Facilitating Participation of Stakeholders during Process Analysis and Design

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Abstract. Collaboration of stakeholders to contribute to process analysis and design is a common practice in organizations to achieve better results. However, while it has been acknowledged that for stakeholders being able to directly influence design not only makes for better results but also increases their motivation, stakeholders are mostly limited to providing information and leave the design for process analysts or consultants. Furthermore, stakeholders are only involved when process analysts ask them to contribute. Consequently, stakeholders are cut off from many activities that shape the resulting process analysis and design. To overcome this problem, we propose a twofold approach: Firstly, we provide a socio-technical concept that increases – in comparison to existing approaches – opportunities for stakeholders to participate in process analysis and design. Secondly, we propose a mix of methods to evaluate the quality of participatory modeling that allows for evaluating stakeholders' inclusion and support deriving suggestions for cyclic improvement of the concept.

1 Introduction

The analysis and design[1] of business processes is a complex task and requires contribution from several perspectives. Therefore it is reasonable to involve several roles into analyzing and designing processes using artefacts such as process models as shared material [9, 16]. We mainly differentiate between two types of roles:

- **Stakeholders:** They are domain experts including managers and operative forces who are familiar with a process (or the requirements for a new process). Domain experts know the context of the process that is to be analyzed and designed. Stakeholders also include people who have a certain interest in a process and can contribute additional insights to its analysis and design. Most stakeholders are not familiar with modeling notations or methods and have to be considered as **lay modelers**.

[1] "Design" in this context refers to newly designing a business process as well as re-designing an existing one.

adfa, p. 1, 2011.

- **Process analysts:** They know how to gather information about a process, ways of analyzing and visualizing it, proposing measures for improvement and design. Process analysts can be considered **expert modelers**. They have a lot of general knowledge about process design but are not familiar with concrete processes and their context.

Both types of roles can overlap but generally there is a knowledge gap between them, especially as process analysts oftentimes do not share the same background with other participants (i.e. they are not part of the same company). Stakeholders are generally not capable of analyzing processes and visualizing them using a modeling notation on their own [28]. They can however contribute their individual domain knowledge [20, 31], but they need support by process analysts to systematically transform this knowledge into graphical processes diagrams based on modeling notation.

To provide this support, process analysts have to gather the relevant information and to be prepared to understand the context of a domain, For this purpose they have a number of different approaches on their disposal such as document analysis, interviews, observations or other ethnographical approaches and workshops (c.f. Dumas et al. [9] for a detailed overview). There are however several problems that are not addressed when only document analysis, interviews or observations take place: Existing processes or the needs for designing new processes are not appropriately understood without an intensive discourse between stakeholders and between them and process analysts. This is especially critical when the process analysts' conclusions about the process are not complemented by the stakeholders' feedback. Furthermore, if knowledge about the context of a process is not systematically taken into account, it will be hard to bring the process into reality. The staff potentially will not comply with the process or at least not be motivated to work in accordance with it [11].

If the aforementioned methods of information elicitation are complemented with discursive workshops, a suitable solution for the knowledge gap problem can be achieved, as workshops allow for perspectives sharing between stakeholders and promote a deeper understanding of the process. However, workshops alone do not provide sufficient opportunities for the exchange of the stakeholders' and process analysts' perspectives because of time constraints and aspects of group dynamics (c.f. section 2).

In order to overcome these limitations and subsequently increase the means of stakeholders to participate in process analysis, we propose an approach that intertwines workshops with phases of asynchronous collaboration where stakeholders can access and work on process models. Since stakeholders usually are lay modelers, we suggest that we will not allow for them to modify a model with respect to a modeling notations. We will rather apply an approach has previously been employed in the domain of computer supported collaborative learning: Allow for participants of courses to asynchronously collaborate on course material using annotations [1, 5, 18, 26]. Applying an approach like this for process analysis and design leads us to the following research question:

RQ 1: To what extent does the possibility of inspecting and annotating process models between workshops increase the experienced influence of stakeholders on process design?

