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Towards Role-distributed Collaborative Business Process Elicitation

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Abstract. Elicitation of business process knowledge can be facilitated by conceptual models of collaborative work. Models of collaborative business processes with actors participating in different roles are complex constructs with flows of individual activities that are coupled via acts of communication. The process of elicitation in such cases can benefit from separating the modeling process for each role and let actors focus on their own contribution to work and their communication with other roles. This paper identifies concepts for model elicitation and modeling support that enable a modeling process distributed across roles and identify collaboration issues while maintaining one consistent overall model representation. A modeling methodology implementing these concepts is presented and first results of exploratory tests are discussed.

Introduction

In the last years, business process models have become a recognized means for representation of knowledge about collaborative work in organizations (Gasson, 2005). They can be used for communication of information about work and facilitate elicitation and alignment of business process knowledge (Rittgen, 2007). The creation of sound and fully specified business process models, in addition, allows to go beyond communication support and enables further processing like validation, optimization and execution of the model (Giaglis, 2001).

Business process models are a representation of organizational work with activities distributed over different actors. Elicitation of information about work thus

has to involve all relevant stakeholders to form a comprehensive model of the work process Antunes et al. (2013). and focus on collecting information from the actual workers to avoid intermediate expert modelers, who may lack tacit knowledge about the actual implementation of work (ibid.). Involving the stakeholders during modeling confronts them with different viewpoints and conceptions of how the collaboration should be implemented (Stuit et al., 2011), which need to be aligned in the process of creating the model.

The goal of the research the present work contributes to is to enable stakeholders to directly create models of business processes without intermediaries and facilitate the uncovering and eventual resolution of different conceptions of the collaborative work process. At the same time, the resulting process models should allow for formal validation and further processing, e.g. in workflow support systems. Similar objectives have been targeted in earlier research (e.g. Herrmann et al. (2007) or Rittgen (2010)). The approach presented here follows a different approach by letting stakeholders focus on solely their individual role in a process (i.e. their activities and communication with others) in contrast to existing works, where an overall view on the whole business process is maintained for all stakeholders. Focusing on the individual contribution to a work process leads to more detailed and refined models that better reflect the actual perception of their work (Dann, 1992) and also enables to explicitly identify different conceptions on the need for communication during work. The objective of the present paper is to explore approaches for model elicitation that enable capturing process knowledge separately for each involved role and support the identification of conflicts in the perceived work process and facilitate the resolution of this issues.

In the next section, the process elicitation approach is described. The following section outlines the requirements on methodological support during elicitation. Focussing on methodology, the subsequent section introduces the concept of role-distributed modeling and describes three different ways of creating role-distributed models. The final section briefly reports on the first in conducting role-distributed modeling and outlines the next research steps.

Elicitation Approach

Depicting collaborative work in business process models requires a clear understanding of the concepts relevant for modeling. Following the approach of role-centric modeling, i.e. describing who is doing what and communicating with whom in the course of collaborative work, the relevant concepts used in the area of business process modeling are “actor”, “role”, “activity” and “communication” (Soderstrom et al., 2002).

Actors are individuals who are actively participating in a work process. Activities of different actors hare carried out in parallel without immediate interaction with others and are coupled via explicit acts of communication (i.e. transferring work results from one actor to another). Decisions on which activities are carried out from a number of options are made by the actor based upon the outcome of a

prior activity or the content of incoming communication.

Business processes are not only valid for one specific set of actors but are specified in a more abstract way for a set of interacting roles. A role is an area of responsibility in a business process. Consequently, several actors are able to take a certain role in a business process. Communication acts are carried out among roles and interlink the activities carried out by actors acting in a certain role.

When designing support for eliciting knowledge about work processes, the different kinds of activities described above have to be considered as fundamental model elements. We distinguish the following types of activities: (a) individual activities carried out by an role (including decisions); and (b) communication acts to link individual activities of different roles: (b1) outgoing communication acts, i.e. actively sending work results or (b2) incoming communication acts, i.e. receiving work results.

A modeling language used to support role-distributed business process modeling has to provide constructs that allow for structuring the model along role boundaries in order to allow for visualizing a model distributed along the involved roles and keep the model parts interrelated (Adamides and Karacapilidis, 2006). Modeling languages using the "role"-concept or equally interpretable constructs as the primary factor of structuring meet this requirement (Giaglis, 2001). UML Activity Diagrams (de Cesare and Serrano, 2006), BPMN (White, 2004), or S-BPM Fleischmann et al. (2012) are examples of business process modeling languages that enable this structuring approach and at the same time have existing tool support for validation or execution.

Separating a process along the involved roles has implications for modeling support. Modelers need support for interlinking and aligning different contributions to a business process and ultimately deriving a commonly agreed upon model of the business process. Each role's contribution to work is created as a separate part of the model. As noted above, one role can be taken by several actors in an organization. Different actors introduce different viewpoints about how one role's contribution can be implemented (Herrmann et al., 2002). These different viewpoints require alignment to derive one single, commonly agreed upon view on a business process. Consequently, an elicitation instrument has to support *collaborative modeling of role behavior*. All participating actors in this case share the same part of the model.

