Defining Auto-Adaptive Modeling Interfaces based on Stakeholder Proximity

Alexander Nolte[1] and Jens Gulden[2]

[1] University of Pittsburgh
135 North Bellefield Avenue, Pittsburgh, PA 15260, USA
anolte@pitt.edu
[2] University of Duisburg-Essen
Universitätsstr. 9, 45141 Essen, Germany
jens.gulden@uni-due.de

Abstract. Collaboratively analyzing complex business processes using graphical modeling notations such as BPMN, EPC and others can be considered a common practice in most organizations. In recent years the use of large interactive displays has increasingly gained attention in these settings due to the possibility for multiple participants to interact with the displayed process models at the same time. Using such displays has the potential to improve the efficiency of collaboration, but they are not capable of solving one of the main issues of such settings in that it is not always feasible for all stakeholders to interact with the same material since they inevitably have different perspectives and are interested in different aspects of a process. In this research-in-progress-paper, we are aiming at creating a system that provides different stakeholders with different visualizations based on their proximity to that visualization. This will allow stakeholders to interact with a representation of a process that is suitable for their needs. We will outline the functionality of this system and describe our proposed approach for evaluation. We will also elaborate on future use scenarios of the concept of proximity in the context of collaborative process modeling.

Keywords: Collaborative modeling, large interactive displays, proximity, adaptive user interfaces

1 Multiple Stakeholder Modeling Scenarios

Visualizations of business processes using specific modeling notations such as BPMN, EPC, and others can be considered a common practice in most organizations. These models serve as documentation for existing processes and as a basis to analyze and subsequently improve them [16]. It is common to document and analyze processes collaboratively, because they usually affect multiple people from different backgrounds such as managers, process participants, software engineers and others. Involving all stakeholders is necessary, in order to ensure a comprehensive documentation of a process that is not solely focused on a single perspective [9]. Approaches to collaboratively analyze processes are commonly referred to as collaborative modeling [17, 15, 18]. Collaboration in this context usually takes place in workshops where process stakeholders are supported by facilitators that guide the communication and translate verbal contributions by stakeholders into elements of a modeling notation.

The use of large interactive displays in these settings has increasingly gained attention in recent years [12, 5, 13] due to the possibility for multiple participants to interact with process models at the same time which increases the efficiency of collaboration since participants can work in parallel on different parts of a model. However, not all participants are knowledgeable about or interested in all aspects of a business process. It is rather common that, e. g., managers are likely to be interested in understanding how different parts of a business process work together, software engineers are probably interested in technical aspects, and process participants are usually more interested in the specifics of the particular processes that they are involved in. Current approaches do not consider these differing needs as all participants work on the same visualization during a workshop. We are aiming at overcoming this gap by providing different stakeholders with different visualizations of a process based on their individual needs.

In this paper we present the concept of a system that shows specific visualizations of a process tailored to the target audience. The approach automatically analyzes the distance between workshop participants and a model display, and alters the visualization of the model based on the information needs of the participants. The aim of this system is to improve the usability of business process models in workshop settings that are supported by large interactive displays. It also serves as a first use case for future work into applications of analyzing proximity in collaborative modeling.

The remainder of this paper is structured as follows. We will first elaborate on problems of stakeholders using specific modeling notations to analyze processes (Sect. 2), before taking a look at related work and discussing different visualization techniques and techniques of user distinction and proximity analysis (Sect. 3). Afterwards we will describe a scenario of how proximity can be used in a workshop context to overcome the different requirements and preferences of different target audiences (Sect. 4), before outlining our system and research design (Sect. 5). The paper finishes with an outlook on our future study and an overview of future use applications for the concept of proximity analysis in collaborative modeling (Sect. 6).

2 Challenges of Collaborative Modeling

While modeling is often scientifically reflected from an introspective single-person viewpoint [11], and knowledge about modeling is often taught and tested as individual competencies, an inherent purpose of creating and working with models lies in communicating. Models are used, when their creators assume that statements about a given subject can be expressed more easily, precisely, or better understandable with models rather than with natural language descriptions. With the help of interrelated model perspectives using different notations on different levels of granularity, the information demands of diverse stakeholders can be addressed, while the central capability of models, providing a shared view on the same subject matters, remains intact through interrelations between the different perspectives.

