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A Meta-Design Approach for Collaborative Process Modeling

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Abstract. Modeling business processes has become a complex design task due to a increasing rate of organizational change. Therefore business process modeling is in search for ways to reach beyond the rigidity of traditional approaches. In order to overcome new challenges, like the involvement of a diverse stakeholder community and variability of models, end-user development (EUD) and collaboration are considered promising instruments. In this paper we propose to enhance collaborative process modeling by EUD concepts. Precisely we apply the Meta-Design guidelines to the domain of business process modeling and present a first prototypic environment for collaborative process modeling along with a case-study. The paper concludes by highlighting benefits and unsolved issues of our Meta-Design based process modeling approach and by indicating the next steps of our research.

Introduction

The variability of business processes and associated process models is a frequently stated challenge in designing flexible and adaptive business process management (BPM) systems (van der Aalst et al., 2003; Kettinger and Guha, 1997; van der Aalst and Jablonski, 2000; Schonenberg et al., 2008; Dadam and Reichert, 2009; Rosemann et al., 2008). While the research focus has mainly been concentrated on creating flexible process modeling techniques and workflow management systems little attention has been dedicated to an in-depth investigation on the flexibility and openness of modeling environments, especially to enable end-user participation in process modeling (Dadam and Reichert, 2009).

Traditionally the process of process modeling follows a linear model with sharply separated phases reaching from analysis to design of a process model and it's instantiation (Weske, 2007). Usually the modeling process is limited to design-time of a system mostly being part of an ex-ante requirements elicitation process. Recent research streams challenge this approach in various ways. For example Dadam and Reichert (2009) have shown approaches for a run-time extension or modification of process model instances which can be fed back to the original process model. Thus, a shift from linear models to spiral models or incremental approaches can be observed. The process of modeling can be seen as a continuous process involving multiple stakeholders and has to satisfy multiple perspectives which might as well change over time. Although not yet sufficiently addressed in research the importance of stakeholder participation has been stated in several empirical studies like Davies et al. (2006).

Organizational context however requires tools which support a flexible and easy participation in the modeling process and which are themselves flexible enough to be adapted to a changing environment. Hereby, the emerging paradigm of end-user development (Lieberman et al., 2006) and research initiatives in the field of collaborative design offer promising approaches for the engineering of open modeling environments to foster the integration of diverse stakeholders into the modeling process.

In this paper we argue that through flexible and open modeling environments the effective involvement of end-users into the modeling process can be supported. As a starting point for our research we articulate challenges of collaborative process modeling and use a Meta-Design approach suggested by Fischer and Giaccardi (2006) to derive key features for a respective modeling environment. We present a preliminary wiki-based prototype for user-driven collaborative process modeling and a case-study. Finally, we conclude by discussing our experiences and open issues of our research work.

Challenges of collaborative process modeling

As a starting point to depict the challenges experienced in collaborative process modeling we will refer to an adapted life-cycle model of a process model frequently proposed in literature (van der Aalst and van Hee, 2004; Weske, 2007). The life-cycle model reveals typical stages of a process model reaching from an initial design idea to a more or less formalized process model.

The life-cycle of a process model is determined by the purpose of modeling (Becker et al., 2000). One predominant purpose is the documentation of "as-is" processes to identify shortcomings and potential improvements. As-is models also serve as a knowledge base for participants in a business process. In many cases it is important to model a "to-be" state of a process. To-be models help businesses to understand organizational and financial impact of a new process or process change (Speck and Schnetgöke, 2003). Another purpose is the creation of models that can be used as a basis for process simulation or can be transformed into an executable

model description (mostly referred as workflow). Hereby, a major challenge deals with dissolving the sharp distinction between “to-be” and “as-is” models thus leading to process models which are close-to-reality at all time of business operation.