The role-based process parts are interconnected by communication acts, which are represented by flows of discrete messages. The following activities can occur in modeling communication (using the concept "message" to represent transmitted results of work): (a) send a message to another role; (b) get notified that a message has been sent to one's own role; (c) request a message from another role to be able to proceed with one's own part of the process; and (d) get notified that another role requests a message to be able to proceed with its part of the process.

The first two communication acts (a and b) are sufficient to describe all communication situations if the business process is modeled in fully sequential manner. This, however, requires actors to wait for another role to send a message before they can proceed with modeling their own process part. Communication acts c and

d are introduced to avoid these delays in modeling and to explicitly allow to express expectations on modeling that might require further discussion. *Elicitation support has to allow the specification of these different types of messages as well as the resolution of inconsistent communication acts across roles.*

Support for Role-distributed Elicitation

A role-distributed modeling support concept is presented here to explore methodological options to meet the requirements described above. A simple modeling language is used for this purpose, following the minimal requirements on a modeling language supporting role-distributed modeling as specified above. Three different types of modeling elements are used:

Activity modeling elements are used for representing activities carried out by a role as well as acts for sending and receiving messages. The semantics of the element (i.e. do something, send, receive) is determined during modeling time. Message elements are used to either send a message (outgoing message element) to another role or request a message from another role (incoming message element). Their respective incoming or outgoing message counterparts are added to the communication partner's modeling surface to link. Incoming messages or message requests, however, do not necessarily need to be processed by the communication partner immediately. They are pooled in tray areas that visualize all unprocessed messages (cf. Figure 1).

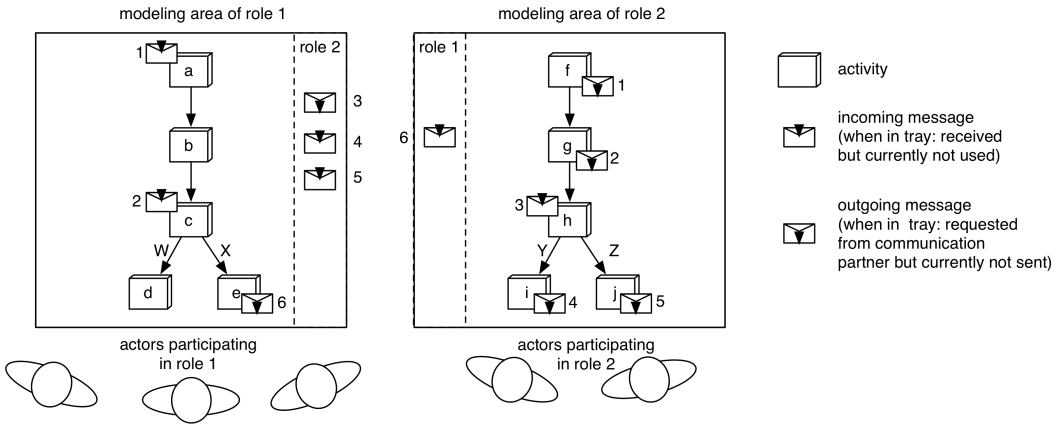

Figure 1. Example setting of role-distributed models in an intermediate stage during modeling.

The use of the three modeling elements are visualized in Figure 1, which shows an elicitation process in an intermediate stage for illustration purposes. The depicted scenario consists of two interacting roles. The behavior of role 1 is modeled by three actors, two actors provide input for role 2. The modeling surfaces include trays for coupling to the respective other role on one of their borders.

Activities (labelled with lower-case letters in Figure 1) are placed on the surface and are associated following their sequential order. Optional paths are represented

by decision parameters placed next to the according association link (labelled with upper-case letters in Figure 1).

The two model parts are interlinked using message elements (labelled with numbers). Following the coupling concept, message elements always exist in pairs of two. The semantics of a message element changes depending on wether attached to an activity element or kept in the tray area: (a) an incoming message attached to an activity (e.g. activities a, c, or h in Figure 1) represents the act of processing a received message; (b) an outgoing attached to an activity (e.g. activities e, i, or j in Figure 1) represents the act of sending a message to a communication partner; (c) an incoming message placed in an tray area represents a message that is offered by a communication partner, but has not yet been processed; and (d) an outgoing message placed in an tray area represents a message that is expected by a communication partner, but has not yet been created and sent.

The messages kept in the tray areas make mutual expectations and potential communication flaws explicitly visible. Requested messages or unused incoming messages that remain in one of the trays always point at a mismatch beween the expectations and the current behavior of the communication partners. During elicitation, this visualization of communication problems triggers negotiation and alignment activities that allow for the specification of a sound overall model.

Three different procedural approaches for distributed model elicitation can be identified following the concept of behavior and communication specification described above. They differ in the point in time when message specification happens. In *ex-ante communication negotiation*, all messages are specified collaboratively by the involved actors before the roles' behaviors are described. The messages are initially placed in the tray areas for each role and a then used during behavior modeling. In *ex-post communication negotiation*, each role's behavior including all outgoing and required incoming messages are modeled separately. In a consolidation step, the communication among the roles is then aligned by mutually matching requested and sent messages. In *ongoing communication negotiation*, messages are put into the trays of communication partners immediately as they are specified during behavior modeling. Inconsistencies or different understandings are discussed immediately.

