modeled or designed but automatically discovered from a workflow model. So, we need to devise an automatic discovery methodology for the workflow-supported social network model, which algorithmically explores the internal social properties of an workflow procedure. Likewise, we have to remind that we won't differentiate the single-actor binding activity type from the group-actor binding activity (realtime groupware activity) type, where a group of actors is simultaneously assigned to cooperatively perform a single activity; almost all current available workflow models do not support such a realtime groupware activity type. However, as a future work, we need to cope with these social relationships caused from the group-actor binding activities in workflow-supported social network models.

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