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Modelling families of business process variants: A decomposition driven method

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ABSTRACT

Business processes usually do not exist as singular entities that can be managed in isolation, but rather as families of business process variants. When modelling such families of variants, analysts are confronted with the choice between modelling each variant separately, or modelling multiple or all variants in a single model. Modelling each variant separately leads to a proliferation of models that share common parts, resulting in redundancies and inconsistencies. Meanwhile, modelling all variants together leads to less but more complex models, thus hindering on comprehensibility. This paper introduces a method for modelling families of process variants that addresses this trade-off. The key tenet of the method is to alternate between steps of decomposition (breaking down processes into sub-processes) and deciding which parts should be modelled together and which ones should be modelled separately. We have applied the method to two case studies: one concerning the consolidation of existing process models, and another dealing with green-field process discovery. In both cases, the method produced fewer models with respect to the baseline and reduced duplicity by up to 50% without significant impact on complexity.

1. Introduction

Every organisation, be it non-profit, governmental or private, can be conceived as a system where value is created by means of processes [1]. Oftentimes, these processes do not exist as singular entities but rather as a family of variants that need to be collectively managed [2,3]. For example, an insurance company would typically perform the process for handling claims differently depending on whether it concerns a personal, vehicle or property claim [4]. Each of these processes for claims handling can be seen as variant of a generic claims handling process [5]. As such, processes with similar inputs and business goals can be seen as variations of a single process in accordance with the definition provided in [5,6].

When it comes to modelling a family of process variants, one extreme approach is to model each variant separately. Such a *fragmented-model* approach [2] or a "*multi-model approach*" [5] creates redundancy and inconsistency. On the other hand, modelling multiple variants together in a *consolidated-model* approach [2] or "*single-model approach*" [5] leads to complex models that may prove difficult to understand, analyse and evolve. In addition to these comprehensibility and maintainability concerns, business drivers may come into play when determining whether multiple variants should be treated together or separately. Striking a trade-off between modelling each process variant separately versus collectively in a consolidated manner is still an open research question. In this context, our overarching research question is as follows.

"*How can a family of process variants be modelled?*"

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(1) for consolidation of process models i.e. integrating a set of process models without changing the behaviour of business process, and
(2) for discovery of process models, i.e. green-field modelling of a business process.

The contribution of this paper is a decomposition driven method for modelling families of process variants. The core idea is to incrementally construct a decomposition of the family of process variants into sub-processes. At each level of the process model decomposition and for each sub-process, we determine if this sub-process should be modelled in a consolidated manner (one sub-process model for all variants or for multiple variants) or in a fragmented manner (one sub-process model per variant). This decision is taken based on two parameters: (*i*) the business drivers for the existence of a variation in the business process; and (*ii*) the degree of difference in the way the variants achieves the business goal of the process (syntactic drivers).

This paper is an extension of a conference paper [7]. In the previous paper, we implemented the proposed method on a case study concerning the consolidation of existing process models. In this extended version, we validate the proposed method on a second case study where the goal is not to consolidate existing process models, but to capture a family of process variants from scratch. In this context, the proposed method is compared with a mainstream method for discovery of process models. Furthermore, the method is further refined with additional criteria for evaluating driver strength and similarity of variants.

The remainder of the paper is structured as follows. Section 2 introduces the conceptual foundation of our method. Section 3 describes the proposed method. Next, Section 4 introduces the case study method and the selection of case studies. Section 5 presents the application of the method to the case studies and Section 6 discusses the case study findings. Finally, Section 7 discusses related work while Section 8 draws conclusions and outlines future work.

2. Conceptual foundation

The proposed method relies on two pillars: (i) a process decomposition method; and (ii) a decision framework for determining if two or more variants of a process/sub-process should be modelled together or separately. We present these two pillars in turn below.

2.1. Decomposition of process models

A number of methods for process decomposition exist [1,8,9]. Although these methods differ in terms of the nomenclature and specific definitions of the various levels of the process decomposition, they rely on a common set of core concepts that we summarise below.

A business process can be described at progressive levels of detail, starting from a top-level process, which we call the *main process* [9]. A main process is a process that does not belong to any larger process. The main process is decomposed into a number of *sub-processes* based on the concept of value chain introduced by Porter [8]. A sub-process is a process that is invoked by another (larger) process according to a call-and-return mechanism. Sub-processes are processes on their own and it can be further decomposed into sub-processes until such a level where a sub-process consists exclusively of atomic activities (called tasks) that do not warrant further decomposition.

Note that the above discussion refers to business processes, regardless of how they are represented. When modelling a business process, however, it is only natural to model each of its sub-processes separately. Accordingly, the hierarchy of processes derived via process decomposition is reflected in a corresponding hierarchy of process models representing the sub-processes in this decomposition.

2.2. Business and Syntactic Drivers

By applying incremental decomposition on a family of process variants, we reduce the problem of determining whether a given process should be modelled in a fragmented or consolidated manner, to that of deciding whether each of its sub-processes should be modelled in a fragmented or consolidated manner. To guide this decision, we propose a decision framework based on two classes of variation drivers. On the one hand, there may be business reasons for two or more variants to be treated as separate processes (or as a single one) and ergo to model these variants separately (or together). On the other hand, there may be differences in the way two or more variants achieve their business goals, which make it more convenient to model these variants separately rather than together or conversely. We refer to the first type of drivers as *business drivers* while the second type of drivers is called *syntactic drivers*.

Business drivers can range from externally dictated ones such as legislative requirements to internal choices an organisation has made such as organisational divisions due to mergers for example [10]. By categorising the many business reasons of process variations into *classes of variation drivers*, a reduction in complexity is achieved [11]. This enables working with a few classes of drivers rather than a multitude of possible root causes [12]. To this end, we use our previously presented framework [6], which is based on [1], for classification of business drivers.

According to this framework (see Fig. 1), organisations operate within a context of external influences, to which they adapt their business processes. In this setting, organisations create an output by procuring resources in order to manufacture a product or a service (corresponding to *how* in Fig. 1). These products and services (*what*) are brought to a market (*where*) for customers (*who*) to consume. Organisations adapt their processes according to these aspects as well as their external environment such as tourist seasons (*when*). These adaptations lead to business process variations.

The key tenet of the framework is that business drivers for variations in business processes, based on their causes, can be classified as *operational* (*how*), *product* (*what*), *market* (*where*), *customer* (*who*) and *time* (*when*) drivers.