Managing Process Variants as an Information Resource[1]

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Abstract. Many business solutions provide best practice process templates, both generic as well as for specific industry sectors. However, it is often the variance from template solutions that provide organizations with intellectual capital and competitive differentiation. In this paper, we present a modeling framework that is conducive to constrained variance, by supporting user driven process adaptations. The focus of the paper is on providing a means of utilizing the adaptations effectively for process improvement through effective management of the process variants repository (PVR). In particular, we will provide deliberations towards a facility to provide query functionality for PVR that is specifically targeted for effective search and retrieval of process variants.

1. Introduction

It is evident that work practices at the operational level are often diverse, incorporating the creativity and individualism of knowledge workers and potentially contributing to the organization's competitive advantage. This diversity needs to be both encouraged and controlled. A major difficulty in this issue lies in the fact that the requisite knowledge, that drives the diverse practices at an operational level, is only tacitly available. This knowledge constitutes the corporate skill base and is found in the experiences and practices of individual workers, who are domain experts in a particular aspect. There is significant evidence in literature on the difficulties in mapping process logic to process models. We believe that this is a limitation in current solutions, and part of the modeling effort needs to be transferred to domain experts who make design decisions based on (1) their expertise and (2) case specific conditions.

In this paper, we utilize a framework for process modeling and deployment [1, 2] that harnesses successful work practice and provides the ability to build

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a valuable information resource from them. The framework consists of: (1) A constraint-based process modeling approach, namely Business Process Constraint Network (BPCN); and (2) a repository for case specific process models, called Process Variant Repository (PVR). It is the last aspect which forms the focus of this paper. The aim of this paper is to provide an effective approach for structuring and querying PVR.

2. Background

Business Process Constraint Network (BPCN) [1] has been developed to provide formal underpinning to the notion of **process templates**. BPCN relaxes rigid process specification to a set of minimal constraints. It provides the ability to accept a set of various constraint types; and provides methods for checking constraint network consistency [2]. These details are not included in this paper, but we will utilize BPCN concepts as background. We refer to the individually tailored process instances as **process variants**, each of which represent the preferred work practice, but are also valid in terms of process constraints as defined by the BPCN. Although all process variants satisfy the same set of constraints, they may vary significantly. Over time, the repository of such process variants can build into an immense corporate resource. We argue that such a resource can provide valuable insight into work practice, help externalize previously tacit knowledge, and provide valuable feedback on subsequent process design and improvement (cf. Fig.1).

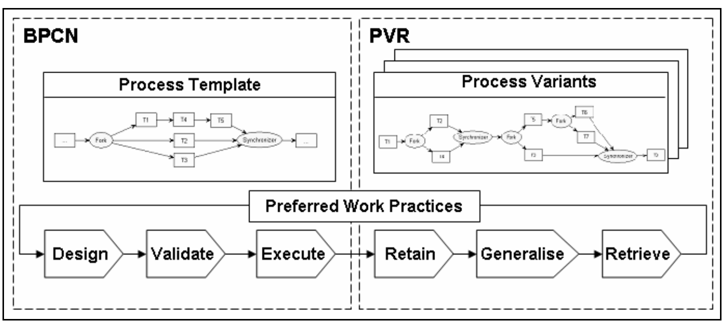

Fig. 1. Framework overview

3. Repository for Process Variants

When a process template completes execution, the model corresponding to the process variant as well as essential execution properties are stored in the PVR.

A **query** is a statement of information needs, which is formulated according to one or more aspects of process variants. We are specifically interested in complex (structural) criteria.

The schema of the repository defines the structure according to which process variants are stored. Confining description of process variants to essential structural aspect, we can define a process variant V by the process model W, where $W = (N, F)$ is defined through a directed graph consisting N: Finite Set of Nodes, F: Flow Relation $F \subseteq N \times N$. Nodes are classified into tasks (T) and coordinators (C), where $C \cup T$, $C \cap T = \emptyset$. Task nodes represent atomic manual / automated activities or sub processes that must be performed to satisfy the underlying business process objectives. Coordinator nodes allow us to build control flow structures (fork, choice, loop etc.) to manage the coordination requirements. Since W represents an executed process instance, coordinator nodes types are limited, i.e. $\forall\ n \in\ C$, CoordType: $n \rightarrow$ {*fork, synchronize, begin, end*}.

