Stakeholder-Driven Collaborative Modeling of Subject-Oriented Business Processes

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Abstract. Subject-oriented business process management (S-BPM) constitutes a new approach that focuses on acting subjects rather than events or data. Consequently, elicitation of business process knowledge can occur in cooperative settings, driven and directly conducted by involved individuals. This specific setting not only is in need of a collaborative modeling environment, but also requires tool support in order to allow people to focus on the work processes to be represented. This paper presents an approach for the collaborative modeling of subject-oriented business processes with the aid of an interactive, distributed platform and introduces concepts for information awareness and tool supported development of cooperative work aspects for effectively supporting modelers. A report on the conducted exploratory user study to elicitate user requirements illustrates potentials for further usability and user acceptance enhancements as well as extensions towards the modeling functionality of the tool set.

Keywords: collaboration, subject orientation, business process modeling, knowledge elicitation, tabletop interface, distributed interaction.

1 Motivation

Work environments involving a group of people require specific cooperation attitudes [26], especially when facing more complex situations and problems [27]. Decided, explicit alignment interactions are vital to successfully accomplish a common understanding on activities and work processes. The perception of each involved individual impacts the identification as well as the final execution of such interactions [11]. The theory of mental models [14] provides a conceptual approach to describe and reflect upon individual perceptions of work, two activities that are considered necessary for the development of a common understanding [16]. Individuals' actions triggered by the involvement in business processes can therefore be explained by the means of mental models [14]. Research in this area has identified a set of methods that aid externalization [13] and alignment of mental models [2]. Diagrammatic models, such as structuring techniques and concept mapping, have shown the ability to support the externalization of

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mental models and accelerate reflection and communication processes [13]. Once stakeholders are involved, the externalization is necessary to establish a common understanding to be able to communicate people's perspectives and share information [20].

The modeling tool set *Comprehand* picks up these approaches and facilitates a modeling environment designed for developing collaborative cooperation interactions represented by diagrammatic models [19]. Physically placeable elements allow for the collaborative creation of models on a computer-augmented interactive tabletop modeling surface and enable simultaneous alterations additionally supported by the tabletop interface [23]. The combination of the tabletop interface with a semantically open modeling language possesses a flexible environment for developing conceptual models from the users' viewpoints [18].

Semantically open conceptual models allow involved people to externalize their perception of work in their language. Such models do not force individuals to adapt to a pre-specified notation, thus preventing an additional mapping step in the course of externalization [9]. Additionally, semantically open notations allow to not only capture the model of work itself, they can also capture the domain concepts that people use to describe their work. A different vocabulary becomes evident and can be resolved in this way [25].

Conceptual models, however, cannot only be used to aid communication about work in the course of alignment of work processes. They can also be used to configure interactive systems that support the alignment process (e.g. via in-place simulation and validation) and the actual work process itself (e.g. via a workflow engine) [1]. Although these usage scenarios also support cooperation, they require a more formalized way of representing the conceptual models in order to make them interpretable for computers [3]. Dori (ibid.) has termed this situation as the "apparent human-machine language orientation dilemma".

Supporting the process of developing formalized models from less structured, semantically open models is a recognized research issue. Different approaches to solve this problem have been examined, ranging from explicitly representing vagueness in models [12] to providing a unified notation for informal and formal models [28] [7]. These approaches, however, focus on language properties rather than providing methodological support for the externalization of more formalized models. By extending the Comprehand approach, the research presented in this paper aims at methodologically bridging the gap between the way people describe their work and the formal models necessary to interactively support these work processes.

Subject-oriented business process management (*S-BPM*) [4] is an approach for modeling business processes from a stakeholder perspective. It explicitly distinguishes between one's individual work (internal behavior) and the communication (interaction behavior) among involved people that is required to successfully accomplish a process. This separation of concerns reasonably supports the elicitation of distributed work process knowledge [20] and allows for a step-by-step integration of different views on cooperative work processes. Tools for direct simulation, validation, and enactment of created models are available

