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Articulation of work process models for organizational alignment and informed information system design

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ABSTRACT

Articulating and representing procedural aspects of work in conceptual models is a prerequisite for informed information system (IS) design. Instruments supporting articulation need to establish common ground about the interaction of the collaborating actors. This article proposes a methodology for the articulation of work processes by inexperienced modelers. It consists of phases of articulation and consolidation of case-based models and interactive elaboration toward comprehensive representation of the process via virtual enactment. The resulting models can be directly interpreted by IS. A case study confirms that the methodology meets the identified requirements and identifies areas of improvement.

1. Introduction

Changes to business processes have an impact on how people work and collaborate within organizations. Being able to quickly adapt business processes to external or internal influencing factors is crucial in the present ever-changing business environment. Remaining competitive in such environments, which are characterized by highly dynamic market requirements and increased employee mobility, is dependent on being able to acquire knowledge about work processes and their context from experienced workers [1] and represent it in a way that makes it accessible for and adaptable to future work situations and new employees [62]. Representing work processes through conceptual modeling is a recognized means of making them visible and adaptable to changing organizational or business requirements, particularly by using them to design and configure information systems (IS) [6]. Failing to involve operative personnel in projects affecting work processes and IS results in ignorance [33] and ultimately leads to ineffectiveness and unclear responsibilities [61].

The existing literature (e.g., [24,50]) shows that this challenge can be met by involving operative staff in conceptual modeling activities, but also indicates that such an approach introduces challenges in the process of modeling that have to be addressed methodologically. People operatively involved in work processes (referred to as "actors" in the following) are domain experts with extensive knowledge about their respective roles in a work process, but normally have little methodological knowledge about modeling [51]. Their role in traditional IS-oriented modeling approaches is thus widely reduced to providers of domain knowledge for expert modelers [46]. An expert-mediated approach of representing work process knowledge in conceptual models bears the risk of introducing the expert modeler's own bias regarding which information should be represented in the model and the interpretation of vague or conflicting statements provided by the actors [20]. This not only negatively affects actors' ability to interpret the information represented in a model [33], but also leaves unresolved potential misconceptions or conflicting understanding of work among the involved actors [24,47]. *The aim of this article is to introduce a model elicitation approach, which is driven by actors and allows them to articulate and align their views on a work process, and still leads to a syntactically correct and semantically sound process model for further processing in IS.*

From a practical perspective, organizations would benefit from such an approach as it supports operative staff to align conflicting understandings and resolve misconceptions about their work. This reduces the effects of unforeseen contingencies [65] and allows to identify potential for improvement in the overall work process [15]. As the work process usually is shaped and supported by IS, these aligned views should be reflected in the models used to design these systems to appropriately support the work process [42].

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Involving actors in modeling activities has been addressed in several fields of research. In the field of system dynamics, approaches such as those of Vennix et al. [68] or Franco and Rouwette [17] focus on involving actors and resolving conflicting viewpoints as noted above. The resulting models, however, are not intended for the development of socio-technical support in IS. Research in the area of business process modeling shows that established formal modeling languages such as Business Process Modeling and Notation (BPMN) [70] are used for modeling driven by actors (e.g., [40]), but lead to the sacrifice of formal correctness and semantic completeness for usability [48], which makes them of limited use for further processing. A third strain of research in the area of socio-technical system design focuses on collaboratively capturing information about work processes from actors by providing notations explicitly tailored for understandability and easy use (e.g., [2,25,29]), while still maintaining a link toward technical interpretability of the created models. The task of transforming these models to representations that can be processed in IS, however, is left to expert modelers (e.g., [58]). Margaria et al. [41] argue in favor of a simple modeling approach that allows actors to create directly executable role-based workflow models and present a framework on how this aim can be achieved with modeling support tools. Fahland and Weidlich [10] and Kabicher and Rinderle-Ma [35] argue in favor of approaching actors with a case- or scenario-based approach to modeling, respectively, in which elicitation focused on capturing case-based process fragments, which are later (semi-)automatically aggregated to form a complete model of the process.