In order for stakeholders to inspect models and create annotations, they at least have to be capable to understand processes and process models on their own. There is some evidence supporting the assumption that they are capable of understanding models of processes they are familiar with [19, 30, 32]. While this seems probable it remains unclear whether or not allowing stakeholder to use process models and annotate them without support by process analysts actually affects participation. This results in the following research question:

RQ 2: To what extend does the concept improve the influence of lay modelers on the outcome of process modeling?

To answer these questions we developed a socio-technical concept that intertwines workshops with phases of asynchronous collaboration using annotations (section 3). In order to come up with such a concept, we reviewed relevant approaches from the fields of participatory design and collaborative work (section 2). To evaluate the subsequent concept we had to develop a novel approach that combines an evaluation of participants perceptions with document analysis methods, interviews and video analysis which will be presented in section 4. This mixed method evaluation allowed us to evaluate the socio-technical approach described in section 3 on a deeper level, thus providing better results (section 4.2). In section 5, we will discuss findings of the study before concluding with a summary of the results and suggestions for future research (section 6).

2 Related work: Collaborative participation and process analysis

In the context of software development it has been found that participation of future users in the design of new systems results in better (i.e. more fitting) products [3] and motivates people to adopt new systems [11]. Similar experiences have been reported in workflow projects [17] especially when it comes to people taking part in process design [13]. However, in order for stakeholders to become co-designers, process analysts and stakeholders have to collaborate during process analysis and design [23]. This means that process analysts not only have to gather information about a process – as in traditional process modeling approaches [9]. Stakeholders in turn also have to learn about using process models since these models are usually the kind of documentation that process analysts use for process analysis and design. Models in this context can serve as a boundary object [34] which supports both sides – stakeholders and process analysts – to collaborate in process analysis and design. In more general terms it means that there is a knowledge gap between process analysts and stakeholders that has to be closed. In order to intensify interaction about and on process models between stakeholders and process analysts, a number of workshop concept have emerged during which stakeholders are supported by facilitators and process analysts to analyze and design processes using process models (e.g. STWT [16] or COMA [32]).

The presented approach (c.f. section 3) extends and improves a participatory workshop concept which was developed to support collaborative process analysis – the socio-technical walkthrough (STWT). The STWT is well grounded in the context of Participatory Design (PD) (cf. [14, 15, 25]) and takes into account the principles of PD as

described in the MUST-Method [21] which are relevant for process design. The MUST-Method is also the basis of recent publications about guidelines and principles in the PD-context (e.g. [4]). However, the STWT is focused on co-located meetings in workshops and does not take cultures of participation [10] into account, which would allow for more participation of a broader audience by employing the principles of Web2.0 technologies. Furthermore, the collaboration mode of workshops leads to the problem of production blocking [8]. Production blocking occurs when participants have to listen while others speak and therefore are hindered to develop their own flow of ideas or might forget parts of them while waiting for their turn. Another problem in small groups interaction is evaluation apprehension [8]: The fear of negative evaluations from other participants might prevent people from sharing negative experiences or unconventional ideas. Additionally, workshops are not a lightweight format of collecting information. Workshops cannot be organized spontaneously (especially when information refinement is necessary) but have to be scheduled in advance, participants have to be selected, topics to be announced etc. In order to address these problems, we have developed a socio-technical approach that allows for intertwining phases of synchronous and asynchronous collaboration (c.f. section 3). It is essential for such an approach to ensure that decisions are taken collaboratively in order to ensure participation thus arriving at the co-creation level [24].

3 WASCoMo – An approach for facilitating the participation of stakeholders in process analysis and design

The aim of WASCoMo (**W**ebbased **A**nnotation **S**ystem for **Co**llaborative **Mo**deling) is to offer the possibility of bridging phases of synchronous collaboration by intertwining them with an asynchronous mode. The process models serve as shared material during synchronous as well as asynchronous phases. WASCoMo is divided into the following three phases (c.f. Fig. 1):