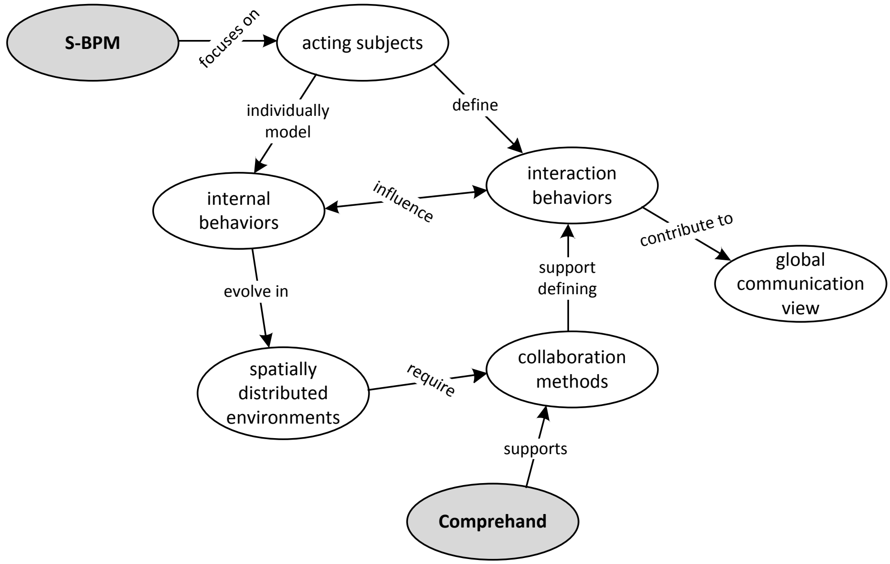


Fig. 1. Interrelation of S-BPM and Comprehand

and enable interactive support of the modeling and work processes. Figure 1 outlines the coherence between S-BPM and Comprehand to gain a better understanding of how the separate parts are linked together.

S-BPM focuses on active organizational elements, the so-called subjects (cf. Figure 1), rather than focusing on events or the data being processed [5, p. 85-86]. Subjects constitute the source of every action and interaction, and are responsible for modeling their internal behaviors as well as for defining their interaction behaviors. Since they are not bound to any specific geographic locations, the modeling processes can take place in spatially distributed settings. Due to this fact, tool support is required supporting users while collaboratively eliciting and modeling distributed process knowledge. Comprehand can therefore be used to provide a tool supported modeling environment enabling the usage of collaborative methods.

The goal of this paper is to integrate S-BPM and Comprehand in a way that allows to capture interaction behaviors and integrates individually modeled internal behaviors in a way comprehensible to users inexperienced in (subject-oriented) modeling. Once the interaction behaviors are well-defined, the outcome is a clearly arranged view on the global communication throughout the entire process, ultimately leading to a model that can be validated and executed without further need for augmentation. Working hypothesis in this paper particularly focus on tool acceptance and usability issues of the existing prototype. Supporting users with a basic set of modeling functions especially in terms of S-BPM, practical experiments and tests are intended to identify effects concerning both the user's modeling process as well as the outcome and constitute the basis for the deduction of continuative implementations and research topics.

In the following section, we are elaborating on our basic approach to collaborative elicitation of business process models. Requirements on information awareness in spatially distributed modeling setting are given in the third section. We then briefly describe the necessary technical infrastructure and give an account of the modeling process and according tools support. In the final sections we report on our experiences during the evaluation of the prototype and discuss potential methodological and technical improvements and extensions of the instrument.

2 Collaborative Modeling of Subject-Oriented Business Processes

The concept of subject-oriented business process modeling is focused on the communication among subjects. The purpose of this communication-oriented interpretation of business models is to identify and reflect upon existing interaction patterns. A set of defined modeling rules based on natural language constructs supports modelers throughout the modeling process. This establishes a more familiar and convenient modeling environment by imitating an ordinary communication flow [6].

From another perspective, this idea can not only be used for the representation of interaction patterns, but can also effect the way of how business process knowledge is elicited. The collaborative modeling of subject-oriented business processes therefore refers to a specific setting where two or more spatially distributed subjects corporately try to create one model. Even though all involved subjects take part in the same model creation process, they individually design their internal behavior and only publish their interfaces with which they communicate. The internal behaviors are thus not visible to others. By abstracting over available internal behaviors, the global communication view can be extracted that in turn fosters a common process understanding.

2.1 Internal Behavior

Internal behavior models illustrate the subjects' contributions to the process irrespective of other subjects' attitudes. It describes the exclusive sequence of actions that is required to successfully accomplish a given task. Function states, send states, and receive states are the constructs that enable the representation of the perceived work situations. Send and receive states here allow modeling of interaction behavior by either defining or using messaging interfaces to or from other subjects.