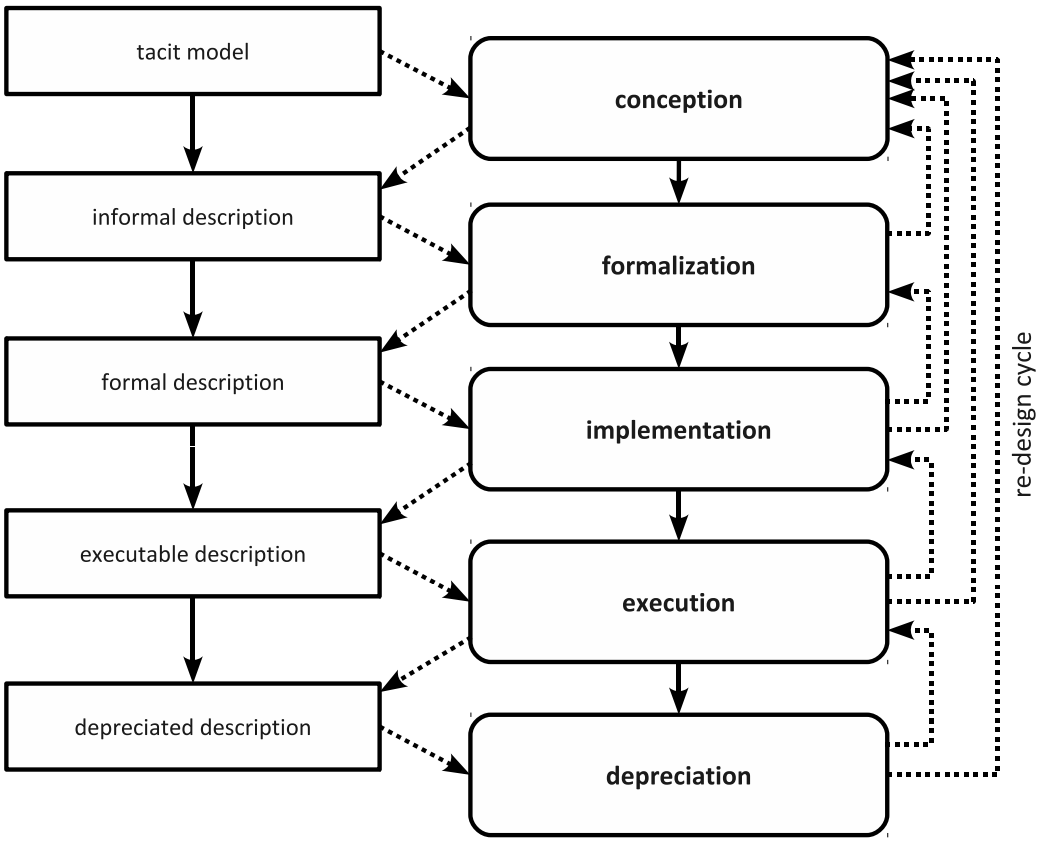

Figure 1. The process model life-cycle showing the different phases and related model representations.

Concerning the artifact as the outcome of collaborative modeling such a process model is characterized by complexity and volatility (Cardoso et al., 2006; Gruhn and Laue, 2006). Complexity is caused by the number of variables that determine a process. Process models are typically constituted by structural entities such as activities, flow logic, events, conditions, decision nodes and attributes like costs and resource allocation. Volatility arises as processes and therefore process models have to be adapted to an increasing rate of changing conditions. A process model artifact runs through a life-cycle starting with a tacit model and ending with a more or less formalized and executable model description (see Figure 1). Respective tools which claim to support the collaborative modeling process would have to enable the coexistence of multiple representations of a model ranging from informal descriptions of a process (e.g. a narrative text), semi-structured descriptions (e.g. a use-case template), graphical process models (e.g. a BPMN[1] diagram) and ex-

[1] Business Process Modeling Notation, for details see http://http://www.omg.org/bpmn/

ecutable descriptions (e.g. a BPEL[2] description). A closely related challenge is stated by Renger et al. (2008): namely the choice of a good starting point for a collaborative modeling effort, meaning that usually an initial or preliminary model provokes communication and problem structuring.

The process model life-cycle can also be analyzed with respect to the diversity of stakeholders typically involved in the design of a process model. First we can distinguish novices from experts regarding the knowledge about a specific business domain. Second we distinguish along the hands-on skills regarding process modeling and associated tools. A third dimension arises when we consider the knowledge about the design of software systems that rely on a more or less formalized business process model. Fourth, stakeholders in a business process typically have a specific organizational role which imposes a specific involvement or behavior in the life-cycle of a business process. Organizational roles range from managerial roles typically having a broad view on a process to employees focusing only on the process fragments that relates to the tasks they are expected to accomplish. Modeling environments should have not only to support but foster flexible and easy participation of diverse stakeholders along the process model life-cycle. A special case in the spectrum of stakeholders is the role of a facilitator. The importance of a facilitator is stated in several studies (e.g. den Hengst (2005); Vennix (1999)) mainly because it is considered to be vital for reaching shared understanding among stakeholders and transferring different views on a process into a valid model.