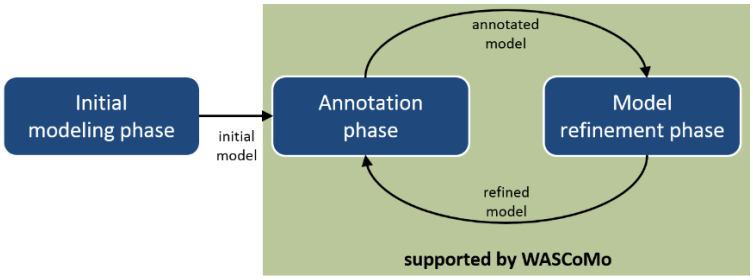

Fig. 1. Phases of the WASCoMo approach

- An **initial modeling phase** during which a first draft of a process model is jointly developed or discussed with stakeholders and process analysts. This usually happens within a facilitated workshop where stakeholders are supported by process analysts to visualize a process within a process model. During this workshop it is also possible to start with a model that was developed based on e.g. interviews conducted in

advance. After the workshop, the resulting process model has to be graphically restructured to increase its comprehensibility, especially for stakeholders. It is also necessary to decide on guiding questions in order for annotations to focus on certain aspects, such as requirements for software-based support or organizational process improvements. Furthermore, we have to provide means of access control and we also have to enable participants to contribute anonymously in order to prevent evaluation apprehension [8] (c.f. section 2).

- An **annotation phase** during which stakeholders may access the respective process model via a web interface (c.f. Fig. 2). This interface allows the participants to create annotations on elements by simply clicking on a green plus sign that appears once an element is selected. Afterwards, they can type the intended text into an input field (c.f. Fig. 2 top right) and submit it. Participants may also comment on existing annotations by selecting the respective annotation and clicking on the green plus sign that appears next to it. This allows for participants to discuss about e.g. suggestions that others made (c.f. Fig. 2 bottom). The color of the annotations alternates for better visibility and – given the annotation was not marked as anonymous – the login name of the person that created an annotation is added next to it in order for others to know to whom they are replying. Before the next phase the facilitator of the next workshop has to look through the annotations as a means to prepare it.

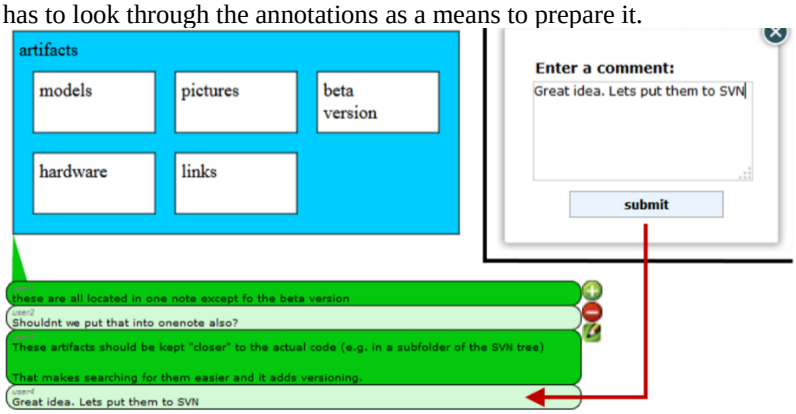

Fig. 2. Annotations on an element (green bubbles) with corresponding input dialog (top right)

- A **model refinement phase** during which annotations are discussed and the result of those discussions are integrated into the process model. This will usually happen during facilitated modeling workshops in which stakeholders are supported by process analysts. During this phase stakeholders and process analysts might jointly decide to add another annotation phase or to end the cycle and process the model in a different way. However, if they decide to do another annotation phase they will have to restructure the model again, in order to make it easier to perceive and decide on guiding questions as well. The annotation and refinement phases may be repeated iteratively until a state is reached that both suffices the goal that was originally stated when process modeling started and the needs of the participating stakeholders have been taken into account.

We deliberately decided not to offer the possibility for modification on the level of the modeling notation during the annotation phase but only allow participants to add annotations since:

1. The required understanding of the notation and threshold to make modifications is much higher than just starting with annotations
2. Creating annotations can happen additively and is more communication oriented, since domain experts can make proposals or criticize aspects of models without providing a solution directly
3. It has been observed in other contexts that annotations on shared material has a positive effect on future workshops [7], initiates and focusses discussions [5] and simulates reflection [1].
4. Decisions about changes on models have to be agreed upon by all participants (i.e. during workshops) thus ensuring participation throughout the whole course of process analysis and design.