Figure 2 generically exemplifies a subject's internal behavior using the available elements mentioned above. This simple scenario outlines a message that is sent by one subject and which is addressed to another involved subject within

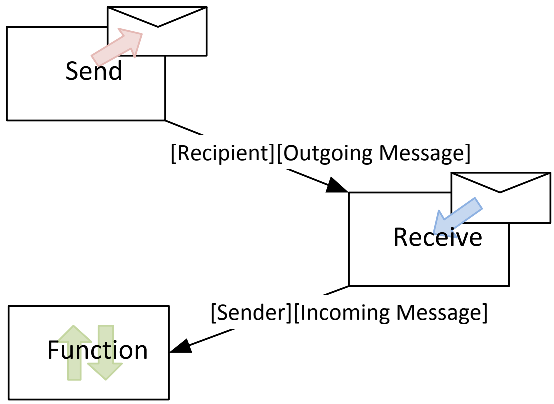


Fig. 2. Internal Behavior

the same modeling session. The message itself is assigned to the edge that interconnects this particular sending state with the subsequent state in the model. The same principle can be applied in case of an receiving state. The subject is waiting for an incoming message that is once again assigned to the edge interconnecting the receiving and subsequent state in the model. Once the message is received the subject can move on to the function state and execute the required individual actions.

2.2 Interaction Behavior

Interaction behavior models encapsulate internal behaviors of subjects and outline how subjects interrelate and communicate with each other. The level of detail regarding the individual sequence of actions decreases and a special focus is drawn on messages that are exchanged among subjects. The communication flow among subjects is taking center stage.

The introduced approach benefits from the subject's interaction behavior that also exhibits the key feature of the collaborative modeling of subject-oriented business processes. Subjects not only define their internal behavior but also think about existing communication patterns that have to be in place to fulfill a certain task and which in turn link them to other subjects. While defining the interfaces that link them together, real world process knowledge is elicited and simultaneously pictured within a model not requiring any special cooperation actions on the part of the users.

Figure 3 shows the encapsulation of the internal behaviors and totally focuses on the interfaces that are established. As you can see in the picture, *Subject 1* and *Subject 2* are not aware of other internal behaviors and are therefore only communicating through the available message interfaces.

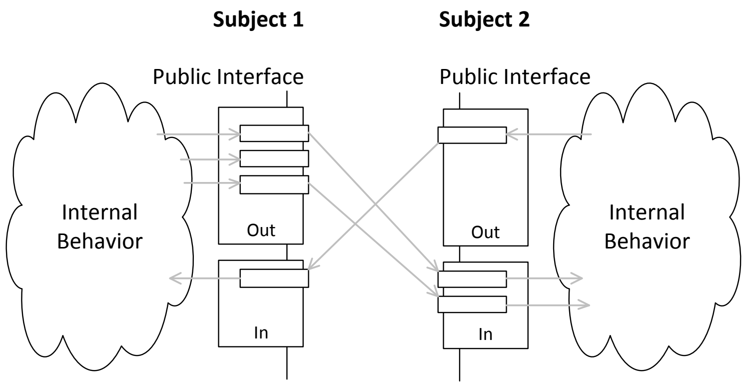


Fig. 3. Interaction Behavior

3 Information Awareness

Applying the Comprehand approach to S-BPM, each subject is represented by a separate interactive tabletop modeling surface. Those surfaces can be co-located or spatially distributed and even be located on remote sites. In either case, special attention has to be drawn on information awareness in order to recognize or prevent potential problems or inconsistencies within the model and keep users up-to-date throughout the entire modeling session concerning other users' actions and behaviors. Concerning this issue, Nacente et al. [17] introduce the concept of *embodiments* to both give users feedback about their own actions and convey the awareness of other users' involvement with respect to characteristics such as the presence, location, and movement [10]. They further draw a distinction between two specificities named *virtual* and *physical embodiments* where, on the one hand, the users' bodies manipulate objects directly and, on the other hand, virtual representations of involved users serve as placeholders and impart information. Both approaches therefore focus on the representation of people in groupware systems.

It is crucial to provide modelers with information regarding the current state and occurring changes of the model in an unobtrusive way. Missing or misleading model information might result in negative effects on the overall usability of the tool and would have to be communicated to users explicitly.

3.1 Appropriation of Spatially Distributed Information

The collaborative modeling of subject-oriented business processes within a spatially distributed setting triggers the generation of a variety of information. In most cases, the generated information is needed at the point of origin as well as by other involved subjects.