All three approaches stress different aspects of the modeling process and appear to be suitable for different modeling purposes. *Ex-ante communication negotiation* creates an common overall picture of the work process to start with and leaves identification of communication problems to the subsequent distributed modeling phase. Uncovered communication problems then require an additional round of alignment. *Ex-post communication negotiation* by contrast forces modelers to initially only focus on their own contribution to the work process. The identification of inconsistent communication acts is most likely here. The alignment of communications acts could lead to the need for a subsequent revision of roles' behavior models, if fundamental inconsistencies, e.g. conflicting communication sequences, are identified. *Ongoing communication negotiation* avoids the need for fundamental revisions of either behavior models or communication acts, as both are specified

simultaneously. Different viewpoints are immediately visible and can be discussed ad-hoc. This immediacy, at the same time, can be challenging for modelers, as they are continuously confronted with incoming messages or message requests while at the same time describing their own behavior.

The three approaches are described here without any preference and are currently subject to closer examination with regards to their practical applicability. The first experiences gained from these explorations are described in the next section.

Initial Experiences and Future Work

The modeling concept so far has been deployed in all three methodological variations in two different practical settings. In all cases, the models were built using paper-based modeling cards without any technical modeling support. In case A, the process of assembling a pneumatic cylinder was subject of elicitation. The actors were 8 students (6 male, 2 female) of business information systems, who were trained in the production process for 2.5 days as part of a practical course. All students already had extensive experiences in business process modeling. The process involved four different roles, of which each was taken be two students. All three methodological approaches were conducted using three different but equally complex variations of the production process. Case B was taken from healthcare sector, where 6 healthcare professionals (4 female, 2 male) modeled the admission process of an elderly client to long-term care (involving 4 roles in total). None of them had prior experiences with modeling, neither were they confronted with explicit process models in their professional life. All three methodological approaches were used in different steps of the elicitation process.

Overall, all participants in either case were able to create correct models (in terms of how the modeling elements were used and linked to other model parts). Differences, however, occurred during the modeling process, which can be attributed to the different backgrounds and prior experiences in modeling. Modelers with no experiences in modeling (in case B) repeatedly showed problems in understanding or correctly using the message elements. They were not able to consistently distinguish between the act of sending or receiving a message and the message itself and consequently had problems in assigning designators to messages. This problem was less evident in ex-ante communication negotiation, where people were not introduced to sending and receiving activities. The misconceptions could largely be overcome by providing examples of correctly designated messages.

The unexperienced modelers in case B preferred ex-post communication negotiation over the other two variants. They were unable to handle the complexity of the ongoing message negotiation setting and did not manage to incorporate the incoming messages while modeling their own role's behavior. Ex-ante communication specification was perceived to cause superficial effort, as they felt they had to go through their work process twice to first identify their communication and then to actually create the model. Two modelers also felt constrained by the already existing messages in modeling their role's behavior. The ability to uncover inconsistent

communication expectations in ex-post communication negotiation was repeatedly noted as the most useful aspect of the whole modeling session.

Preferences were different for the experienced modelers in case A. They preferred ongoing message negotiation as it was perceived most efficient and being the fastest way to reach a consistent overall model. Ex-ante message negotiation was considered a well suited approach and hardly led to the need for revisions after behavior modeling. It was generally preferred over ex-post message negotiation, which was considered to be cumbersome and hardly providing any added value.

As no clear preference for any methodological approach can be identified, future research will further examine the effects of the different points in time during modeling when communication acts are made explicit. The next steps are to resolve issues in understanding the semantics of the modeling elements — in particular the message element — for inexperienced modelers. In a further step, advantages and disadvantages of the different methodological approaches for different combinations of modeling goals, and prior modeling experiences of the participants will be examined. A more elaborate empirical setting will be used to overcome the limitations of the explorations described above, which mainly suffer from limited comparability and observably different complexity of the modeling subjects (with the production process being more accurately describable than the healthcare process).

A second strain of research and development currently worked on is tool support. Based upon an existing interactive tabletop modeling environment (Oppl and Stary, 2011), means to support a technically augmented distributed modeling workflow, including the currently omitted requirements on communication support, are currently implemented. Additionally, a mapping between the the modeling language used here and S-BPM (Fleischmann et al., 2012) is currently worked on, which will allow to validate and execute the created models. This will enable to identify model errors that can remain undiscovered due to the distributed nature of model elicitation (such as dead-locks by mutually waiting for messages to be sent).

Summarizing, the approach presented here is a first step towards business process model elicitation that explicitly uncovers existing or potential collaboration issues in organizational work processes. The modeling approach enables to independently create models for each involved role and aligning the communication acts among these roles in the course of the modeling act. The resulting models can directly be mapped to modeling languages that are supported by BPM tools for validation or workflow support. While the initial experiences with applying the modeling approach in practical settings are promising, future research has to adress methodological considerations to facilitate model alignment across roles as well as technical means of modeling support.

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