4 Analyzing participation in collaborative modeling

In order to evaluate the WASCoMo concept with respect to the research questions described in section 1 we refer to an approach proposed by Mendling et al. [27] which aims at assessing whether a participant can be considered a lay modeler or not (c.f. RQ 2). With respect to **RQ 1** we had to develop a concept that not only covers process model quality but also collaboration quality and the impact of annotations on both the process models as well as the collaboration itself. While there are approaches available to measure the quality of models [2, 12, 22] as well as the quality of collaborative modeling [33] none is entirely suitable for this context.

Approaches to measure model quality either focus on syntactic quality [12] or on process analysts' evaluations [22]. Syntactic quality is not focal in our setting as we mainly aim at using models to systematically analyze and design processes (c.f. section 1). Evaluations by process analysts do assess whether WASCoMo increases the quality and domain-related appropriateness of process models. We are rather looking for measures of the impact of the opportunities to collaborate on models not only in workshops but also in between them using annotations.

We identified the framework by Ssebuggwawo et al. [33] as a potential starting point as they focus on the perception of the participants and differentiate collaboration modeling success with respect to four categories: **Quality of the end-product (model)**, **quality of the modeling procedure**, quality of the usage of the modeling language and **ease of use of the medium**. For the latter we backed the items proposed by Ssebuggwawo et al. up with a usability evaluation using discount usability heuristics proposed by Nielsen [29]. Furthermore, we left out the quality of the modeling language aspect as we are mainly interested in the understandability and domain-related appropriateness of process representations.

However, in order to evaluate the quality of WASCoMo with respect to the research questions we did not want to solely rely on participants' perceptions. We rather developed a mixed-method approach [6] thus adding objective data to the aforementioned categories if available. This data is mainly based on **comparisons of different versions**

of the process model while it went through the different phases of WASCoMo (c.f. Fig. 1). We put special emphasis on how the models evolved with respect to their content and we also evaluated the **complexity** of each version. The reason for this is that WASCoMo especially aims at supporting lay modelers thus requiring them to understand what the models represent. As Mendling et al. [28] found model complexity being a major factor in process model comprehension, we used the **connectivity** of a model [28] as a means of evaluating the complexity of the models. Furthermore we also developed measures in order to evaluate the impact of annotations on process models thus aiming at finding evidence with respect to RQ 1:

1. **Number of modifications:** Analyzing video footage of the workshops we counted the number of modifications that were conducted based on each annotation. Modifications were considered as adding elements or relations, modifying (i.e. changing their label) or deleting them.
2. **Granularity:** We rated each annotation with respect to the area of a model it referred to. These ratings reach from "single element or relation" via "part of a model" and "whole model" to annotations that are related to the overall approach that is taken when talking about the model.
3. **Number of replies:** As WASCoMo is meant to support collaboration on models it seems adequate to also measure the impact of an annotation with respect to collaboration. We expect annotations to have more impact on collaboration if there are more replies.
4. **Position:** Due to the question whether lay users as well as modeling experts are equally capable of contributing we also analyzed whether an annotation was placed at the right position within the model.

Although this list is not complete with respect to the range of possible measures, it yet provides a good overview of how annotations affected the model (1 to 3) and the collaboration on it (4). We also developed a **classification scheme for annotations** with respect to whether they aimed at the process depicted in the model, the way the modeling notation was used, the way the model was used and whether or not they were used for communication (i.e. being direct replies to other annotations).

We backed all the aforementioned measures up by conducting **interviews** with selected participants covering aspects such as whether they found it reasonable to be able to create annotations on process models during different workshops, whether WASCoMo affected their sense of ownership and how they used the web interface in order to get a more complete picture. Backing up the aforementioned measurement by Mendling et al. [27] in order to assess whether or not a person can be considered a lay modeler or not, we also asked them about their confidence in understanding the model.

4.1 Study

In order to evaluate the quality of the WASCoMo concept and thereby answering the research questions described in section 1 we studied the concept in several cases. Here we describe the typical procedure of such a study with respect to one case. We deliberately chose a real life context for all studies as we perceived this to affect the motivation of stakeholders to participate actively.