Our work addresses collaborative modeling settings in which a group of stakeholders with different professional backgrounds are locally joint together and synchronously perform modeling activities [15]. In such a constellation, it becomes a challenge to balance out the beneficial aspects of modeling, which allow models to take in an interfacing role between different groups of stakeholders, with the ability for all involved modelers to amplify cognition and communication, rather than hinder communication by the use of natural language interpreted differently by the involved groups. Different groups of stakeholders require different views on models and are used to different levels of detail and granularity resulting from their particular information demands. In real-time scenarios, there is thus a demand to make sure that each group of stakeholders is able to cognitively access their relevant parts of the model, without at the same time disrupting other groups during their modeling activities.

We present an approach for a modeling scenario where multiple stakeholders meet in the same room and jointly perform modeling activities at large interactive displays. For such a setting, we suggest an automatic adaptation mechanism that adjusts the views in which models are presented to the information needs according to the respective stakeholders. The view will be adapted depending on which stakeholders are currently working on a model. We expect such a mechanism to not only improve efficiency of collaborative modeling activities, but also to lead to fundamental changes of how collaborative modeling in close proximity can be performed in the future.

3 Related Work

A number of publications cover the area of software-supported collaborative multi-stakeholder modeling. Mendling et al. [11] discuss specifics of collaborative business process modeling, and identify multiple characteristics that are relevant when software is considered supportive in collaborative settings. This covers, e. g., the ability for communication, coordination, and group decision making in each of the stages of the modeling process, such as modeling, validation, and verification. The majority of the work that had been examined for this purpose presupposes that collaborative modeling takes place in remote settings, where participants are distributed over large physical distances.

Both remote collaboration settings, and collaborative modeling in near local proximity, are reflected by Forster et al. in [6], who discuss specifics of human modeling behaviour in collaborative modeling environments. In our paper, we particularly focus on co-located collaborative modeling scenarios with participants meeting in the same place.

For the domain of business process modeling, Silva and Roseman [20] identify that "[c]urrent approaches to support stakeholders' collaboration in the modelling of business processes envision an egalitarian environment where stakeholders interact in the same context, using the same languages and sharing the same perspectives on the business process" [p. 1]. We share this analysis and consider it even generalizable for other modeling domains beyond business process modeling.

Monsalve et al. [2] examine variations of different modeling languages on the concrete level of notation elements, relative to the information demands of different stakeholders. The intended application of that work again lies in the field of business process modeling, with the declared aim to "simplify business process modeling notations". By doing so, the work offers a set of stakeholder-related notation concepts for a given domain. The suggested notations can be integrated as one component into a solution for automatic interface adaptation as proposed in this work.

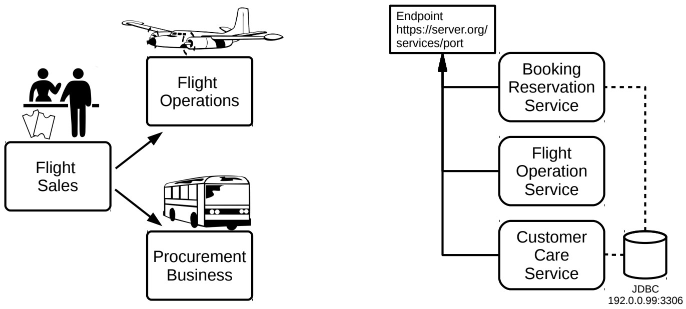
Proximity in the context of collaborating using large displays has been a focus of study in the field of human-computer interaction (HCI) in recent years. Approaches such as the one presented by Butscher and Reiterer [3] indicate the feasibility of altering visualizations based on the proximity between users and visualizations in front of large interactive displays. These studies however are distinctly different from the approach presented here in that they do not focus on complex graphical visualizations such as business process models.

There are multiple different approaches to distinguish users that are interacting with large interactive displays. Examples for such approaches are technologies that distinguish users based on their hand shape [19] or based on their fingerprints [10]. These systems however are only capable of distinguishing users that directly interact with an interactive display. They are thus only marginally useful for our projected scenario since we are aiming at altering a visualization based on a specific target group that does continuously interact with the displayed material. Other approaches such as the ones presented by Pratte et al. [14] and Turnwald et al. [21] appear to be more feasibly for this setting since they rely on Kinect cameras to distinguish users in front of a large display. These systems however are only capable of distinguishing users but they are only not capable of identifying them. Identifying users however is crucial in our setting since we aim at providing specific users with a specific visualization. We regard a combination of bluetooth beacons and mobile phones [4, 22, 1] as the most appropriate way to track users proximity in front on a large display.

