



# Repeated use of process models: The impact of artifact, technological, and individual factors



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## ABSTRACT

Business process modeling has received a lot of attention from practitioners and researchers alike. Organizations make significant investments into process modeling in terms of training, tools, and resources. Yet, having invested into creating large process model collections, process models often fall into disuse, provoking the impression that the initial investment has been lost. While previous work has aimed at exploring model re-use as a design principle, our work examines repeated use of a model as a behavior and thus aims at identifying factors that facilitate or hinder the repeated use of process models by individual users. We develop a conceptual model of factors that can influence an individual's intention to repeatedly use process models. We evaluate this model through a cross-sectional survey of process model users from a large European financial institution. Our results indicate the importance of quality and ease of understanding of process models to repeated use, alongside individual factors, such as motivation and individual expertise. We identify means that help organizations to promote the repeated use of process models, which can assist them to increase the benefits of process modeling.

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## 1. Introduction

Process models provide information about the tasks, data, resources, and actors of a business process [1]. They are used for describing business requirements for organizational, technical systems design, or redesign decisions [2]. Many organizations commit ongoing and substantial investments in process modeling and the creation of process model collections [3]. For example, a manufacturing company that we are in contact with has a core modeling team of more than 20 people and over 1000 casual modelers in different lines of business who create new process models or maintain existing ones.

After having invested in the creation of process models, organizations often face the problem that models fall into disuse, which means that investments in process modeling are at risk of being lost [4]. In order for process modeling to be beneficial, the *repeated use* of models by end users has been identified as a key challenge [5]. With repeated use, we mean using an existing model again at a different *point in time* for the *same* or a *different task*. This notion of repeated use is broader than continued use because it includes using a model beyond its original context in terms of task or time. Repeated use thus requires a post hoc

decision to use a model again, while in continued use, this decision has been taken earlier. Moreover, our understanding of repeated use is not limited to the use of models for one purpose (e.g., process documentation) or one task (e.g., creating new models based on existing fragments) only but explicitly includes the use for multiple purposes (e.g., process improvement or software development). Understanding this notion of repeated use is important because key benefits of process modeling can only materialize if models are repeatedly used for multiple purposes [6].

Understanding repeated model use is also different from understanding successful modeling. Various studies into modeling success have identified factors that relate to project-specific and modeling-related characteristics [7], or the level of flow orientation in the models themselves [2]. These studies, however, do not explain why certain organizations manage to stimulate repeated use of process models while others suffer from models only being rarely used, or why some users repeatedly use models while others do not. We try to answer this question. We make three main contributions:

- 1) We developed a conceptual model that explains user intentions for repeatedly using process models. The model integrates different categories of factors and explicates their connection with intentions for repeated use.
- 2) To test our model, we developed an instrument to assess users' intentions for repeated use.

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- 3) Using this measurement instrument, we conducted the first empirical study on individual users' intentions to repeatedly use process models.

Our findings suggest that individual and artifact (i.e., model)-related factors are substantially more important than organizational or technological factors. This implies that any initiative for improving repeated use has to focus on the interaction of individuals with process models in the context of specific work tasks.

We proceed as follows. Section 2 positions our work in the literature on process modeling research. Section 3 defines our theoretical model based on four categories of factors relevant for repeated use we identified in literature. Section 4 describes our survey design. Section 5 presents the obtained data and results from our statistical analysis. Section 6 discusses our findings and highlights implications for research and practice. Finally, Section 7 closes with concluding remarks.

## 2. Background

Our research question is an empirical one. Empirical research in process modeling, broadly, is concerned with a) model creation, b) model interpretation, and c) scenarios of model use.

*Model creation* refers to the act of constructing a model. Overall, this stream of research is not densely populated. Model creation as a behavior has been studied through using specific tools that track and mine the interaction of a modeler with a modeling tool [8,9]. This work shows that good modeling outcomes are correlated with certain behavioral patterns during modeling. This implies that appropriate tool support for modeling is likely to result in better models [10–12].

*Model interpretation* focuses on the understanding of process models and the factors influencing it. Studies in this stream relate to characteristics of modeling grammars, of individual models, and of model readers. For instance, ontological deficiencies of modeling grammars appear to be a hindrance for understanding, since certain matters cannot be represented in a concise and clear way [13]. Notational deficiencies also affect understanding [14], as do model characteristics such as size and complexity [15]. Finally, personal differences such as cognitive abilities [16], education, and modeling knowledge [17] also explain variations in model understanding.

