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Impact analysis and change propagation in service-oriented enterprises: A systematic review

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ABSTRACT

Context: The adoption of Service-oriented Architecture (SOA) and Business Process Management (BPM) is fairly recent. The major concern is now shifting towards the maintenance and evolution of service-based business information systems. Moreover, these systems are highly dynamic and frequent changes are anticipated across multiple levels of abstraction. Impact analysis and change propagation are identified as potential research areas in this regard.
Objective: The aim of this study is to systematically review extant research on impact analysis and propagation in the BPM and SOA domains. Identifying, categorizing and synthesizing relevant solutions are the main study objectives.
Method: Through careful review and screening, we identified 60 studies relevant to 4 research questions. Two classification schemes served to comprehend and analyze the anatomy of existing solutions. BPM is considered at the business level for business operations and processes, while SOA is considered at the service level as deployment architecture. We focused on both horizontal and vertical impacts of changes across multiple abstraction layers.
Results: Impact analysis solutions were mainly divided into dependency analysis, traceability analysis and history mining. Dependency analysis is the most frequently adopted technique followed by traceability analysis. Further categorization of dependency analysis indicates that graph-based techniques are extensively used, followed by formal dependency modeling. While considering hierarchical coverage, inter-process and inter-service change analyses have received considerable attention from the research community, whereas bottom-up analysis has been the most neglected research area. The majority of change propagation solutions are top-down and semi-automated.
Conclusions: This study concludes with new insight suggestions for future research. Although, the evolution of service-based systems is becoming of grave concern, existing solutions in this field are less mature. Studies on hierarchical change impact are scarce. Complex relationships of services with business processes and semantic dependencies are poorly understood and require more attention from the research community.

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Contents

1. Introduction

The complementary relationship between Service-Oriented Architecture (SOA) and Business Process Management (BPM) has paved the way for organizations to become more competitive while automating processes and systems across business lines. Services and supporting business processes are inherently dynamic. Therefore, flexibility to accommodate different functional, structural, regulatory and technological changes is considered crucial in business environments.

Change management in service-based environments and Business Process Models is an emerging research area entailing numerous nontrivial issues and problems [77,81]. Process models are mainly used in the earlier system development stages and are equally clear to both software engineers and the business community. These models are always prone to different kinds of changes, such as new regulatory laws, changes in business policies or strategies, or emerging technologies. Without proper control, such changes to process models may have disruptive effect on the overall system due to structural, functional or qualitative anomalies [72]. Therefore, process flexibility and change are deemed of crucial concern in the Business Process Management (BPM) domain [15]. Adaptive business process management systems [67] and version management of business processes [92] are relevant areas of change management in this regard; however, our focus is specifically on impact analysis and propagation of business process changes. From Service Oriented Architecture (SOA) point of view, services are also subject to constant changes and modifications.

Table 1
Electronic databases.

Identifier	Database	URL
ED1	ACM	http://dl.acm.org/
ED2	IEEE Xplore	http://ieeexplore.ieee.org/
ED3	Science Direct	http://sciencedirect.com/
ED4	Springer Link	http://link.springer.com/
ED5	Wiley	http://onlinelibrary.wiley.com/
ED6	Emerald Insight	http://www.emeraldinsight.com/