We started each study by conducting an initial workshop during which a first draft of a model was developed (c.f. workshop 1 in Fig. 3). Afterwards the model was distributed among the participants of the workshop. The participants then had two weeks to work on the models with respect to a guiding question that was agreed upon during the previous workshop. In order to work on the model, the participants used the web interface described before (c.f. Fig. 2 in section 3) and created annotations on the model (c.f. annotation phase in Fig. 3). After these two weeks another workshop was conducted during which the annotations were included into the model (c.f. workshop 2 in Fig. 3).

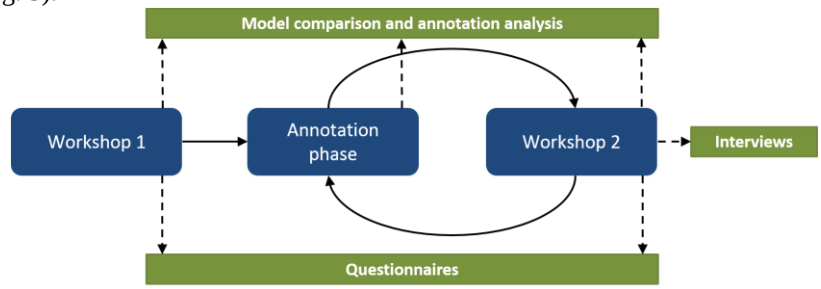

Fig. 3. Concept to analyze WASCoMo

We applied the different instruments mentioned in the beginning of this section on different occasions during the study (c.f. Fig. 3 for an overview). We compared three different versions of each process model that emerged during the study (c.f. Fig. 3 top). We also analyzed the annotations that were created on the process model with respect to the aforementioned classification scheme as well as to the impact they had by applying the quality measurements described at the beginning of this section. Furthermore we applied the modified questionnaires suggested by Ssebuggwawo et al. [33] after each workshop and compared the respective results in order to find a trend in the respective scales. The first of those questionnaires also contained the questions proposed by Mendling et al. [27] that referred to modeling expertise. Following the final workshop, we also conducted semi-structured interviews with selected participants.

4.2 Results

We conducted 10 workshops with 18 participant analyzing 5 processes (c.f. Table 1 for more information). Participation ranged from two to seven participants in the respective workshops. The models were annotated 95 times in total which results in an average of 19 annotations per model and a maximum of 48 annotations for one model. The majority of the annotations (58) focused on the process depicted in the model while 21 were used for communication, 14 focused on the way the modeling notation was used and 2 focused on the way the model itself was used during the course of the study. Among the participants were 14 people that we consider lay modelers and four participants that were experienced in process modeling. With 7 participants being inactive the remaining 11 participants created an average of roughly 8,6 annotations per participant and a maximum of 31 for one participant. In the annotation phase, participation overall has thus

been considerably lower than expected which leads to proposing a number of potential improvements for WASCoMo in section 5.

Table 1. Descriptive statistics about the study conducted

Participants	N = 18 (11 active) 14 lay modelers, 4 experienced modelers 8,6 annotations per participant (31 maximum)
Models	N = 5 (3 versions per model) 19 annotations per model (48 maximum)
Annotations	N = 95 58 focused on the process depicted 21 were used for communication 14 focused on the way the modeling notation was used 2 focused on the way the model was used

In what follows we will describe some of the most relevant findings we derived from the analysis. We will focus on how the participants perceived the approach as well as how it affected the resulting models thus leading to answering the research questions stated in section 1.

Quality of the annotations

Analyzing the annotations with respect to their quality we found that each annotation on average led to about 1,8 **modifications** with all but 36 annotations leaving a trace. While 36 annotations not leaving a trace might sound to be a lot one has to note that 11 annotations remained unchanged in the models as they e.g. contained examples for process steps. One example for such an annotation is a participant stating: *"Hint: Reports on malfunctions are only accepted via telephone in case of an emergency."*[2]. Furthermore, it can be noted that **models that received more annotations also were changed to a larger extent** during the following workshops (c.f. a model with 48 annotations received 68 modifications while another model with 5 annotations only received one modification). It can also be noted that most annotations focused on a future to-be process (31) rather than on the appropriateness of the current as-is process (27) leading to the assumption that the participants were more concerned about altering the process rather than arriving at a complete description of its current state.