The promises of end-user development

End-user development (EUD), as depicted by Lieberman et al. (2006), aims at shifting development tasks from programmers to end-users and thus evolving systems from being "easy to use" to being "easy to develop", primarily to enable users to design software solutions which highly fit to their needs and perceptions. The EUD paradigm has emerged in the field of software engineering and reaches beyond the claim of agile methods (Cockburn, 2007) and participatory design (Muller and Kuhn, 1993) which involve users at design-time in the development process but do not enable them to actively shape applications to their specific needs at run-time. Although rooted in software engineering EUD shares many basic ideas with disciplines like CSCW (Lieberman et al., 2006) and recent phenomena like Web 2.0 or Social Media (cf. the long tail of software by Kraus (2009)).

The basic assumption behind EUD shows commonalities with findings in Business Process Management (BPM). It is the increasing frequency of change and diversity in life-cycles for individuals and for organizations as well as an environment which need an increasing flexibility and adaptivity of technical systems claiming to support the user in his activities. Fischer and Giaccardi (2006) state that "creating the technical and social conditions for broad participation in design activities is as important as creating the artifact itself". The EUD paradigm tries to be applicable

[2] Business Process Execution Language, for details see http://www.oasis-open.org

to any domain involving software support and does not anticipate much about the outcome or object of a collaborative design process. In the case of business process modeling the outcome of a socially enabled design process would be a process model artifact that represents multiple views and does not claim to be in a final state. Thus, process model evolution is considered a natural and ever emergent phenomenon which has to be included by design in any processing modeling technique or tool.

The application of the EUD paradigm to process modeling environments seems – at least from our point of view – to have potential for future research. In this paper we investigate the potentials of the EUD paradigm and in particular the Meta-Design approach by (Fischer et al., 2004) in the context of business process design.

A Meta-Design approach towards process modeling

In order to examine collaborative process modeling under the perspective of EUD, we investigate the Meta-Design guidelines by Fischer et al. (2009). Basically, Meta-Design comprises a set of very generic guidelines which are valuable for developing and providing EUD environments. Due to our focus on process modeling we highlight the important aspects of the Meta-Design guidelines and derive key features for a collaborative process modeling environment according to the specific problem domain.

Addressing design and usage in the scope of EUD (Lieberman et al., 2006), it has to be manifested that modeling itself is considered as the design phase while applying models in business operation or instantiation of workflows in software comprises the usage phase. However, the border between design and usage is very indistinct, as collaboration between different users fosters adaptation of a pre-defined environment during usage.

Moreover and with respect to the "seeding, evolutionary growth, reseeding" (SER) model by Fischer and Giaccardi (2006), the process models do not have to be complete before they can be used (e.g. filed in an archive, inspected by other users, verified by experts, shared within a company or community, etc). For a collaborative approach towards process modeling we even consider that partially incomplete process definitions can be executed in a workflow engine and be complemented by end-users (with different roles) on execution time (Neumann and Erol, 2009).

Support human-problem interaction

The very first Meta-Design guideline deals with the issue that domain experts do not want to be bothered with computers and software problems but with domain-specific tasks and challenges. Due to the complexity of computer systems, process modeling tools and process models, an environment for designing and managing process models must hide non-modeling issues (like operating system facilities, distracting features or disturbing information) from end-users.

Therefore we argue, an environment for modeling business processes collaboratively must provide (1) the facilities for process modeling, (2) support mechanisms for single user interactions (i.e. recommendations of activities and activity sequences for specific situations and problems), (3) visual feedback on the process definition (e.g. highlighting control flow errors), (4) feedback on collaboration with other users (e.g. conflicts through concurrent editing), as well as (5) a catalog of design solutions to typical problems (i.e. pre-defined templates for business processes which could be shared within a company or community).

