Resolving Violations in Inter-process Relationships in Business Process Ecosystems

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Abstract. In service-based environments, each accessible service relies on business process(es) such that changing these services usually requires changing their supporting process(es). Managing process changes is not trivial due to there may exist complex relationships between processes. Changing a process may lead to further changes to related processes to preserve their relationships. We propose resolution patterns, based on semantic effect analysis, to resolve relationship violations between processes.

Keywords: inter-process relationship, semantic effect, resolution patterns, change propagation.

1 Introduction

Service-Oriented Computing (SOC) utilizes services as the constructs to support the development of rapid, low-cost and easy composition of distributed applications [7]. Web Services have emerged as the current most promising technology based on the SOC concept. They provide the basis for the development and execution of business processes, which are normally invisible to the business partners, that are distributed over the network and available via standard interfaces and protocols [7]. As business environments constantly change over time, enterprises are expected to be able to adapt to many changes to their business services to keep their competitiveness. Changes to these services usually require changes to their supporting business processes. Managing process changes challenges the enterprises with the fact that their process repositories have complex features [6], involving hundreds even thousands of models in which they might be related to each other. In this context, changing one single process may lead to further changes made to related processes in order to preserve their relationships. This is, in fact, a process for propagating changes between interrelated processes. In dealing with such complex repositories, it becomes error-prone, costly and labor intensive to propagate, properly, the changes initiated from a process model to its related process(es). As such, identification of changes and development of procedures for preserving the relationships become critical tasks.

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Hence, techniques and tools are required to assist process analysts. There has been, however, very little work on supporting change propagation in process model collections [1]. Our proposed framework aims to fill this gap. We view a collection of interrelated process models as an ecosystem [2]. In such ecosystem, process models play a role analogous to that of biological entities in a biological ecosystem. They are created (or discovered, using automated toolkits [3]), constantly changed during their lifetimes, and eventually discarded. Changing a process may cause perturbations (i.e. inconsistencies) in the ecosystem in the form of critical inter-process relationships being violated. In this view, a process ecosystem is considered to be in an (consistency-)equilibrium if its all inter-process relationships are mutually consistent. Change propagation is, therefore, reduced to finding an equilibrium in a process ecosystem.

In this paper, we propose a taxonomy of all possible process changes that can violate relationship constraints between a pair of semantically effect annotated processes. By relying on semantic effect analysis, we also construct a set of resolution patterns to resolve any violation triggered by process changes described in the taxonomy. We develop our framework based upon our previous work in formalizing inter-process relationships [6]. Further, some of these patterns have also been practically used in our previous work in dealing with change propagation in process ecosystems [5]. We, however, illustrate the proposed approach by using a detailed example.

This paper is structured as follows. Sect. 2 briefly describes related foundations. Sect. 3 identifies the taxonomy of process changes. Sect. 4 proposes our resolution patterns. Sect. 5 illustrates the proposed approach. Sect. 6 discusses related work. Sect. 7 concludes and layouts some future work.

2 Foundations

Semantic Effect-Annotated Process Model. An effect annotation relates to a particular result/outcome to an activity in a process [4]. An activity represents the work performed within a process. Activities are either atomic (called a *task*) or compound (called a *sub-process*) [9]. In an annotated BPMN process model, as our approach relies on, we annotate each activity with its (immediate) effects. We define the immediate effects as the immediate results/outcomes of executing an activity in a process. This annotation allows us to determine, at design time, the effects of process execution up to a certain point in the model. These effects are necessarily non-deterministic, since a process might have taken one of many possible alternative paths through a model to get to that point. We define a procedure for *pair-wise effect accumulation*, which, given an ordered pair of activities with their corresponding effect annotations, determines the cumulative effects after both activities have been executed in a contiguous sequence. We, however, only deal with a restricted subset of BPMN framework, i.e. start/end empty events, XOR and AND gateways, task, sub-process and message flow.

Let t_i and t_j be an ordered pair of activities connected by a sequence flow such that t_i precedes t_j. Let $e_i = \{c_{i1}, \ldots, c_{im}\}$ and $e_j = \{c_{j1}, \ldots, c_{jn}\}$ be the