We also found that with respect to granularity most annotations (60 out of 95) **focused on specific aspects** of the process. One example for that is depicted in Fig. 2: *"Shouldn't we put that into onenote also?"*.

With respect to the **number of replies** we found 21 total replies to 74 annotations which results in an average of 0,28 replies per annotation. While this again seems to be not much, analyzing the interviews showed that communication not only happened on models but also in face-to-face situations between process stakeholders. While this can be expected we found indications in interview statements such as *"I have talked with*

[2] It should be noted that the statements by the participants were translated as the study was conducted in Germany and the participant subsequently communicated in German.

[participant] and [participant] about the model […] I integrated the result of our communication in the model afterwards". This provides evidence that models were used even during face-to-face communication thus leading us to the assumption that the models were part of communication at work.

We also found different usage strategies with respect to:

- **Time:** Some participants stated that they deliberately chose not to use models at work but rather in the evening (*"I did not think about the models during work"*) while others used the models every time *"something crossed my mind"*.
- **Frequency:** Some participants only used the models once or twice while others used it regularly (mostly between 5 to 10 times).
- **Collaboration:** As stated before, some participants looked at the models together and integrated the result of their communication afterwards while others communicated directly on the models as can be seen in Fig. 2.

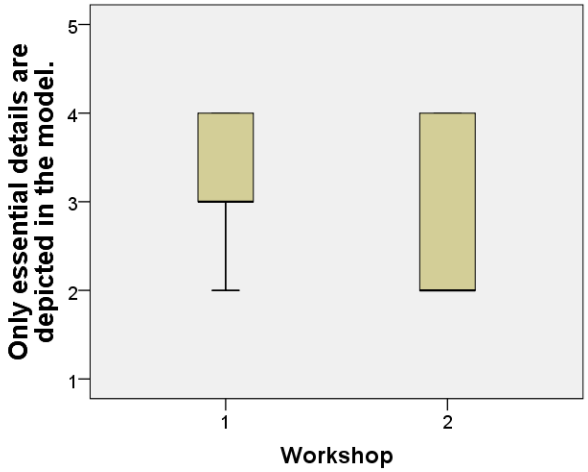

Fig. 4. Development of perceived quality from workshop 1 to workshop 2.

Aspects of model quality

Looking at the complexity of the models after each workshop it can be noted that it almost stayed identical as it increased from 1,4 to 1,43 on average per model. One aspect of this is that modifications to models were **mostly about details** like the ones depicted in Fig. 2 where the elements that represent artifacts just had to be assigned to other process elements by e.g. moving them to a different position. While working on details in general can be perceived to be positive it also led to some people perceiving it as adding too much details to the model. This trend is depicted in Fig. 4 which shows a downward trend from workshop 1 to workshop 2 (median down from 3 to 2).

Furthermore, we found a decrease in participants' perceived understandability of the model between workshop 1 and workshop 2 (after workshop 1 the scores were between 3 and 5 while after workshop 2 they were between 2 and 5). However, not a single annotation was placed at the wrong position in the model. This leads us to the assumption that the participants realized the complexity of the process models when working on them alone during the asynchronous phase subsequently leading them to question

their ability to understand them. Nonetheless, we did not find any supporting evidence that underpins the assumption that the ability of the participants to understand the models was negatively influenced by the WASCoMo concept.

Aspects of perceived quality of the approach.