Collaborative modeling tools must somehow act as a facilitator to enable users to focus on the problem instead of hassling with the tool and provide features to mediate shared understanding.

Underdesign for emergent behavior

The second guideline of the Meta-Design framework addresses the support of a tool throughout the modeling process and recommends to "underdesign" the modeling artifacts to achieve emergence of behavior. It requires that a model artifact is not delivered as a finished product, but allows users to solve parts of the overall problem stepwise thus supporting the concepts of "hackability" and "remixability" of (user-created) solutions.

In the scope of process modeling a tool is required that enables users to modify parts of (probably large) process definitions, to verify and store these fragments of a process separately, and also to share them with others. In sum, users should be able to decompose the design problem (a process definition) into smaller design elements and combine them with other elements which can be even given by other users. Concerning reusing design elements, such a process modeling tool might also consider data given from other users as an additional component for designing processes.

Enable legitimate peripheral participation

As a consequence of user contributions to software (i.e. the overall environment and process models), the third Meta-Design guideline refers to policies and procedures for incorporating this user input for software tools and for making them aware of their influence on the system.

For the context of collaborative process modeling, a tool requires facilities for sharing outcomes of other users, like process models or parts of them. In combination with the last guideline, underdesign for emergent behavior, user participation can also be fostered by allowing "incomplete" processes as well as process fragments, so that users can slowly start to get into process modeling instead of being confronted with large, complex process models and the creation of them. Finally and regarding Fischer et al. (2009), process modeling should also support so-called satellite communities, i.e. spaces for people in a certain domain or working on specific types of processes and process fragments which will be incorporated into the overall environment when mature.

Share control

The forth guideline deals with user control within EUD environment with the particular goal to support different roles in the modeling process as well as in the process. Therefore, the Meta-Design framework proposes to enable users to share control within software systems, e.g. by granting access to artifacts they have created or by authorizing others for certain actions.

Projecting this guideline onto collaborative process modeling, the environment must involve the different stakeholders, as elaborated in the former section, and give them adequate authority (control) according to their responsibility and role. Following the experiences from successful open source projects (Fischer et al., 2009), granting authority attracts user who want to influence the EUD environment as well as the outcomes (the process models).

Due to the collaborative character of our process modeling approach, we highlight two important issues here. On the one hand and with respect to privacy issues in online communities (Dwyer et al., 2007), users must have control over their data and share this control on a fine-grained level. On the other hand, collaborative authoring of documents (Borghoff and Schlichter, 2000) required facilities for controlling edit operations in order to avoid conflicts between different users. Both aspects are relevant for collaborative modeling of business processes.

Promote mutual learning and support

As users have different levels of skills and knowledge, this Meta-Design guideline refers to knowledge sharing mechanisms that encourage users to learn from each others. An EUD environment for process modeling could include tools like forums, mailing lists, chat rooms, and other tools to exchange knowledge among peer users. Current technologies like social networking platforms (Facebook, MySpace, etc.) also apply recommendation strategies to support users in working with a system and connecting them to peers.

All in all, an environment for process modeling requires strategies for supporting users in using the design facilities, finding relevant artifacts (e.g. templates or fragments of process definition) and peers (e.g. expert in the same domain or the owner of a relevant business process), and fostering practice sharing within a community.

Reward and recognize contributions

Similarly to the last guideline, this one addresses the need to motivate users for actively participating in the evaluation of the EUD environment, precisely by rewarding and recognizing their contributions. As motivation of human beings can depend on many (intrinsic and extrinsic) factors, Fischer et al. (2009) postulate that many different strategies could be applied.

In the context of process modeling, contributions must be assigned to users. Apart from simple benefits like optimization of time and effort for an individual

contributions must be recognizable. It is necessary that they can be found within a software system, or that they are suggested actively by a platform (as observed at many networking sites). Furthermore, a reward strategy such as explicit user feedback (cf. Facebooks like button or the possibility to comment items) is highly recommended. Finally also statistics about usage or linking of process models and navigation facilities might increase the findability of user contributions.

