adaptation and evolution frameworks for service based inter-organizational workflows

saida boukhedouma, university of sciences and technology houari boumediene (usthb), algiers, algeria
zaia alimazighi, university of sciences and technology houari boumediene (usthb), algiers, algeria
mourad oussalah, university of nantes, nantes, france

abstract

this paper describes pattern-based frameworks for adaptation and evolution of service-based workflow process models meeting specific cooperation patterns widely recognized in the b2b area. in the authors’ previous works, they focused on restructuring and interconnecting workflows using the soa paradigm so as to deal with more flexible inter-organizational workflow (iowf) models. the main issue of this paper is the question of flexibility of iowf process models where the authors distinguish two main aspects: adaptability and evolutivity affecting different levels of the iowf process. for that, they define three categories of adaptation called functional, behavioral and interactional adaptations and two categories of evolution called functional evolution and organizational evolution; then, they conceptualize some adaptation and evolution patterns which can be applied on the iowf process models. the authors’ adaptation and evolution frameworks are developed according to themvc pattern and operate on process models specified with bpel. thanks to their high modularity, the frameworks are easily extensible and allow the reusing of patterns to implement other ones.

keywords

abstraction, behavioral adaptation, bpel, functional adaptation, functional evolution, interactional adaptation, iowf, organizational evolution, pattern, service

introduction

during the two last decades, the concept of virtual enterprise had more and more attention in the area of business processes, especially interorganizational processes which have been subject to major structural transformations due to the emergence of new technologies (lee et al., 2010). thus, several tools and technologies have been adopted to promote the cooperation between business processes called b2b cooperation or networked business. from there, two major challenges were identified and have attracted the interest of many researchers. the first challenge is interoperability for which several models have been developed (guedria, 2014; dorloff & kajan, 2012) because business processes are designed and implemented separately on heterogeneous platforms. the second challenge is flexibility (afflerbach et al., 2014) because the dynamic character of networked business requires organizations to quickly respond to the rapidly changing business structures.

in our research, we focus on structured b2b cooperation which is based on process models clearly defined because in many situations, especially for the management of big projects, business partners need to agree together in order to build structured and durable cooperation. also, cooperation between...
businesses can be envisaged in different ways according to different cooperation schemas. Initially, the Workflow technology has been adopted to support structured cooperation; in (Van der Aalst, 1999, 2000), generic inter-organizational workflow schemas (called IOWF-architectures) have been defined and widely recognized in the literature; we refer to the “Capacity sharing”, the “Chained execution”, the “Subcontracting”, the “Case transfer”, the “Extended case transfer” and the “Loosely coupled” architectures. Thus, we consider them as basic B2B cooperation schemas, because they express the different ways in which businesses can cooperate together and cover a wide range of existing business processes. However, in their initial form, these architectures suffer from rigidity inducing a difficulty to adapt the process models to changes (Chebbi, 2007), especially changes which affect the structure of interaction between two WF fragments. Consequently, in our work we set two main objectives; the first one is the definition of new cooperation schemas to support more flexible IOWF process models while meeting the generic IOWF-architectures considered. The second one is to provide mechanisms for flexibility support of the IOWF process models newly defined.

In order to deal with process models flexible enough, we have proposed in our previous work (Boukhedouma et al., 2014), new cooperation patterns based on the SOA paradigm, by establishing a correspondence of concepts between activity-based workflow and service-based workflow. For that, we have introduced a new concept called Service-Based Cooperation Pattern (SBCP) to support the definition of IOWF process models based on services, while meeting the initial IOWF-architectures considered. Globally, our aim is to redefine and implement a set of structurally well defined and fairly widespread models for WF interconnection and to support their changes at functional, behavioral, interactional and organizational levels.

The use of services to build flexible business applications is not new; early in the 21st century, companies explored the use of Web services standards within their e-business context to accelerate applications development and integration inside and outside the enterprise (Bose & Sugumaran, 2008). In the literature, many approaches dealing with dynamic composition of services have been proposed (Casati & Shan, 2001; Mehandjiev et al., 2006; Pedraza, 2009; Boukadi, 2009; Barba et al., 2013; Esper, 2010). Also, the question of WF flexibility has been clearly addressed, through several works such as (Muller et al., 2004; Kumar & Yao, 2009; Pesic et al., 2007; Minor et al., 2010; Charfi et al., 2009; Döhring et al., 2011; Ben said et al., 2015) which provide different approaches and mechanisms for adaptation, evolution and reuse of process models, particularly specified as an orchestration or choreography of services.

Notice that in these approaches and others, services are considered as “black boxes”, with only visible inputs and outputs. In our work, we deal with WF interconnection and flexibility support of WF processes which are provided as a composition of services with different abstraction levels. Hence, depending on the IOWF schema to meet, WF processes can be perceived as “black boxes” or “grey boxes” to respectively exhibit no details or some details of the process, required for interconnection.

After recalling the main ideas of our approach for WF interconnection using services, the current work focuses on two aspects of flexibility which are the adaptability and the evolutivity of IOWF process models based on services. Notice that in our case, adaptation and evolution are reflected at functional, behavioral, interactional and organizational levels of the IOWF processes. Thus, we describe the set of adaptation patterns which are categorized in three main classes (service adaptation patterns, control flow adaptation patterns and interaction adaptation patterns) according to the three dimensions on which the concept of SBCP is defined. For evolution aspects, we focus on two main perspectives: the expansion of functionalities and the expansion of cooperation respectively called functional evolution and organizational evolution; this latter is particularly supported by the concepts of generalized cooperation patterns and composite cooperation patterns. For illustration, we provide
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