4 Highlighting Strategies for Different Groups of Stakeholders – A scenario

In this section we will present a scenario that outlines the usage of our system in practice. The scenario demonstrates the diversity of information needs by different stakeholders based on the example of an airplane Flight Sales process. Figures 2a and 2b show the same model using multiple perspectives and different levels of granularity. These different views can be considered suitable for different example stakeholder groups, or combinations of stakeholders.

A general perspective on the fundamental building block activities of the process is displayed by the high-level process composition view shown in Fig. 1a. This overview perspective can be assumed to be an appropriate entry point for any heterogeneous group of stakeholders to achieve a common understanding of the process in question, thus it offers a general default fall-back perspective to activate for a diverse combination of stakeholders. It also provides a perspective that is suitable for managers since they are usually more interested in the bigger picture of how different process parts work together while operational personnel would probably go more into the details about the specifics of process parts they are directly involved in. An example for this would be a sales clerk who is more interested in the specifics of the Flight Sales process rather than the specifics of, e. g., Flight Operations (c. f. Fig. 1a).



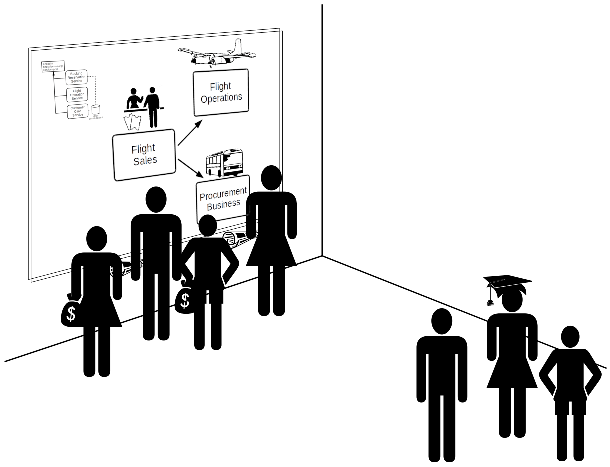
(a) (b)

Fig. 1: Example business process composition model of a Flight Sales process on a high aggregation level (a), example technology model of web-services for executing the Flight Sales process (b)

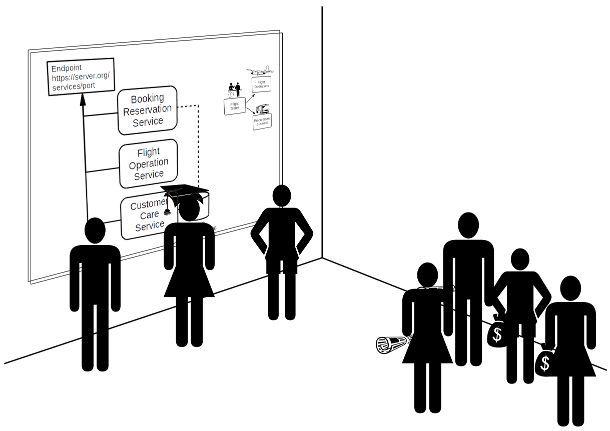
A technology-oriented perspective is provided by a service model view, which explicates technological details about the web-service involved in executing the Flight Sales process. The service model is shown in Fig. 1b. This perspective is suitable for software engineers, technologically skilled business analysts or any individual interested in the technical details behind the process.

Fig. 2 provides examples of the two model fragment in different highlighting modes, the first one pointing out the business process composition view to provide an easy to understand business analysis perspective on the process. This is shown in Fig. 2a. The second highlighting option puts the focus on technology details of the underlying web-services. Fig. 2b exemplifies this.

It should also be noted that the perspectives presented here are not independent from one another since they essentially cover the same process from different points of view. The activity Flight Sales (c. f. 1a left) is thus connected to the Booking Reservation Service and the Customer Care Service (c. f. 1b) while the Flight Operations activity (c. f. 1a top) is connected to the Flight Operation Service (c. f. 1b). These connections can be established as part of a collaborative activity during a workshop when the individual teams have reached a sufficient representation of the part of the process they are interested in.