Foster reflective communities

The last guideline given by Fischer et al. (2009) focus on the utilization of collective intelligence in order to solve complex design problems. Thus, EUD environments should include facilities for collaboration and communication, i.e. to create a shared understanding among domain experts and to build and sustain a community of end-user developers. This aspect is of particular relevance for process modeling, as several stakeholders from different areas are involved into business processes. In accordance with key features derived in former guidelines and functionality of social networking platforms, we propose typical features like sharing, rating, tagging, and commenting process models, enabling collaboration and communication between users, recommending process templates and peer users, etc.

Derivation of key features

Summarizing this section, the left-hand side of Table I gives an overview of the original Meta-Design guidelines which are kept very general and thus applicable for nearly all kinds of EUD environments. Next to each guideline we highlight the key features of a collaborative process modeling environment which relates to this specific guideline.

In the next section we will present a first prototype of a process modeling environment considering at least some of the key features derived from the Meta-Design guidelines.

A Wiki-based modeling environment

In a recent research effort we incorporated EUD principles into a wiki framework to achieve a prototypic open modeling environment. The basic wiki application was built upon a well established and broadly used open-source community platform, namely OpenACS (see Demetriou et al. (2006)). XoWiki – a wiki framework for OpenACS based on the object-oriented, Tcl-based scripting language XoTcl – is currently implemented in the context of numerous e-learning platforms (Neumann, 2007).

The wiki approach seems – at least from our point of view – to fulfill the guidelines proposed by the meta-design framework in various ways (see references to Table I in brackets). First, the wiki system is by design an open environment that

Meta-Design guideline & key concepts by Fischer et al. (2009)	**Derivation of key features of a collaborative process modeling environment**
1. Support Human-Problem Interaction: avoid computer and handling problems, focus on domains and tasks of end-users	(a) consideration of process modelers and non-modelers, (b) recommendations of possible process tasks, (c) visual feedback of process definition, (d) feedback on collaboration, (e) provision of design solutions (e.g. templates)
2. Underdesign for Emergent Behavior: use simple modeling components to be reused by users	(a) possibility to partition large process models, (b) separate verification and storage of process fragments, (c) sharing of fragments
3. Enable Legitimate Peripheral Participation: provide policies and procedures for user participation, create awareness of influence	(a) involvement of other users (e.g. assigning modeling task), (b) allowance of incomplete processes to be completed by others, (c) possibility of merging process fragments of others into a process, (d) support of satellite communities (see 1.)
4. Share Control: support different roles in the modeling and the process, grant access to artifacts	(a) access permissions for processes and fragments, (b) preservation of privacy in the community, (c) concurrency awareness and control to avoid editing conflicts
5. Promote Mutual Learning and Support: foster knowledge sharing amongst users	(a) practice and knowledge sharing through recommending process tasks, fragments, and peer actors, (b) typical social networking functionality
6. Reward and Recognize Contributions: motivate end-users to participate actively (multiple strategies)	(a) possibility to assign modeling tasks and visual feedback on overall outcome (see 3. and 1.) and user contributions, (b) (implicit or explicit) user feedback on process models (comments, I like button of Facebook, etc.)
7. Foster Reflective Communities: use collective intelligence to solve complex design problems	(a) facilities for collaboration and communication amongst end-users, (b) typical functionality of social networking platforms (sharing, rating, tagging, recommending, etc.; cf. 5.)

Table I. Specialization of the (generic) Meta-Design guidelines for collaborative process modeling.

facilitates broad participation in the creation and modification of model artifacts regardless the characteristics of a specific stakeholder. Second, typical wiki features like descriptive page identifiers, simple linking by page titles, on-the-fly creation of pages that do not already exist and flat structure of content are a good starting point for an open and end-user oriented collaborative environment.

XoWiki supports multiple representations of process models ranging from simple textual descriptions to use-case templates and graphical representations (see Figure 2). The ability to configure the user-interface and the diversity of representations of a model offers each stakeholder an appropriate access point to articulate design problems and find solution suggestions. XoWiki can be configured to allow only strict formal process descriptions through forms and associated validation mechanisms but also may be configured to allow simple (underdesigned) textual descriptions and graphical diagrams ($\rightarrow$[3] 1a, 3a). Process models and fragments can be enriched with various media formats like documents, videos, images, audio files, etc. Such rich process descriptions can be collaboratively developed, linked, bookmarked, searched etc. in a single environment ($\rightarrow$ 5b, 7b).

