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VIVACE: A framework for the systematic evaluation of variability support in process-aware information systems

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ABSTRACT

Context: The increasing adoption of process-aware information systems (PAISs) such as workflow management systems, enterprise resource planning systems, or case management systems, together with the high variability in business processes (e.g., sales processes may vary depending on the respective products and countries), has resulted in large industrial process model repositories. To cope with this business process variability, the proper management of process variants along the entire process lifecycle becomes crucial.
Objective: The goal of this paper is to develop a fundamental understanding of business process variability. In particular, the paper will provide a framework for assessing and comparing process variability approaches and the support they provide for the different phases of the business process lifecycle (i.e., process analysis and design, configuration, enactment, diagnosis, and evolution).
Method: We conducted a systematic literature review (SLR) in order to discover how process variability is supported by existing approaches.
Results: The SLR resulted in 63 primary studies which were deeply analyzed. Based on this analysis, we derived the *VIVACE* framework. *VIVACE* allows assessing the expressiveness of a process modeling language regarding the explicit specification of process variability. Furthermore, the support provided by a process-aware information system to properly deal with process model variants can be assessed with *VIVACE* as well.
Conclusions: *VIVACE* provides an empirically-grounded framework for process engineers that enables them to evaluate existing process variability approaches as well as to select that variability approach meeting their requirements best. Finally, it helps process engineers in implementing PAISs supporting process variability along the entire process lifecycle.

Contents

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1. Introduction

Each product an enterprise develops or produces and each service it delivers to its customers result from the coordinated execution of a set of *activities* (i.e., business functions). In this context, *business processes*[4] act as the drivers enabling this coordination [131]. Consequently, *process-aware information systems* (PAISs) provide a guiding framework in enterprise computing, supporting the entire business process lifecycle [128]. More precisely, a PAIS constitutes an information system that manages, executes, and analyzes the internal business processes of an enterprise (e.g., sales business processes) based on explicitly specified *process models*. In turn, these models may refer to actors (e.g., sellers), application services (e.g., web services), and business data (e.g., products) [35]. Examples of PAISs include workflow management systems (e.g., ADEPT2 [98], YAWL [3]), enterprise resource planning systems (e.g., SAP R/3 [113]), and case management systems (e.g., FLOWer [35], PHILharmonicFlows [59]).

The increasing adoption of PAISs in enterprises during the last decade has resulted in large process model repositories [105,32,37]. Usually, such repositories comprise collections of related *process model variants* (*process variants* for short). On one hand, respective process variants pursue the same or similar *business objective* (e.g., product sales, patient treatment, or car maintenance). On the other, they show differences in several respects due to their varying *application context*, e.g., the regulations to be obeyed in different countries or the type of product to be delivered to customers [100,32,125].

A collection of related *process variants* is denoted as *process family*. In practice, a process family may comprise dozens or hundreds of process variants [87]. In the automotive industry, for example, we found a process family dealing with vehicle repair and maintenance in a garage, which comprises more than 900 process variants [48]. The latter share *commonalities* (i.e., process fragments shared by all process variants), but also show country- and vehicle-specific *variations*. In turn, [73] reports on more than 90 process variants for handling medical examinations in a hospital. Finally, consider check-in procedures at an airport, which are characterized by a high degree of variability as well. Example 1 describes the check-in process in detail and discusses its different sources of variability. Note that we will use this process as running example throughout the paper.

Example 1 (*Check-in process*). We consider the process every passenger has to go through when checking in at an airport. Even though this process is similar irrespective of the airport the passenger departs from and the airline flying with, numerous variations exist depending on distinguished factors. For example, variability is caused by the type of check-in (e.g., online, at the counter, or at the self-servicing machine), which, in turn, determines the type of boarding card (e.g., electronic versus paper-based). Other sources of variability include the flight destination (e.g., information about the accommodation is required when traveling to the US) and the type of passenger (e.g., unaccompanied minors and handicapped people might require extra assistance). Depending on the type of luggage (e.g., bulk or overweight

[4] Note that we use the terms *business process* and *process* synonymously throughout the paper.

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