A Language for Designing Process Maps (Extended Abstract)

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Motivation

Organizations are complex entities that consist of units and people that work together in order to satisfy the needs of customers. Many organizations are inclined towards vertical-thinking i.e. placing the focus on functional and hierarchical structures. However, as organizations today require flexibility and ability to address emerging business challenges, they often shift towards horizontal-thinking through better understanding of their business processes (Reijers, 2006). Business Process Management (BPM) is widely adopted by organizations as a method to increase awareness and knowledge of their business processes. In this context, business process modeling is used as a method to represent business processes in form of business process models i.e. graphical representation of business processes.

The number of organizations adopting BPM is quickly increasing. By this means, so is the number of business process models as result of BPM initiatives. Within a single organization this number often ranges from hundreds to even thousands of business process models. In order to handle such large amount of business process models, organizations structure them in terms of a process architecture. A process architecture defines how the set of business process models of one organization can be systematically organized (Malinova et al., 2013). It includes a process map, which is considered as the top-most view of the process architecture where the organization's business processes and the relations between them are abstractly depicted. The details of each business process shown on the process map are stored in the lower levels of the corresponding process architecture (Dumas et al., 2013).

The purpose of a process map is to show a visual and holistic view of all business processes of one organization. A process map provides an overview of how an organization operates as a whole without necessarily going into the process details (Malinova and Mendling, 2013). Therefore, the design of a process map is vital not only for the understanding of the company's processes, but also for the subsequent detailed process modeling. This is primarily because a process map is typically designed at the beginning of BPM initiatives and is thus used as a foundation for the detailed process modeling. A process map is often the result of the process identification phase of the BPM lifecycle, and is used as a foundation for the subsequent phases (process discovery, process analysis, process redesign, process monitoring & controlling), where the detailed process modeling, process improvement and process monitoring takes place.

Despite their importance, the design of process maps is still more art than science, essentially because there is no standardized modeling language available for process map design. Whereas managing process model collections has recently been a focal point of research (Dijkman et al., 2012), aligning the process models in terms of a process architecture is still an ongoing research effort. There exist well-defined standardized languages for modeling the details of business processes (e.g. BPMN,

EPC, UML), however, to the best of our knowledge, there is no such language for supporting the design of process maps. Due to the lack of a dedicated process map language, we are faced with a high heterogeneity of process map designs from practice, although they all serve a similar purpose. This has accordingly been our main motivation for commencing the research presented in this thesis. The research question for this thesis is the following: How to effectively model processes on an abstract level?

Contributions

This doctoral thesis focuses on the development of a language for designing process maps. In particular, the thesis provides the following contributions.

Reference BPM Framework: First, we present a holistic reference BPM framework. The framework is a consolidation of procedural frameworks introduced by prominent BPM researchers (Rosemann and vom Brocke, 2010, Dumas et al., 2013, Davenport, 1993, Harrington and Harrington, 1995, Kettinger et al., 1997, Jeston and Nelis, 2008, Becker et al., 2013, Weske, 2012). The framework includes eleven BPM elements, each holding activities organizations need to consider when adopting BPM. The framework points to the importance of acknowledging the design of process maps for the subsequent BPM success in organizations.

Method for assessing cognitive effectiveness of process maps used in practice: We found that it is important for models to be designed appropriately, because the appeal of a model has an effect on the user using the model (Malinova and Mendling, 2013). Therefore, as a second contribution, we provide a method for assessing the cognitive effectiveness of process maps designed and used in practice. For this, we follow the nine principles for cognitively effective visual notations introduced by Moody (2009). In addition, we employ the cognitive fit theory by Vessey (1991) to check whether the design of process maps has an effect on the BPM success in the respective organization. We argue that, a process map that does not comply with the conditions stated by the principles by Moody (2009) is difficult to interpret, and thereby yields unwanted, unanticipated or no beneficial effects. Our findings show that the design of process maps does indeed has an effect on the company's BPM success. Especially, a process map that does not comply with the principles for cognitively effective process maps could hinder the BPM success of the respective organization. This method could be followed by all who wish to assess the cognitive effectiveness of models and their subsequent effect.

Quality requirements for modeling languages and models: Modeling languages are typically used by both individuals and organizations, all having diverse backgrounds and stemming from various industries. Therefore, during the development of modeling languages this diversity needs to be taken into consideration, such that languages would serve relevant users in the most effective and efficient ways. One way of ensuring this is to develop the language for designing process maps according to well-established quality requirements for modeling languages. Thus, a third contribution of this thesis is the extensive list of quality requirements for modeling languages and models we have derived by conducting a systematic literature review on quality of modeling languages and models. Quality requirements are used as things according to which other things are developed,

judged or measured. We found 79 relevant papers from which we retrieved 319 quality requirements. We use a subset of these quality requirements as basis for developing the language for designing process maps.