Annotations were mainly used to **remember to mention certain aspects during workshops,** as the following statement indicates: *"you do not forget what you wanted to say"*, *"... would have been gone if not for the comments"*. Furthermore, the possibility of accessing and annotating models also had a **positive impact on the communication during the second workshop** as the respective item (median up from 4 to 4,5) as well as interview statements indicate *"comments led to us discussing about it more"*. Participants even were satisfied with decisions during the second workshop **when their proposals were not accepted,** as the questionnaires indicate. We also found indications that participants **perceived that they had more control of the modeling process** when workshops are complemented with an asynchronous phase. These stem from the fact that all items which cover the influence of a participant of the modeling process either increased *("My contribution led to us discussing different perspectives on a process"*, scores ranged between 2 and 5 after the first workshop and from 3 to 5 after the second one) or stayed identical (*"I actively participated in achieving the goal of modeling"* and *"I contributed to reaching an agreement"*) or increased between the two workshops. Furthermore, the participants stated that **decision making during workshops became faster** due to the annotations serving as a means to exchange arguments before thus leading to faster decisions during workshops. This assumption is underpinned by the respective item in the questionnaires (median up from 4 to 4,5) as well as by statements of participants during interviews (*"... agreement was then achieved during the workshop"*).

Lay modelers compared to experienced modelers

Comparing the results for the aforementioned categories with respect to annotations contributed by lay modelers to those stemming from experienced modelers it can be stated that the overall quality of annotations that were created by **experienced modelers** was **slightly better** (median 2,75 for experienced modelers and 2 for lay modelers). This is mainly due to **lay modelers focusing more on details** of the process i.e. specific elements rather than process parts or the process as a whole. Furthermore, it has to be noted that experienced modelers on average contributed more annotations (7) than lay modelers (≈4,79). This effect however is mainly due to all inactive participants being lay modelers. Ruling these out of the calculation even puts lay modelers ahead of experienced modelers (≈9,57 annotations). When it comes to evaluating the **perceived quality of the approach there is no difference** between lay modelers and experienced modelers as they both rate the respective items in the questionnaire equally (c.f. the median on the item *"I actively participated in achieving the goal of modeling"* was 4 for both lay and experienced modelers). It can thus be stated that lay modelers and experienced modelers participated equally when active with annotations from experienced modelers being perceived as slightly better with respect to the quality dimensions described in the beginning of section 4.

5 Discussion

The evaluation of WASCoMo reveals that – despite participation being lower than expected – the possibility of inspecting and annotating process models between workshops was used by the stakeholders as a substantial opportunity for influencing process analysis and design (c.f. RQ 1) on multiple levels. Firstly, WASCoMo positively affected the quality of the process models especially with respect to the achieved level of details and to prioritizing a future to-be process instead of the current as-is situation. We also found that the more the models were annotated the more they were changed during the following workshops. Apparently, the possibility to inspect models and create annotations between workshops had an impact on their evolution. Secondly, the way people participated was positively influenced by WASCoMo: The participants perceived to have more influence on the modeling process after the annotation phase. Annotations also helped participants to remember aspects they wanted to mention during workshops and allowed for discussions on proposals thus accelerating negotiations and decision making at the second workshop. Furthermore, the web-based availability of process models encouraged people to gather around it and to discuss the model face-to-face while adding results of those communications as annotations. Consequently, we suggest that WASCoMo positively influences the resulting artifacts as well as the way participants perceived their influence on process design.

Adding onto that, there are also indications that WASCoMo particularly improved the influence of lay modelers on the outcome of process modeling (c.f. RQ 2). Despite annotations stemming from experienced modelers being perceived as slightly better with respect to the quality dimensions described in the beginning section 4, it can be noted that both lay modelers and experienced modelers were equally capable of influencing the outcome of process modeling by annotations. We have to mention though that the perceived understanding of the models slightly decreased after the second workshop on the part of the lay modelers. However, there were no other indications that would back up the assumption that understanding actually decreased after the annotation phase. Thus, this might indicate that the perception changed due to the participants realizing the complexity of the model while working on it without expert support during the annotation phase. Compared to other approaches, which focus on the modification of models, the usage of annotations reduces the dependency of lay modelers on experts, and therefore relatively increases their influence. This argument is backed by other findings such as both, lay modelers and experienced modelers, equally perceiving WASCoMo to allow them for actively participating in process modeling and consequently in designing the processes.