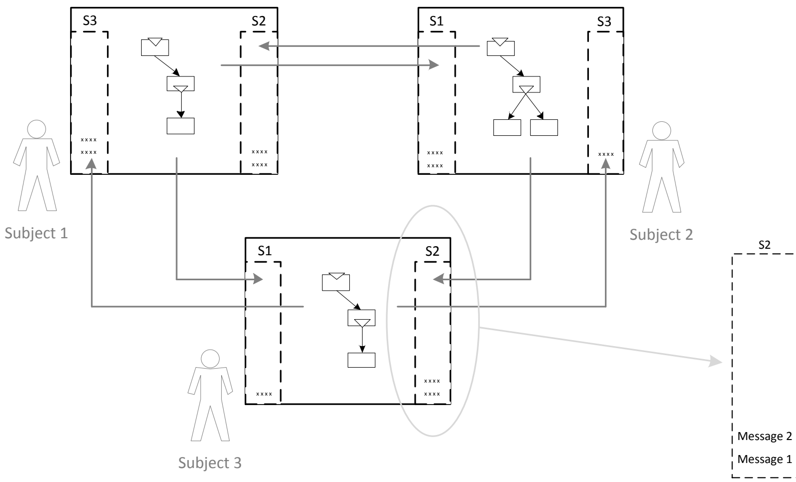


Fig. 4. Notification Trays

Due to the distributed environment and since the exchange of messages is a key feature of S-BPM, Comprehand is in need of a user interface that facilitates a mechanism to accurately notify users of incoming messages. The concept of *virtual embodiments* [17] is applied due to the lack of direct contact to other subjects in the modeling session. The implemented *Notification trays* serve this purpose and provide virtual connections among available modeling environments. As illustrated in Figure 4, every subject is interconnected to all other subjects via a notification tray. In other words, every available subject within the modeling session is represented through a dedicated notification tray on the tabletop interface.

Once a message is received from a subject, meaning that another subject has defined a message by using a sending state element, the message appears within the designated notification tray. For instance, if *Subject 2* defines and addresses a message to *Subject 1*, the message is displayed in the notification tray *S2* on the tabletop interface of *Subject 1*. Consequently, the modeler can respond to this event by assigning the message to a receiving state element in his or her own model (internal behavior).

3.2 Supporting the Construction of Consistent Models

S-BPM defines a set of rules that have to be adhered to establish a consistent process model that can be validated and executed. Any rule violations conclude in a non-executable model and require iterative adaptions until the model is completely corresponding with the specification of S-BPM.

Comprehand provides an error and information message concept that guides users through the fault correction process once inconsistencies have been identified in the model. Error messages are displayed on demand directly on the tabletop interface and are context-sensitively adapted to the present situation. Conspicuous colors and flashing message box borders are used to additionally attract the user's attention to make him or her aware of apparent errors in the model.

The tool enables following inconsistency prevention mechanisms in its current implementation:

1. Messages can only be assigned to edges if certain rules are adhered. These rules ensure that the point of origin represents a sending or receiving state element and that the edge on which the message should be attached is directed and outgoing.
2. Once a message is defined and attached to an edge interconnecting a sending state element, the system checks whether other subjects already demand the message's availability. In this case, the sending subject is not allowed to detach or redefine the message until all other attachments have been deleted.

4 Architecture and Infrastructure

The Comprehand system [18] provides the technical foundations for the addressed extensions that are described in section 2. The open source framework *ReacTIVision* [15] is responsible for the optical recognition of codes in real-time and controls the input stream of elements used on the tabletop surface and precisely evaluates the elements' positions as well as their rotations [22]. The tabletop interface combined with a projector simultaneously serves as an output channel and enables a coherent information output that is used to show the system's reaction towards the model [22].

Compared to the original infrastructure described in [18], some adaptations were implemented to effectively support the collaborative modeling environment. Figure 5 outlines the system's infrastructure including two spatially distributed subjects represented by two separate modeling environments (Comprehand tabletop interfaces). As defined in the concept of S-BPM but not explicitly shown in the figure, these subjects could also constitute computer systems, databases, etc as well.

Due to the spatial distribution of the modeling platforms, network cabling and appropriate network elements are necessary to enable a network-based communication via the Ethernet protocol. Either a local network or the access to the dedicated server over the internet are adequate implementations to meet these requirements.

