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The use of software product lines for business process management: A systematic literature review

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ABSTRACT

Context: Business Process Management (BPM) is a potential domain in which Software Product Line (PL) can be successfully applied. Including the support of Service-oriented Architecture (SOA), BPM and PL may help companies achieve strategic alignment between business and IT.
Objective: Presenting the results of a study undertaken to seek and assess PL approaches for BPM through a Systematic Literature Review (SLR). Moreover, identifying the existence of dynamic PL approaches for BPM.
Method: A SLR was conducted with four research questions formulated to evaluate PL approaches for BPM.
Results: 63 papers were selected as primary studies according to the criteria established. From these primary studies, only 15 papers address the specific dynamic aspects in the context evaluated. Moreover, it was found that PLs only partially address the BPM lifecycle since the last business process phase is not a current concern on the found approaches.
Conclusions: The found PL approaches for BPM only cover partially the BPM lifecycle, not taking into account the last phase which restarts the lifecycle. Moreover, no wide dynamic PL proposal was found for BPM, but only the treatment of specific dynamic aspects. The results indicate that PL approaches for BPM are still at an early stage and gaining maturity.

Contents

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1. Introduction

The current complexity of the corporate world has required dynamism from the Information Technology (IT) infrastructure in order to provide technical solutions to conduct business [1–3]. In this context, Business Process Management (BPM) [4,5], Service-oriented Architecture (SOA) [6,7] and Software Product Line (SPL, or simply PL) [8,9] may provide technical and systematic support to improve the competitive edge of organizations [10]. If used together, they could help companies achieve the expected strategic alignment between business and IT [11,12].

BPM support the lifecycle of business processes by involving different parties which act cooperatively and seek to achieve common business goals [4,5]. The activities include the definition, execution, monitoring, control, analysis, and improvement of business processes [4,13]. As for SOA, it addresses the integration of different applications through the provision and consumption of electronic services (e-services), providing the exchange of services considering an interorganizational scope; in SOA, software is broken down into services running distributed in a network [6,7].

BPM and SOA, when used together [14], can help in achieving the strategic alignment between business related areas and IT [15], which is important to synchronize IT resources and efforts with the key strategic business objectives of an organization [11,12]. Whereas, in BPM, the focus is on managing the business processes that align the different organization activities in cross-flows [13]; on the other hand, SOA provides a modern and flexible platform capable of providing support to those processes through a combination of structured IT resources based on the service-orientation paradigm [7].

So that BPM and SOA can fulfill their role in the organizational environment, a systematic approach is desirable to provide quality and productivity increases [14,15]. In terms of systematization, PL can be applied given that analysts and engineers have successfully used PL concepts in various application domains [8,9]. PL exploits software reuse for developing a family of products with reduced time to the market and with improved quality, including in the BPM and SOA contexts [10]. BPM is one of the potential domains in which PL concepts can be successfully applied [16].

Dynamic PLs (DPLs) are a specific type of PL [17]. A DPL produces software that can adapt to changes in order to meet user needs, taking into account resource constraints [18]. DPL have been efficiently providing a way to handle product changes at runtime within the general context of PL [19]. Although DPLs are built around the central idea of a typical PL, there are important differences between them [18]. More specific than general PLs, DPLs can be applied to the BPM domain in order to meet the dynamism requirements of IT infrastructure such as stated by Tallon [1], Overby et al. [2] and Lee et al. [3].

Aiming to contribute to this research area, an extensive Systematic Literature Review (SLR) was conducted on the existing research works presenting PL and BPM joint implementation approaches, including the SOA support for BPM. Considering the flexibility needs inherent to the BPM domain, special attention was given to the application of DPL concepts into such a domain. Therefore, the main objective of this paper is to present the results of this investigation conducted so that researchers interested in this area may have a broader picture of it and some important questions may be answered.

The remainder of this paper is structured as follows: Section 2 presents the basic concepts related to BPM and PL; Section 3 presents some works similar to the SLR presented here; Section 4 presents the methodology applied to conduct this SLR; Sections 5 and 6 present, respectively, the review results and the discussion of the results; Section 7 presents a discussion of the validity threats considered for this SLR; and, Section 8 presents the conclusion of this paper.

2. Background

In this section, the basic concepts related to BPM (Section 2.1) and to PL (Section 2.2), which are used in the rest of the paper, are presented.

2.1. Business process management

BPM (Business Process Management) has been presented as a key factor to the success of an IT infrastructure prepared for today's organizational demands [15]. Moreover, BPM is seen as a competitive edge for the organizations, as with it they can determine and exhibit their maturity level [16].

According to van der Aalst et al. [4], BPM includes methods, techniques, and tools to support the design, enactment, management, and analysis of operational business processes. BPM can therefore be considered an extension of classical Workflow Management approaches and systems [4]. Several specification and modeling languages and tools have been proposed to be used in BPM, from which the BPMN (Business Process Model and Notation) language [20] has become the 'de facto' standard language to represent business processes. Nevertheless, other languages such as UML Activity Diagrams have also been used for modeling business processes [21,22].

A business process consists of a set of tasks performed in a specific sequence to achieve a common business goal [13,23]. The BPM lifecycle includes several phases, such as [4,5]: (a) business process modeling; (b) business process model instantiation; (c) business process enactment and administration; (d) business process monitoring and auditing; and, (e) business process assessment and optimization. In the last phase, the execution history can be analyzed, looking for ways to improve the business process, which leads to business process remodeling, restarting the cycle all over again [13]. Considering the markets' current dynamics, each sequence in such lifecycle is usually completed in a very short time, due to the constant need for new versions of the business processes running in the organizations [24].

In order to make the management and integration of business processes possible, from a technical point of view, different technologies have been proposed, including, not so recently, the middleware frameworks such as CORBA, DCOM and Java-RMI [25], which were properly used in the intra-organizational context. As the need for interoperability has evolved towards interorganizational cooperation, the existing solutions failed to meet their objec-