Apart from answering the research questions stated in section 1 we also aimed at identifying **potentials for improving the concept** with respect to the web interface (the technical support) as well as the overall organizational approach (c.f. Fig. 1). Compared with the goals of a workshop's facilitator, who tries to get multiple feedbacks by every participant, the number of annotations and annotators was relatively low. The need for encouraging more intense participation especially with respect to motivating stakeholders to participate at all thus became obvious. To meet this requirement, we identified two approaches: **Increasing the awareness** about ongoing annotating in the models, and **providing external prompts** to activate the participants. Those prompts could e.g. be provided by facilitators or fellow co-workers asking questions or giving hints that

an annotation has been commented by another participant. These measures require the socio-technical combination of technical support (such as sending messages to participants) with organizational conventions, such as asking participants to directly address their co-workers when phrasing their annotations, or asking facilitators to prompt comments through provocative statements. Furthermore, participants should be encouraged to ask questions about parts of a model or process they feel that they do not fully understand especially during and after the annotation phase. This in turn could lead to increased participation especially by lay modelers.

There are however also some methodological **limitations** with respect to the evaluation and the findings. It is not possible to confirm hypotheses about the appropriateness of the WASCoMo approach for two reasons: A) Since we conducted evaluations in practical fields it was not possible to establish control groups which were involved in the same process design under the same conditions but just without an annotation phase. Consequently, we cannot be sure whether the same effects could have been achieved by only running a second workshop after the first one. This shortcoming is due to testing the concept in real practical contexts where the influencing factors cannot be controlled as it is the requirements for repeated experiments. It can also be assumed that it would be extremely difficult if not impossible to control all influencing variables such as differing goals or group composition in an experimental setup. However the practical context not only allowed us to gather a lot of explorative data that includes objective and subjective measures thus covering different perspectives (c.f. section 4), it also can be assumed that the real life context affected the motivation of stakeholders to participate as the resulting process affected their everyday work. There is a strong plausibility that the annotation phase had an effect but the possibility of the second workshop interfering with those effects cannot be ruled out. B) The relatively low number of participants as well as the different contexts in which WASCoMo was used, limits the statistical evaluation with respect to the significance of the observed effects. We tried to mitigate these effects by considering additional data such as annotations, models, server logs and interviews but this cannot compensate the limited evidence of the descriptive statistics.

6 Conclusions and outlook

The socio-technical approach of WASCoMo was designed to intertwine phases of synchronous collaboration (e.g. in workshops) with phases of asynchronous inspection and annotation of process models. In the current state, WASCoMo has to be continuously improved or adapted to the requirements of a practical context and is therefore presented in combination with a formative evaluation method. The method includes different measures such as questionnaires (aiming at the quality of collaborative modeling as it is perceived by the participants), interviews and content analysis. It is thus suitable for providing an in-depth perspective on multiple aspects of collaborative modeling considering the quality of the resulting models as well as the perceived quality of the outcome and the impact of annotations on process models. The innovation which is implied with the presented approach is twofold: On the one hand a fine tuned level of involving lay modelers into using graphical representations of processes is provided; on the other hand, a rich methodological basis for formative evaluation and succeeding

improvement of the lay modelers' involvement is proposed and has been tested in several cases.

On an exploratory level there is empirical evidence that lay modelers are able and willing to participate in the annotation phase and by doing so have subsequently increased their influence on process analysis and design. We also found evidence suggesting that WASCoMo positively influenced the perception of stakeholders about being in control of the modeling process. Furthermore, we found that the concept gave equal weight to the influence of lay modelers and of expert modelers. Therefore, the concept can serve as an additional method of collaborative process analysis and design as it allows for domain experts and stakeholders to improve the information basis for analyzing and designing processes.

One of the critical aspects is the low degree of participation during the annotation phase. This observation points into two directions. On the one hand it might mirror the need for socio-technical improvement of the WASCoMo concept. On the other hand, the low participation can be an indicator for interest conflicts or insufficient motivation for supporting organizational change with respect to business processes in that particular context where we conducted the study.

Further research should bring insights about how we can reliably differentiate between these two reasons for low participation. It will be interesting to observe how the effects of WASCoMo evolve over longer time periods when the combination of annotation phases with succeeding workshops is repeated several times while working on the same process or when participating in the design of several different processes. A further challenge is the involvement of participants who did not participate in a workshop and are only involved during the annotation phase. This type of involving stakeholders can help to increase the number of potential participants but implies more effort and measures to encourage and motivate people's willingness to take part.

7 Literature

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