A dedicated server supporting the Extensible Messaging and Presence Protocol (XMPP) [24] performs communication management among subjects and represents the central point in the network. All communication as well as control messages are handled by this particular server. The messages are therefore not only used to provide the collaborative modeling functionality, but are also available to serve as foundation for further modeling process analysis and model

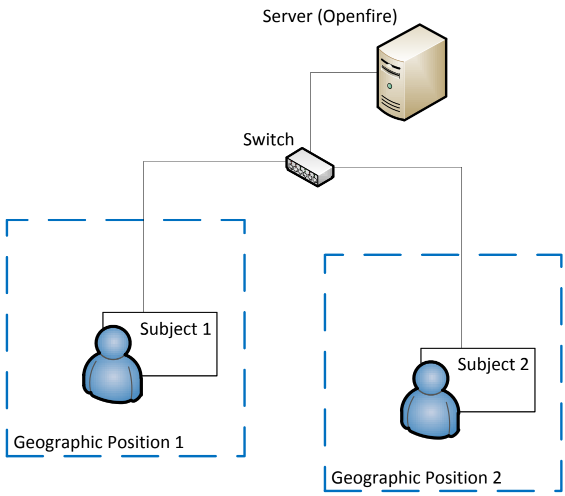


Fig. 5. Network Diagram

reconstruction issues. The XMPP protocol itself provides a flexible, scaleable, and extendable framework for the implementation of numerous communication channels, such as text messaging, audio streaming, and video streaming. Based on Matthias Freudenberger's research results, the *Openfire* implementation in combination with the *SmackAPI* is used throughout the project [8].

5 Modeling Process

This chapter consolidates the theoretical concept introduced in the previous chapters with *Comprehand* and gives a hands-on approach on working with this tool. The existing features as well as the newly introduced concepts and implemented tools, such as the *Message Tool*, are explained in the following sections. It aims at giving an practical overview of how the tool can auxiliary support the user's modeling experience and possibly can impact the outcome.

5.1 Constructing the Model of Individual Behavior

The tangible modeling elements constitute the foundation of business processes that are modeled with *Comprehand*. The users therefore have to place the desired elements on the tabletop interface. The system automatically identifies the chosen elements with their exact position and rotation and registers them in the data model. The position and rotation of each element can simply be updated through moving the element to the desired position.

Elements on the surface can be named at any given point in time. Once the particular element is selected, users can open the input field by pressing the blank key on the keyboard. Hitting the enter key closes the input field, confirms the entered text, and displays it directly next to the element.

Users can interconnect elements by temporarily placing them in close distance. As soon as the minimum distance between two elements falls below a defined value, the system interconnects these two elements by projecting a virtual line starting from one element to the other. As long as the concerned elements are within the range of recognition, the system will identify them as connected regardless of the elements' later positions and rotations. The connection can only be deleted by using a dedicated *Eraser Tool*.

Since the S-BPM approach requires a defined flow of communication, the tool has to support the definition of directed edges. By using the *Arrow Tool*, already established connections between two elements can be directed by directly placing it on the connection.

5.2 Establishing the Interaction Behavior

In addition to modeling the internal behavior, *Comprehand* also supports modeling the interaction behavior in terms of determining the communication interface. A *Message Tool* has been introduced to enable users to easily handle incoming as well as outgoing messages. The context sensitive tool shows the appropriate menu once it is used and assigned to a link interconnecting a sending or receiving state element with another element. Irrespective of the context in which it is used, the handling is always the same and happens in a consistent way. In doing so, available items are display around the tool and can be selected by turning the tool until the desired segment is highlighted. Once the tool is removed, the highlighted item is selected for further processing tasks. Regardless the context, the tool always shows an empty segment among the available items allowing users to deselect items.

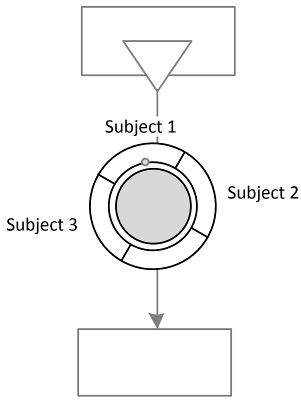
In case of an element representing a sending state, as outlined in Figure 6(a), the message tool displays all available subjects as items. By turning it, the desired subject can be selected and the message can be defined as described in section 5.1 using the input box after removing the message tool from the tabletop surface. Once the message is defined, it is assigned to the edge and the addressed subject is notified immediately.

Using the message tool in the context of a receiving state, as illustrated in Figure 6(b), the message tool displays all available messages as items. The items are an accumulation of all messages displayed within the subjects' notification trays. By turning the tool, the desired message can be selected and is assigned to the edge.