A language for designing process maps: Fourth, we define the intra-language parts (abstract syntax, semantics, concrete syntax) of the language for process maps. We follow an explorative method; hence we rely on empirical data for the language development. We primarily relied on empirical data in order for the language to reflect actual usage in practice. The empirical data we used for the language development was a collection of process maps and a qualitative in-depth study with one of our industry partners. We used the process map collection to define the process map meta-model which includes all concepts and concept relations organizations include in their process maps. The qualitative in-depth study enabled us to ensure the process map meta-model is saturated. Accordingly, we reuse symbols in our language which have already been used in practice as part of process maps. We follow this approach in order to ensure the language will consist of elements already familiar to organizations. During the language development, the quality requirements we collected by means of the systematic literature review are also followed. As a result, we ensure the language for designing process maps is also grounded in literature.

Method for checking language suitability for a particular purpose: BPMN has become the de-facto standard for business process modeling. However, despite its wide user acceptance, even organizations that use BPMN for modeling their business processes do not use this language for designing their process maps. Thus, our fifth contribution is a method for checking language suitability for a particular purpose. We use this method to assess the suitability of BPMN for designing process maps, since the purpose of a process map is different than the one of a business process model. The method includes using the four semantic mapping relationships of equivalence, intersection, subsumption and disjointness (Rizopoulos and Mçbrien, 2005) to match BPMN elements with process map concepts. We use the results of the semantic mapping to assess BPMN's expressiveness for designing process maps. We follow the representation theory by Wand and Weber (1993) and its two criteria of completeness and clarity to argue that BPMN is unsuitable to depict a correct and clear abstract overview of all business processes of one organization.

Experimental evaluation of the language for designing process maps: Last, we evaluate the developed language for designing process maps by means of an experiment. In order to be able to evaluate the language for process maps, we need to assess the effectiveness of each concept the language offers. To test the effectiveness and efficiency of a modeling language, a counterpart is required against which we compare the language. However, since, to the best of our knowledge, there exists no other dedicated modeling language for designing process maps, we cannot assess process maps created by two different modeling languages. We have already evidenced that a process map designed using BPMN would be a subject of potential misinterpretation. Therefore, we decided to use textual representation as a benchmark against which we compare the visual language for designing process maps. We consider text as the best alternative, because it will induce the least bias from the participants. Also, using text will also help us represent the correct semantics of all process map concepts, which, for instance, is not the case with BPMN. Hence, we assess the effectiveness and efficiency of process maps designed using elements from our language against process maps that have not been designed using our language,

instead the concepts have been textually represented. We found that, a process map designed using the elements of the newly developed language leads to users performing better in terms of both accuracy and time, than a process map not using the full range of the elements from the newly developed language for designing process maps.

Implications

The research we have conducted for this thesis and the consequent results have strong implications for BPM research and for practice. In terms of practice, we showed that up until now process map design has been more an issue of a craftsmanship rather than science. Thus, the language we have defined will support practitioners when designing their process maps. It will release them from the burden of, first relying on their own creativity when designing process maps, and second choosing among the numerous elements existing process modeling languages offer in order to be able to capture their requirements. Most importantly, having a language which offers appropriate elements for all concepts shown in the process map would assist practitioners in ensuring they depict a correct overview of their company's operations, accordingly decreasing threats of potential misinterpretation.

Furthermore, a process map could be used as a tool to abstract from the details of many process models to a single model which captures the essence of their performance. Thus, research about the design of process maps complements prior research on managing process model collections. However, compared to the existing literature which has a more technical focus, process maps could be used to understand process model collections from a more strategic perspective. In this way, managing process model collections could take the turn of adopting a top-down approach, rather than the bottom-up one followed until now. Beyond the language for designing process maps we present in this thesis, the approach we follow to develop the language is one that, to the best of our knowledge, has not been applied before when undertaking this task. Therefore, this approach could be followed by all who wish to develop a modeling language which is grounded in both practice and literature.

Future Research

The research concerned with process maps presented in this thesis is only a starting point from where a stream of potential research arises. First, the language we propose does not yet include the full range of visual variables introduced by Bertin (1983). This is mainly because visual variables such as color and size are highly dependent on the organizational context. Therefore, despite the formal concepts included in all process maps, additional research is necessary in incorporating additional variables in process maps, as these further assist in transferring the knowledge in a cognitively effective manner (Moody, 2009, Malinova and Mendling, 2013). Also, taking into account that the process map design is considered as a strategic step and as such the foundation for the consequent BPM implementation in organizations (Malinova and Mendling, 2013), a process map design could strongly influence the subsequent detailed process modeling. This is namely another potential direction of future research about the usage of process maps. Such research would

involve exploring the utility of process maps in practice, which will result in usage patterns that could lead to explaining the specific role process maps play for organizations.

Moreover, the relations between the processes shown on the process map and the process details stored in the lower levels of the corresponding process architecture have not been fully identified. We are aware of the typical hierarchical decomposition of processes (Malinova et al., 2013), however this type of decomposition does not apply to all organizations. Hence, identifying the different types of relations between abstract and detailed process models is a starting point for using a process map as complementary to the business process models already existent in organizations. As a result, the process map language will be used interdependently with any of the process modeling languages that are used today. Also, abstracting from the large process model collections to the respective process map and all concepts it includes is an issue that yet needs to be addressed. This stream of research would especially be useful for organizations that already own a collection of process models, but lack an overview of their business processes.

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