[3] We use the right arrow symbol to symbolize references to the guidelines in Table I

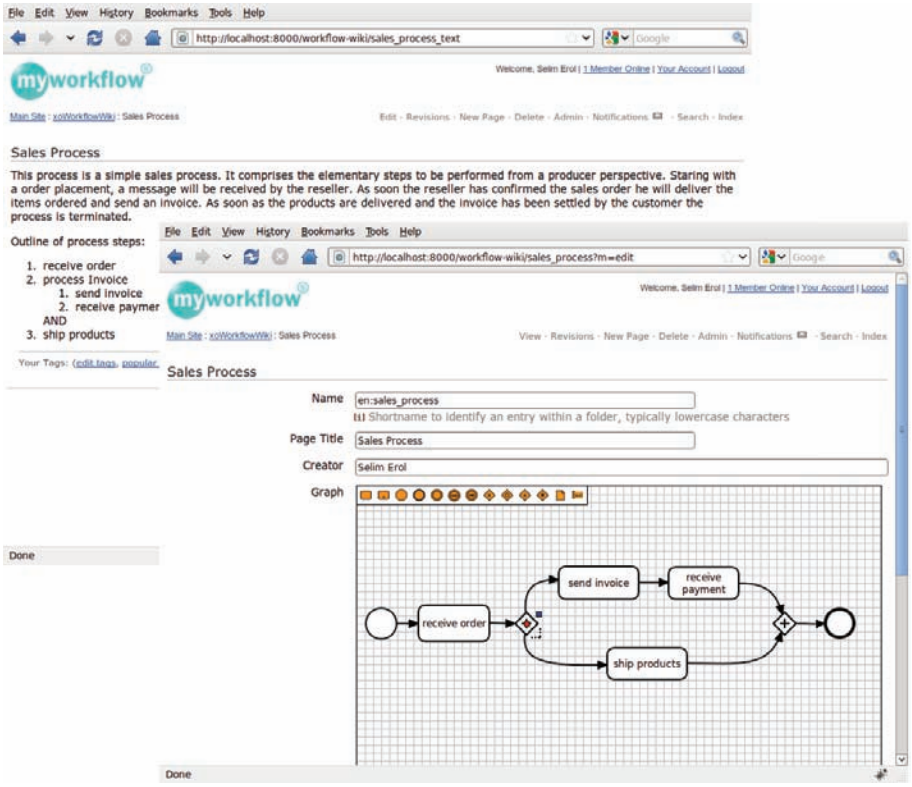

Figure 2. Different user-interfaces representing a textual description of a simple sales process and an associated graphical representation.

Process descriptions of any kind can be divided and linked into arbitrary fragments (→ 2a, 2b, 3b, 3c). Vice-versa process model fragments can be connected to form higher-level models. Apart from vertical fragmentation, horizontal fragmentation is possible by extending and linking fragments to each other. The combination of bottom-up and top-down modeling is considered to support the creation of seeds and emergent design behaviors. In addition to the mechanism for fragmentation of process models legitimate peripheral participation is enabled via typical commentary and tagging functions. Such process model descriptions can be exposed to discussions, reflections and contributions from the community without necessarily intervening the design process (→ 2c, 6b, 7a). The coexistence of different descriptions each reflecting a specific view and state of a process model fosters knowledge sharing and mutual learning among multiple stakeholders. The exploration of comments and revision histories additionally enables stakeholders to learn from the evolution of a process model description.

In scenarios (e.g. in organizations) where a certain degree of control of "who-may-edit-what" is desired XoWiki offers a fine-grained user and role concept to define content policies from complete openness to multi-level access policies (→ 4a). The content flow component of XoWiki (Neumann, 2008) provides explicit state modeling for all wiki objects. By using this component, one can define workflows for the processing of wiki pages. One can for example define release processes,

complex page flows or other user interaction sequences. The workflow is based on the state design pattern (Gamma et al., 1995) and can therefore provide a different behavior and/or different presentation depending on the state and the defined user roles ($\rightarrow$ 4a). This mechanism can also be used to define the development process of a business process models. One can offer different user-interaction controls at design time of the business process models, or define release steps, or simply make the state of a modeling fragment explicit.