Consider the following collection of process variants in Fig.2 (V_1, V_2, V_3 and V_4) satisfying same constraints, which are: *T1* must be performed before *T5*; *T2* and *T4* must be done in parallel. PVR can be expected to contain hundreds if not thousands of such variants for a given process.

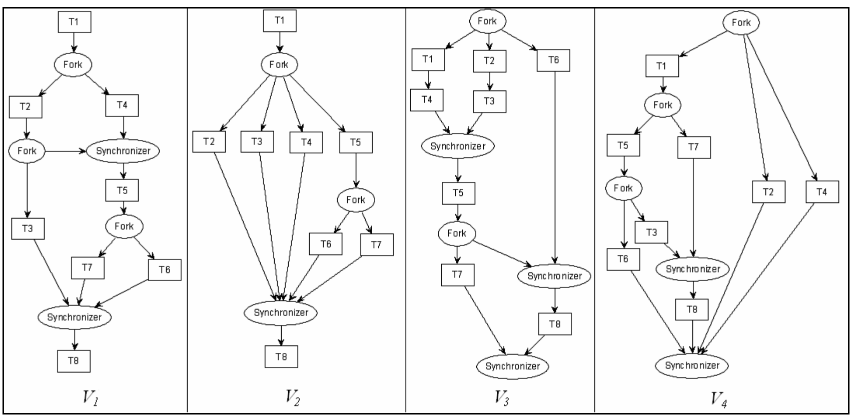

Fig. 2. Example Process Variants V_1, V_2, V_3 and V_4

We propose to define queries on structural aspect as **process fragments**, defined using the graphical language used in W. Let Q be the process (sub)graph that represents a query, i.e. the criteria for selection of process variants. We define similarity between Q and a process variant V through two relationships, namely **equivalent** and **subsume** [3]. For example, query graph Q_1 as given in Fig.3, is subsumed by process variants V_1 and V_2.

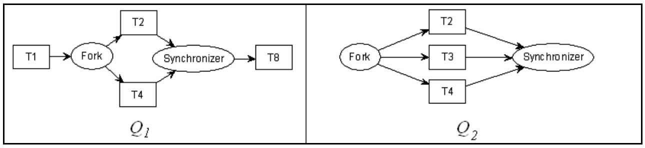

Fig. 3. Example Queries Q_1 and Q_2

In order to determine whether a given variant is in an equivalent or subsume relationship with a specified query, we propose a matching method `SELECTIVE_REDUCE`, which uses graph reduction techniques to determine the match. The method is assumed to be executed on only those variants from PVR where the node set of the variant is a superset of the node set of a specified query. The basic intuition behind `SELECTIVE_REDUCE` is to firstly eliminate from the node set of the variant all task nodes that are not contained in the node set of the query, and secondly to reduce the flow relation using three reduction rules [3], namely *sequential*, *adjacent* and *closed*. Fig.4 illustrates the applications of these reduction rules, where the solid rectangles represent the relevant tasks required by the query and the hollow rectangles the irrelevant tasks. The goal of the original algorithm in [3] is to reduce a process graph into an empty graph in order to verify structural correctness. In our approach, the algorithm is modified to reduce a variant that has an equivalent or subsume relationship with the query, into a structurally identical graph (not empty) as the query. In [4], a detail description of the algorithm can be found.