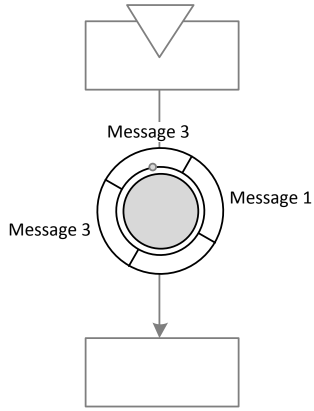
6 Exploration Study Design

On the basis of practical experiments and tests, which were conducted at *S-BPM One 2011*[1], several usage patterns have been identified in terms of the usability

[1] Third International Conference on Subject-Oriented Business Process Management, S-BPM One 2011, Ingolstadt, Germany, September 2011.



(a) Sending Context



(b) Receiving Context

Fig. 6. Message Tool

of *Comprehand*. Potential enhancements are derived based on the exploration results. The modeling scenario as well as the exploration setting used for the study are illustrated in the following section.

6.1 Modeling Scenario

Figure 7 illustrates the modeling scenario which was used to conduct the practical experiments and tests. The scenario pictures the vacation application and involves three subjects named *Employee*, *Secretary*, and *CEO*[2].

The employee triggers the entire process by having the desire to go on vacation, and therefore, has to complete the required vacation form. Once the vacation form is completed, the secretary has to be informed by sending the particular form.

As soon as the message is sent, the scenario switches to the secretary who has to handle the vacation request appropriately. After receiving the vacation form, he or she checks for internal conflicts and then forwards the request to the CEO by sending a *vacation request* message. The incoming employee's message obviously differs from the vacation request which is sent to the CEO. Both the name and the data which are associated with the message illustrate the disparity due to the context of communication. Consequently, the CEO decides upon the vacation request and sends back both possible answers represented by

[2] Due to hardware restrictions, the CEO was not present in terms of an independent modeling environment, and therefore, was simulated by a computer. The required messages (confirmation and rejection) were artificially infiltrated.

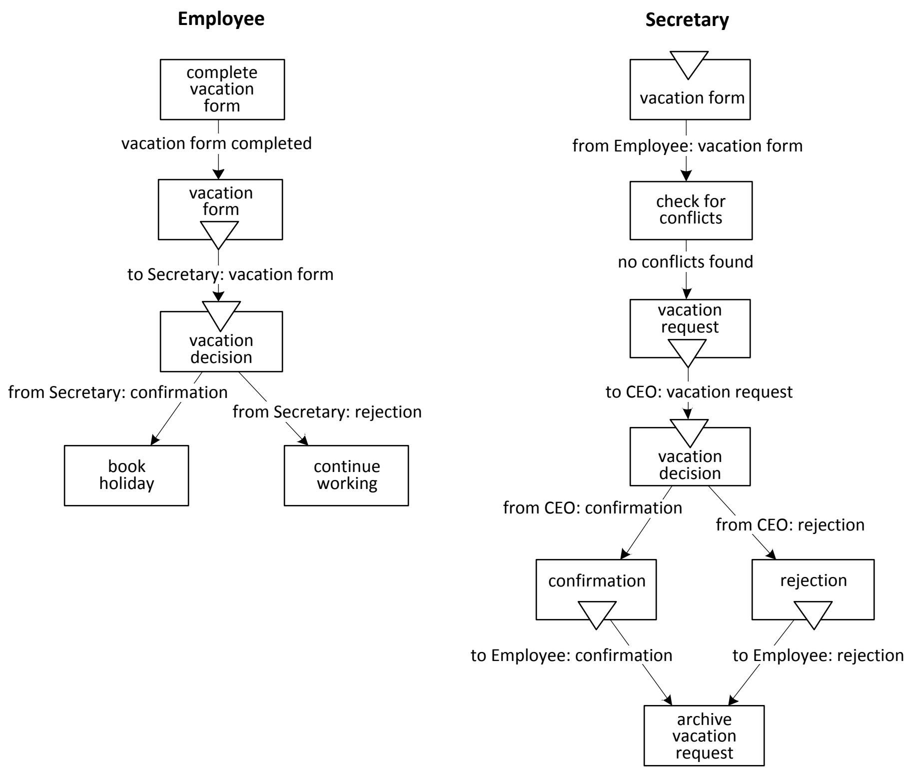


Fig. 7. Modeling Scenario

the messages *confirmation* and *rejection*. The secretary's responsibility now is to simply forward the answer to the employee and archive the vacation request for departmental purposes.