Through the concept of activity graphs (Neumann, 2007) the system provides an awareness mechanism which reveals individuals contribution to a process model ($\rightarrow$ 1d, 5a, 6a).

The process modeling wiki described is fully implemented as a prototype that can be used for a web-based shared development of business process models. So far, we have not evaluated the system in the larger scale but we have conducted first usability studies and a case-study which will be described in the next section.

Case-study: a book order process at New Media Lab

The Case

At the Institute of Information Systems and New Media at the University of Business and Economics in Vienna we have recently decided to support our book ordering process by means of software. The basic idea was to enhance the existing process which was characterized by multiple entry of the same data and mostly outdated information on the book's actual location and availability. This resulted from the use of multiple applications (e-mail, local database application, library catalog) to order a book and store data on a book. The administration of the book records by office staff lead to an out-of-date information on the books' actual location and availability. This was mainly due to the fact that staff members exchanged books without informing the office management. The meta-data (author, title, year of publication, ..) of a book proved to be incorrect or incomplete in many cases. The process knowledge which existed tacitly scattered among the different parties involved was not externalized in any way.

In order to capture the different views and knowledge of the "as-is" process we used the wiki-environment proposed above. Therefore we created some introductory pages and also linked to external resources, especially for tutorials on the modeling technique to be used. The introductory pages can be classified in information about the general use of the wiki, information about the purpose and goal of the case-study and information on how to contribute to a process model. We also included a sample process model and a preliminary and yet very high-level model of the book order process.

Along with the invitation of the stakeholders we conducted a short individual training to explain the background of the task and give some motivational support. The stakeholders finally involved comprised five members of the scientific staff both at senior and junior level, the head of the institute and our office management staff.

While scientific staff partly had expert modeling skills the employee responsible for book administration did not have any knowledge about process modeling.

Lessons learned

The case-study presented reflects a typical situation in process modeling. The capturing of the "as-is" process is the basis for a continuously evolving "to-be" process model. In the following we will outline selected experiences we gained during this study.

During our introductory face-to-face sessions at the beginning of the modeling we frequently experienced the objection that this process is that simple that it can be described in one sentence. We traced that back to the fact that each stakeholder only had a limited view on the process and therefore initially underestimated the complexity of the process. With the course of the study and the increasing number of contributions these objections became obviously invalid.

Although the office management staff member had no modeling skills she could quite accurately describe the sequence of activities, conditions and information objects involved in the process. To externalize her knowledge she used a simple wiki page with a built-in rich-text editor. The representational style she has chosen was narrative and semi-structured with bullet points. Her contribution proved to be a valuable input for modeling experts.

During the starting phase reflections on the model to be created were mostly dominated by concerns about how to use the tool. This valuable feedback for further development of the tool somehow contradicts the first guideline of the meta-design approach which demands that a respective tool should not hinder human-problem interaction. However, the reflections on the tool abated with the further use of the tool. Another issue that led to discussions during the design process was the usage of symbols for modeling links to other process fragments or sub-process pages.

Some of the participants commented on the usefulness and usability of the tutorials without recognizing the possibility to contribute or change them the way they want them to be. We have to say that we did not stress this possibility explicitly in the introductory session. We continuously modified and extended the learning materials during the study according to user comments.

Although initially intended to have a high level process model developing into detailed sub-process models we experienced a fragmentation taking place from the very beginning. This was due to the fact that some of the modelers feared the interference with other modelers working on the same page. A first analysis of revision histories of the model fragments revealed that some participants contributed many revisions over several weeks. Others participated once contributing only one revision.

The role of a facilitator proved to be important in two ways: First, participants needed a introduction to the task as a starting point for their contributions. Second, a kind of linking and alignment had to be performed to integrate individual modeling efforts.

The preliminary results of the case-study will enable us to reflect on the validity of the guidelines proposed for collaborative modeling. For further evaluation we will have to involve a broader audience into the modeling process (e.g. the company responsible for shipping the product, library service) and observe the evolution of a process model over a longer time-period.

Related work

Renger et al. (2008) summarized the most prevalent challenges of collaborative modeling found in literature in the fields of problem structuring methods, group model-building and enterprise analysis. One of the key issues is the importance of a facilitator in the modeling process. Other key issues are the choice of a starting point and modeling in parallel. The literature review is comprehensive but is focused on providing a general (high-level) analysis of challenges in collaborative modeling. Nonetheless, this served us as a basis for more concrete challenges especially when it comes to requirements for tool support.