The stream on *scenarios of model use* investigates how process models are used in practice and which issues might hamper their effective use. For example, zur Muehlen and Recker [18] show that only few constructs of BPMN are used in practice. Other case studies emphasize guidance, communication, and coordination as positive effects stemming from model use [7,19,20]. Pitfalls of process modeling appear to be, among others, lack of top management support, lack of tool support for process visualization, and lack of connection between process design and execution as the most urgent, which might be rooted in the different mindsets of practitioners, researchers, and tool vendors [21].

In sum, these studies do not explicitly address the repetition or continuation of process model use. In fact, knowledge about what happens after the creation and initial use of a model overall is limited. As insights into the factors that influence repeated use will help to increase the organizational impact of process modeling, more empirical research in this area is needed.

### 2.1. Repeated use versus re-use of process models

It is important to understand that repeated use of models is not the same as re-use of models. Re-use of process models has been extensively studied from a technical perspective under the umbrella of “design for re-use.” In this line of work, re-use is understood as applying some fragments of a model or an entire existing model [22] in the creation of a new or revised model. Discussions include, for instance, various types of re-use patterns [23].

Several techniques support model creation based on re-usable fragments. Their goal is to guide business users in understanding and adopting the concepts of a specific fragment [24]. This requires corresponding querying techniques [25] and the automatic identification of recurring fragments [26].

The re-use of complete process models has partially overlapping requirements. Respective solutions are built based on ontological reasoning [27] and information retrieval concepts [28]. This requires similarity measures [29] and matching concepts [30], amongst others.

Research in this area is rich in terms of technical concepts and techniques that support the re-use of process models for the purpose of creating new ones. However, these contributions clearly focus on the technical component and do not cover an understanding of peoples' intentions to repeatedly use models, e.g. to regain knowledge about a processes. In particular, questions of when and why a particular act of repeated model use is happening remain unanswered. Also lacking are insights into factors promoting or hindering repeated use, not for the sake of creating new models but for application in different tasks and initiatives. We take this step and discuss repeated use as a behavior next.

### 2.2. Repeated use and re-use as behaviors

Due to the lack of empirical research on repeated process model use and on intentions for repeated model use in particular, we set out to deduce a broader set of relevant factors influencing intentions for repeated use from other fields. We therefore extended our literature review to fields involving information artifacts and information seeking behaviors. For instance, seeking information about processes from models is similar to seeking knowledge about products when intending to repurchase them, which brought us to the field of marketing. Our review also included literature on knowledge re-use as well as more technology-centered scenarios such as software re-use, code re-use, and database query re-use. Results from our literature review and the implications our study are summarized in Table 1.

Based on our review, we derived the following four conjectures, which inform our conceptual model of repeated process model use behavior:

- Repeated use will be dependent on the *properties of the artifact*. This conjecture has been found in the context of model re-use [33] as well as in research on re-use of software, [34] software code [35, 36], and repurchase intentions [40]. While re-use is potentially influenced by the fit of the artifact to the task a user aims at re-using it for [33,34,38,39], the perception of the quality of an artifacts has been found to be another determinant in the context of code re-use [35,36] and repurchase intentions [40]. This indicates that repeated use will vary depending on an individuals' perceptions of the properties of an artifact (e.g., its quality).
- *Individual factors* should also play a decisive role in a person's intention to repeatedly use an artifact as indicated by research on knowledge re-use [31], code re-use [35,37], query re-use [39], and repurchase intentions [40]. There is, however, no consensus when it comes to which individual factors influence repeated use. Some studies identified motivation as one important factor [31,37], while others focus more on how familiar a user is with an artifact and the domain [31,35,39].
- *Organizational factors* might also promote or hinder repeated use as has been found in the context of knowledge [31,32], software code, and database query re-use [34,35,38,39]. Identified factors are support by colleagues [32] or the existence of re-use processes [34,35].
- Accessibility also has been identified as a factor influencing repeated use, especially in the context of knowledge re-use [31,32] and repurchase intentions [41]. Since access mainly happens through IT systems, *technological factors* such as usefulness, ease of use [41], and ease of access [31] may impact repeated use.

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