Finally, the employee who is waiting for a decision upon his or her vacation request can either book the hotel and go on vacation or continue working depending on the incoming message.

6.2 Exploration Setting

Led by the model illustrated in Figure 7, users were asked to independently go through the given example scenario step-by-step using two Comprehand tables located in the same room. The intended course of action was designed to guide the modelers to the usage of all elements and tools available in the context of collaboratively modeling subject-oriented business processes.

During the entire inquiry period, five groups of 2 to 10 people were available for observation. On average, one to three persons per group took an active part in the modeling process, and therefore, were potential candidates for identifying behavior patterns towards the acceptance and usability of the tool.

Discussions throughout the overall modeling process as well as after the sessions in terms of the exchange of experiences constituted the foundation for the determination of prospective enhancements. The most relevant insights that have been identified are described in the following section.

6.3 Initial Findings

The implementation of the study described above has provided user feedback and observations on conceptual shortcomings of the current tool support. The following list briefly describes the observed issues and illustrates the underlying indications:

Inability to choose the correct element type during modeling. There was indication that modelers have difficulties modeling business processes in a predictive way. For modelers, it appeared that it is hard to choose the right element at the time of use.

Inexistent tool support for common modeling behaviors. Observations showed that the modelers unconsciously follow similar ways of modeling business process models. Similarities emerged in the course of the performed scenarios.

No overview of global process. There were marginal differences among the various models due to the given example scenario. However, the observed modelers tended to gather process information of other subjects' internal behaviors.

No tool support for complex process models. The example scenario was intentionally aligned to the limited modeling area of Comprehand. Even though the predefined scenario, users reached the limit of both available modeling area and code recognition zone by moving the modeling elements or extending the model.

7 Resolution of Shortcomings

In the former section, the major conceptual and technological shortcomings of the current implementation of the tool set were identified based on an exploratory user study. This section presents possible solutions to conceptually enhance the usability of Comprehand and discloses continuative research questions.

7.1 Generic Elements

The approach presented here is a solution to the issue *Inability to choose the correct element type during modeling*. Comprehand currently supports the modeling of subject-oriented business processes using function, send, and receive state elements as they are defined in the concept of S-BPM. Users that prefer modeling the internal behavior preceding the communication behavior are therefore especially aggrieved since they are forced to anticipate the continuative course of the model. Appropriate elements have to be chosen at the time of their usage. A dynamic role assignment during the modeling process is not possible.

A conceivable approach to enhance the flexibility of creating models would be the introduction of a generic element [21, p. 10]. For the time being, generic elements have no semantic classifications and are aimed at decoupling the prevailing model from the target solution. These elements serve as placeholders and sustain their final role not until the model has evolved sufficiently. In other terms, modelers are free to specify the actual role of elements arbitrarily to any given time. This concept is expected to significantly influence the modeling experience by providing a more flexible and convenient way of modeling. Both modeling extremes, meaning modeling the internal behavior preceding the communication behavior and modeling both behaviors just in time, are then supported equally.

7.2 Tool Supported Model Development

The approach presented here is a solution to the issue *Inexistent tool support for common modeling behaviors.* Available information awareness features, described in section 3, guide users through the modeling process but do not exhibit any support by automatically anticipating and applying particular needs derived from the user's displayed modeling behavior.

The conducted user tests and practical experiments have identified following two main attributes which might improve the tool supported development of models with Comprehand:

1. Anticipation of edge directions considering typical modeling behaviors
2. Anticipation of edge titles considering preceding elements

The first item refers to remkarable modeling behaviors that can be used to effectively support users during the modeling process providing context sensitive suggestions regarding the direction of edges. The course of an evolving model underlies such behaviors which are unconsciously followed by users. Observations have shown that models typically possess an intuitive modeling flow from both top to bottom and left to right. Being aware of this particular flow of modeling, the tool can anticipate the desired edge direction and can instantaneously place the appropriate arrowhead. In case of a misplace arrowhead, meaning that the system has wrongly interpreted the desired flow of the model, the user is allowed to toggle the direction using the *Arrow Tool.* Further possibilities of creating inconsistent models in terms of undirected and double directed edges can be obviated by restricting the system to only enable the toggling of directions.