(a)



(b)

Fig. 2: Auto-adaptive emphasis on different model types based on stakeholder proximity

5 An Approach for Automatic Model Highlighting by Proximity Analysis

For a solution which provides automatic support for performing switches between perspectives and highlightings as outlines in the previous section 4, it is necessary to develop a formalization to assign groups of stakeholders to appropriate model views. This formalization has to take into account that stakeholders with different information needs may simultaneously access the model. The adaptive view mechanism should in this case choose an optimal jointly suitable perspective on the model for all involved stakeholders. Our system will use distance measuring techniques to estimate what individuals are interacting with the model and provide model views that appropriately fulfill the according information needs.

In order for our proposed system to have the desired effect we require three separate pieces of information:

1. We need to be able to identify each person as a certain stakeholder with respect to the process that is being modeled.
2. We need to be able to assess the desired visualization for each stakeholder.
3. We need to be able to assess the proximity between each individual stakeholder and part of a the model that is displayed on a large interactive display.

The former two only need to be identified once at the start of a workshop, while the latter needs to be continuously monitored.

Before conducting a workshop we will identify potential roles and corresponding information needs based on the process that will be analyzed and based on the goal of the workshop. These roles will then be fed into a web-based system that will be used at the start of a workshop to allow stakeholders to self-register. The registration will allow participants to couple their mobile phones with a role that can be selected based on the roles in the system. This information then allows us to track users in front of a display based on their mobile phone and provide them with a visualization that is suitable for their information needs.

6 Conclusion and Future Work

The conceptualizations presented in this paper have laid the foundation for a novel business process modeling support approach, which allows to dynamically adapt model perspectives to physical locations of modelers. The approach is implementable on the basis of existing proximity analysis technology and with the help of large interactive displays.

We are currently in the process of preparing an initial evaluation of our approach which will be based on an existing touch enabled process modeling editor [8]. For the study we will divide the participants into two groups that will work in parallel on their perspective on a process model. The setup will be based on the approach described by Grapenthin et al. in the context of software management [7]. They use each wall of a room for a different visualization of the software that will be developed. We will adapt this approach by using two walls of a room for two different perspectives on the same process. A third wall will be used to show an overview of both visualizations in order to allow stakeholders to align their respective views and indicate connections between them. The whole workshop will be supported by an experienced process modeller. Interactions will be video taped for future analysis and we will have an observer for each group taking notes of the process of the collaboration. The focus of the observation as well as the subsequent analysis will be to assess the feasibility of the approach. We are specifically interested in identifying patterns of how people move between displays and how this setup affects their collaboration. These insights will then be used to build a fully functional prototype based on proximity measurement technology described in section 3. This prototype will be subject to further evaluation that focuses on aspects such as handling diverse groups of users in front of the same screen. This could, e. g., be done by showing different visualizations and their connections on different layers that become more or less transparent as the respective stakeholders come closer to the wall or move further away from it. The prototype will also undergo quantitative user studies focusing on a multidimensional scheme of measurements that cover aspects such as collaboration efficiency, stakeholder involvement, the stakeholders understanding of the modeled process, acceptance of the system, and the quality of the final product.

We finally envision additional application scenarios for proximity technology in collaborative modeling workshops. One of these scenarios is to assess the proximity of workshop participants among each other, thus to identify who collaborates with whom during the course of a workshop. This information might be useful for facilitators and participants in order to ensure that different stakeholders with different perspectives actually engaged in a meaningful exchange, contributing to the overall quality of the model while improving the collaboration experience.