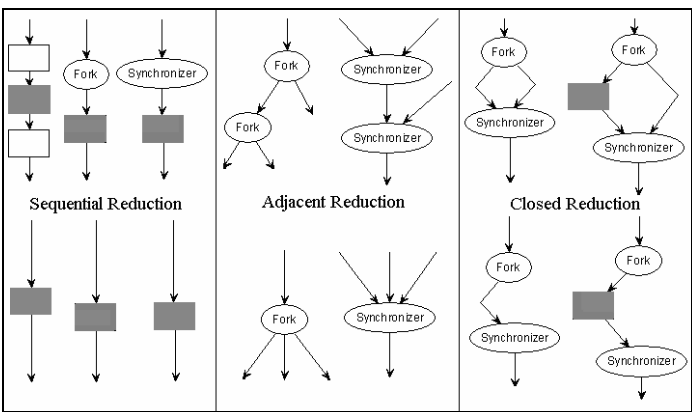

Fig. 4. Sequential, Adjacent and Closed Reduction Rules

Applying `SELECTED_REDUCE` on all variants given in Fig.2 (V_1, V_2, V_3 and PV_4) for query Q_1 gives reduced structures PV_1, PV_2, PV_3 and PV_4, as illustrated in Fig.5. V_1 and V_2 are said to be **exact matches** with Q_1 since the reduced process graphs of V_1 and V_2 (PV_1, and PV_2) are isomorphic to query graph Q_1. V_3 and V_4 are termed **partial matches** with Q_1 as containing the same set of tasks as the query, but the process graphs are structurally different from Q_1.

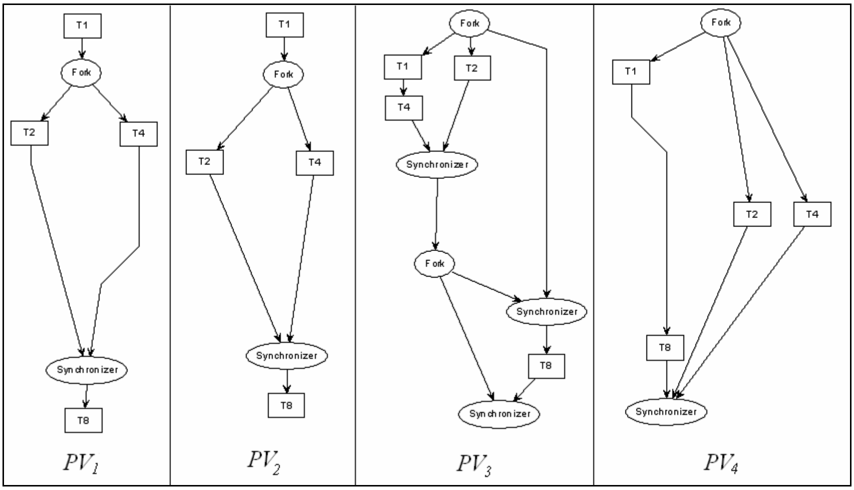

Fig. 5. Reduced process variants PV_1, PV_2, PV_3 and PV_4 against query Q_1.

We propose a simple method based on flow (edge) counting to provide further insight into partial matches [4]. The method finds out the similarity between a reduced process graph (of partially matched variant) and a query graph by first comparing the number of matching flows between the two, and the similarity degree is given by the percentage of matching flows among the total number of flows in the reduced process variant. The query facility of PVR can potentially retrieve a very large result, it will be important to provide functionality to further refine query criteria. ***Multi-aspect queries*** will play an important role [5], where structural search is combined with search on operational properties, e.g. find process variants that correspond to the structure of query Q_1 (Fig. 2) and no test was performed by a senior engineer.

4. Related Work

Process models have been regarded as an information resource in many aspects of modern enterprises [6, 7]. The most common way to capture, maintain, manage and diffuse knowledge associated with the best practices can be found in knowledge-based systems [8] and Case-Based Reasoning (CBR) based workflow management [9]. Another predominant technique has been process diagnosis and redesign. The diagnosis activity referred to as Business Process Analysis (BPA), which is assisted by various Workflow Mining techniques [10].

5. Summary

This paper provides methods to benefit from a repository of process variants, namely PVR. The presented methods provide effective means of searching and matching process variants against a given query (example process structure), and generate result sets that can be conveniently ranked. The work reported in this paper focuses on queries on the structural aspect, but can be extended to multi-aspect queries. The results of the proposed query facility in PVR can provide deep insights into ongoing work practices, identify areas of process improvement, and contribute to systematic and well-informed process evolution.

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