The second item addresses the automatic naming of edges based on preceding elements. Even though this concept can only be applied in case of preceding function state elements, it would simplify the modeling process by decreasing the user's workload. A generic naming algorithm would create the titles by consolidating the name of the preceding function state element with a phrase expressing a finished state. For example, the edge, following a function state named "Complete Form", would be named like "Complete Form Done" or "Form Completed". The implementation of this idea comes along with limitations regarding the use of generic elements mentioned in 7.1. Since the role assignment is performed at a later time by the user, the modeling elements will temporary just serve as a placeholder and cannot be identified immediately to automatically name the following edge. In this case, the naming algorithm cannot be applied. Once an element is determined as a function state and the name is set, the edge can be named automatically as long as it is not set manually.

7.3 Common View on Internal Behaviors

The approach presented here is a solution to the issue *No overview of global process*. Once a modeling session is taking place, modelers are responsible for modeling their internal behavior as well as for defining their interfaces which are required for the communication with other subjects. While being focused on the development of their individual model, they do not obtain a common view on neither other subjects' internal behaviors nor the global communication within the entire process. The modelers are therefore very close-minded and focused on their individual point of view on the process. On this account, internal and interaction behaviors are an exclusive result of the own process knowledge and are not influenced through actions caused by other subjects in any way. This might lead to inefficiencies in models caused by subjects trying to achieve local optima rather than trying to contribute to obtain a global optimum.

In this regard, group awareness is considered as an important aspect towards accomplishing a task collaboratively with respect to pursuing the process contributions and activities of others [17]. Nacenta et al. (ibid.) describe following elements that positively impact the information awareness and in turn the overall result:

– Who is working.
– Where they are working (in the task and workspace).
– What they are doing.

Thus, Comprehand has to enable an integrated view on other evolving models (internal behaviors) to foster a common view on the entire process model. The overall goal is to establish an overview of the entire model to accomplish a common understanding and view on activities and processes of all involved subjects. Modelers can then better decide on an appropriate solution of their own behavior according to the realization of an effective and efficient cooperation among all sub-processes.

7.4 Tool Support for Complex Process Models

The approach presented here is a solution to the issue *No tool support for complex process models*. Comprehand has to get by with a very limited and restrictive modeling surface in terms of available spatial space. Users quickly encounter restrictions especially when modeling more complex business process models containing numerous elements and edges. There are two potential concepts that are intended to increase the modeling possibilities respective the construction of these models:

1. Temporary removal of unused elements
2. Embedment of sub-models

Item one is targeted to manage the available modeling surface by simply removing the elements that are not taking center stage in the current model state. However, the elements are not removed from the data model and keep persisting until the user removes them explicitly. This concept allows users to easily clean up the modeling surface without losing any model information but also goes along with some negative aspects. Since the elements are associated with unique identification codes and do not have any external labels, it is hard to identify the previously assigned meaning once they have been removed from the surface.

The second concept introduces the embedment of parts of the model into one element. Designated elements therefore contain parts of the existing model but are still present on the modeling surface. An approach for defining an interface with which the collapsed model can be interconnected has to be developed.

Using concepts to enhance the ability to create more complex models can be additionally supported by a monitor showing the current state of the entire model including elements that have been removed or embedded due to the lack of modeling space.

8 Discussion

Using the Comprehand approach and tool set to support the collaborative modeling of subject-oriented business processes is a new approach to foster the elicitation of business process knowledge in a stakeholder-driven setting. In its first implementation, the focus has been on providing a technical support platform consolidating methods derived from *Mental Model Alignment* [2] in the context of *Articulation Work* [27], the concept of *S-BPM*, and a spatially distributed collaborative approach to elicit process knowledge. Based on these results, further research can now be conducted to study possible impacts on the elicitation of subject-oriented business process knowledge as well as how this tool can effect learning processes of the S-BPM method itself.

People are capable of externalizing knowledge in terms of diagrammatic, formalized models once they receive appropriate tool support [21, p. 17]. This paper has described the usage of Comprehand in the context to facilitating a working environment in which users do not have to focus or even be aware of modeling language constraints and rules. In fact, it is feasible to almost completely focus on eliciting available process knowledge while the tool set keeps track of the model state and provides modeling scaffolds whenever necessary. Using Comprehand to create an active learning environment for conveying and teaching the S-BPM method is another potential research and application area. The aim here is to identify and support individual learning processes while people are externalizing business process knowledge, using the subject-oriented approach supported by an interactive platform.

Consequently, further research will focus on how Comprehand can help to develop people's subject-oriented business process understanding and externalize their work-specific knowledge even in spatially distributed environments. Research areas will include the identification of positive and negative aspects concerning the outcome in terms of the quality of the business process model and the perceived mapping accuracy between the real world and the model.

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