All of the aforementioned approaches aim at facilitating work modeling by actors without formal process modeling experiences. They either focus on supporting actors' needs in a collaborative modeling process or aim at producing executable models that can be processed directly in IS. The challenges addressed in both areas are of high relevance for the aim of involving actors in IS design, but have not yet been addressed in an integrated approach. *This article addresses this issue and introduces a methodology to facilitate actors' collaborative articulating of their work processes. It furthermore presents a support tool for conflict resolution and model elaboration, leading to formally correct models that are necessary for technical processing in IS.*

Collaborative articulation of work process models should lead to common ground [5] for all involved actors and serve as an agreed-upon basis for further use. This is necessary, because actors' mental models of how they contribute to a work process and how they interact with each other can be assumed to be inconsistent [65]. This eventually leads to problems in collaboration [68]. Existing work on collaborative conceptual modeling hardly addresses explicitly the differences in how people perceive collaborative work processes [52]. Also, no account is given on how to resolve these differences to an extent that allows reaching common ground on how to collaborate [57]. *The methodology presented in this article contributes to this area of research by introducing a modeling method that makes visible differences in understanding and requires resolving them to be able to finish the modeling process.*

The research reported on in this article methodologically follows a design science approach [26]. The modeling approach and the proposed tools are to be considered the *designed artifacts*. Although involving operatively active people in the work process modeling for the sake of IS design has been recognized as a relevant field of study, the *rationale* of this study is that no approach so far has addressed how to support the process of articulating and aligning potentially conflicting views on work processes while still maintaining a model representation that can be directly processed in IS. The *contribution* of this study is a methodology that enables nonexpert modelers to collaboratively create conceptual models of a shared work process by articulating and aligning their individual views on the work process. The resulting models are technically interpretable in IS. The methodology is supported by a set of tools that facilitate articulation, alignment, and conceptual modeling to achieve these ends. *Research rigor* is ensured by deriving the designed artifacts' requirements from the relevant literature in the fields of articulation support in collaborative settings and conceptual modeling support for inexperienced modelers. This brings together the research domains that are relevant as indicated in the design rationale. The artifact design process solely is based on these requirements. Consequently, *evaluation* in this article focuses on assessing whether these requirements have been met. A case study has been conducted to evaluate the designed artifacts in the intended field of application, and to identify the potential advantages and areas of improvement for the results presented.

The remainder of this article is organized as follows. In Section 2, we elaborate on the question of *how conceptual modeling can be adopted for articulation support*. In Section 3, the methodology designed to meet these requirements is introduced and described in detail. A brief description of the tools that have been developed to support the different methodological phases closes Section 3. In Section 4, the case study used to examine *if the proposed modeling approach meets the identified requirements* is presented. The article concludes with an account of the limitations of the presented research and a discussion on the potential for future methodological and technical developments.

2. Conceptual modeling for articulation support

Representing the procedural aspects of work in conceptual models is one prerequisite for informed IS design [6]. Commonly adopted modeling languages such as BPMN [70] and event-driven process chain (EPC) [44] provide constructs to describe the activities that constitute a work process and their causal relationships. Most of these modeling languages aim at representing models for further processing by means of technology (such as simulation or workflow execution; see [6]). Conceptualizing work in a technically interpretable manner, however, is not always feasible when capturing information about work processes from inexperienced modelers. People's mental models about their work processes are likely to be incomplete and inconsistent [60]. When using a modeling language oriented toward technical interpretability [38], its semantically exact specified constructs might be too limiting to fully capture the information that people articulate based on their mental models [11].

This challenge has been recognized for years in the area of socio-technical systems design [24]. One approach to overcome modeling constraints imposed by model semantics is to explicitly allow for vagueness in the models, deliberately leaving aside information that is incomplete or inconsistent at the time of modeling. This approach is implemented in modeling languages such as SeeMe [23], which explicitly introduces a construct to express vagueness, but also BPMN [70], which allows the use of a reduced set of model constructs with relaxed semantics when creating models with the involvement of inexperienced modelers [70]. This approach allows models that are syntactically correct and do not contain any semantically incorrect information to be quickly captured. However, it potentially omits information that is considered inconsistent or nonconsensual in the modeling situation.

The approach presented in this article explicitly targets such inconsistencies and focuses on their resolution in the course of modeling. Information is provided by the actors and directly represented by them in the model. They follow a multistep approach through the modeling process, which is described later. Modeling is initially carried out on an individual level to collect