References

1. Dragan Ahmetovic, Masayuki Murata, Cole Gleason, Erin Brady, Hironobu Takagi, Kris Kitani, and Chieko Asakawa. Achieving practical and accurate indoor navigation for people with visual impairments. In *Web for All*, 2017.
2. Alain April, Alain Abran, and Carlos Monsalve. Representing unique stakeholder perspectives in BPM notations. *Software Engineering Research, Management and Applications, ACIS International Conference on*, 00:42–49, 2010.
3. Simon Butscher and Reiterer Harald. Proxemics-aware multi-focus visualizations to support mutual awareness during co-located collaboration. In *Workshop CMIS 2015 (in conjunction with ITS '15)*, 2015.
4. Sudarshan S Chawathe. Beacon placement for indoor localization using bluetooth. In *Intelligent Transportation Systems, 2008. ITSC 2008. 11th International IEEE Conference on*, pages 980–985. IEEE, 2008.
5. Sebastian Dweling, Tarik Tahiri, Benedikt Schmidt, Alexander Nolte, and Mohammadreza Khalilbeigi. Collaborative business process modeling on interactive tabletops. In *Proceedings of the 21st European Conference on Information Systems*, pages 1–7, 2013.
6. Simon Forster, Jakob Pinggera, and Barbara Weber. Collaborative business process modeling. In *EMISA 2012 - Der Mensch im Zentrum der Modellierung, Vienna, Austria, September 13-14, 2012. Proceedings*, pages 81–94, 2012.
7. Simon Grapenthin, Matthias Book, Volker Gruhn, Christian Schneider, and Kai Völker. Reducing complexity using an interaction room: an experience report. In *Proceedings of the 31st ACM international conference on Design of communication*, pages 71–76. ACM, 2013.

8. Thomas Herrmann. Seeme in a nutshell – the semi-structured, sociotechnical modeling method, 2006. http://www.imtm-iaw.rub.de/imperia/md/content/seeme/seeme_in_a_nutshell.pdf (2017-05-15).
9. Thomas Herrmann. Systems design with the socio-technical walkthrough. *Handbook of research on socio-technical design and social networking systems*, pages 336–351, 2009.
10. Christian Holz and Patrick Baudisch. Fiberio: a touchscreen that senses fingerprints. In *Proceedings of the 26th annual ACM symposium on User interface software and technology*, pages 41–50. ACM, 2013.
11. Jan Mendling, Jan C. Recker, and Johannes Wolf. Collaboration features in current bpm tools. *EMISA Forum*, 32(1):48–65, January 2012.
12. Alexander Nolte, Ross A Brown, Craig Anslow, Moritz Wiechers, Artem Polyvyanyy, and Thomas Herrmann. A concept for collaborative business process modeling in interactive spaces. In *Collaboration Meets Interactive Spaces: Theory and Practice*, pages 259–286. Springer Verlag, 2016.
13. Stefan Oppl and Christian Stary. Tabletop concept mapping. In *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction*, pages 275–282. ACM, 2009.
14. Sydney Pratte, Teddy Seyed, and Frank Maurer. Projected pixels: Exploring projection feedback in multi-surface environments. In *Workshop CMIS 2015 (in conjunction with ITS '15)*, 2015.
15. Michael Prilla, Alexander Nolte, Thomas Herrmann, Gwendolyn Kolfschoten, and Stephan Lukosch. Collaborative usage and development of models: State of the art, challenges and opportunities. *International Journal of e-Collaboration. Special issue on "Collaborative usage and development of models"*, 9(4):1–16, 2013.
16. Jan Recker. Opportunities and constraints: the current struggle with bpmn. *Business Process Management Journal*, 16(1):181–201, 2010.
17. M. Renger, G.L. Kolfschoten, and G.J. De Vreede. Challenges in collaborative modelling: a literature review and research agenda. *International Journal of Simulation and Process Modelling*, 4(3):248–263, 2008.
18. Peter Rittgen. Collaborative modeling - a design science approach. In *HICSS*, pages 1–10. IEEE Computer Society, 2009.
19. Dominik Schmidt, Ming Ki Chong, and Hans Gellersen. Handsdown: hand-contour-based user identification for interactive surfaces. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*, pages 432–441. ACM, 2010.
20. A. R. Silva and M. Rosemann. Processpedia: an ecological environment for bpm stakeholders' collaboration. *Business Proc. Manag. Journal*, 18(1):20–42, 2012.
21. M. Turnwald, A. Nolte, and M. Ksoll. Easy collaboration on interactive wall-size displays in a user distinction environment. In *Workshop Designing Collaborative Interactive Spaces for e-Creativity, e-Science and e-Learning.* Citeseer, 2012.
22. Faheem Zafari, Ioannis Papapanagiotou, Michael Devetsikiotis, and Thomas J. Hacker. Enhancing the accuracy of ibeacons for indoor proximity-based services. In *IEEE ICC*, 2017.