Recent empirical work was also conducted by Rittgen (2009, 2010). In several experiments, case-studies and interviews he investigated business needs and success factors for collaborative business process modeling. He studied practical business experiences and needs in collaborative modeling. Although Rittgen's studies provide a valuable basis for our approach it is actually limited to small and expert oriented groups and does not provide insights when it comes to open modeling environments where the community of participants is not predetermined.

Decker et al. (2007) have investigated the use of wikis in requirements elicitation. They provide an outline of advantages in using wikis compared to other tools. Many of the propositions are equally valid for collaborative process modeling. In (Decker et al., 2004) a methodological approach and platform is presented for participative process modeling and learning. Results of three case-studies show that higher user acceptance and perceived model quality can be reached through user participation. A process modeling method especially designed for user participation is suggested by Becker et al. (2007). The approach consists of a set of language constructs and a procedure model which "allow for an easy and straightforward modeling of a public administrations process landscape". The researchers proved the applicability of their approach in several projects.

Concerning tool support for collaborative modeling we want to outline two distinct developments: one approach is presented by Hasso Plattner Institute and has integrated a web-based modeling editor into Google Wave (Hasso Plattner Institute, 2010b; Dreiling, 2010). Thus, allowing users collaboratively annotate and communicate on process models while actively modeling. The same research group has launched a community portal for sharing and collaboratively editing models (Hasso Plattner Institute, 2010a). Another development is an open platform for sharing scientific workflows (Roure et al., 2007).

Conclusions and outlook

In this paper we highlighted challenges and problematic aspects of collaborative process modeling and proposed to apply concepts of end-user development to enhance process modeling. We also tried to come up with a EUD based approach towards collaborative process modeling which is based on the Meta-Design guidelines. As a first proof-of-concept, we presented a prototypic environment which is designed according to the Meta-Design guidelines for process modeling.

Overall we think that the complexity and volatility of designing business processes requires such a step towards an open and collaborative design process. At this early stage of our research it is already apparent that specific aspects – such as the emergent behavior through under-designed, the active involvement of stakeholders, scaffolding and mutual learning support, rewarding and reorganization mechanisms, as well as reflection and community aspects – are of particular relevance for an open process modeling environment. To underpin this assumption we have derived key features for such modeling environments from the Meta-Design framework and incorporated them partly in a wiki-based modeling environment.

Although we have not realized all key features, we have developed a prototype modeling environment that is intended to be an open design space where stakeholders are encouraged to contribute and share knowledge regarding processes. For instance, stakeholders are able to design process fragments within their scope of responsibility and according to their domain knowledge. These specialized parts of process models can be shared, reused and improved. Stakeholders are not limited to one representational style of a process model (e.g. a process BPMN graph) but are able to contribute in various ways (e.g. simple textual descriptions or comments). The wiki-based modeling environment is not limited to support the continuous and user-driven evolution of process models but allows also to collaboratively develop associated artifacts like tutorials and other learning resources. Finally, the modeling environment has also to be considered as subject of continuous evolution. Thus, feedback mechanisms should not only be targeted at the design object – in this case a process model – but also at the tool claiming to support the design process.

A case-study was conducted to validate the prototype modeling environment along with the theoretical assumptions. The preliminary results of the case-study show us that the users involved reflected both on the modeling object and the modeling environment. We experienced remarkable differences with regard to the extent of contributions from individuals and the type of contribution (e.g. informal vs. formal). During the case-study we also observed a strong need for instruction and facilitation during the modeling process.

In sum, this leaves us two important issues to continue research work. On the one hand, it is necessary to develop an evaluation framework for process modeling environments which claim to support organizations in collaborative model building. Similar prototypical attempts from other research groups (see e.g. Hasso Plattner Institute (2010b) and Roure et al. (2007)) encourage us to establish a framework that provides basic theoretical concepts to collaborative modeling and furthermore

forms a basis for evaluation. On the other hand, we will go on with development work on our wiki-based modeling environment and also evaluate it in the form of user studies and ex-post data-analysis. We will have to rigorously study the impact of different collaborative features on modeling outcome.

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