

A policy-based authorization model for workflow-enabled dynamic process management

Jian Cao^{a,*}, Jinjun Chen^b, Haiyan Zhao^c, Minglu Li^a

^a Department of Computer Science and Engineering, Shanghai Jiaotong University, Shanghai 200240, PR China

^b Centre for Information Technology Research, Swinburne University of Technology, Australia

^c College of Computer and Electric Engineering, University of Shanghai for Science and Technology, Shanghai 200093, PR China

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ABSTRACT

Although workflow has been widely used to support the modeling and execution of business process, the majority of current workflow management systems are not designed and suited for supporting dynamic business processes. One of the deficiencies is the inability to model realistically the organization of an enterprise to manage the dynamic human-centric business processes. A framework for workflow-enabled dynamic business process management is described in the paper. It includes an organizational model and an authorization model for supporting dynamic business processes. More specifically, authorization policies are expressed in an SQL-like language which can be easily rewritten into query sentences for execution. In addition, the framework supports dynamic integration and execution of multiple access control policies from disparate enterprise resources. Finally, a prototype implementation of the dynamic business process management framework is described.

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1. Introduction

Generally speaking, a workflow has three independent dimensions, namely: process logic, IT infrastructure and organization (Leymann and Roller, 2000). Process logic describes the “*what*” in terms of which activities are to be performed and in which sequence the activities are executed; IT infrastructure describes *which* IT resources, such as software programs that perform a particular activity, are required; the organization dimension describes the organizational structure of a company or an enterprise in terms of partners, departments, business roles and people, which provides the *who* should perform what activity.

As workflow has been applied to an increasing number of areas, many designs and implementation technologies exist (Becker and zur Muehlen, 2002). Many workflow models such as web service composition languages BPEL4WS (IBM, 2004) and Enterprise Application Integration (EAI), do not define or include any notion of human activities. Similarly, researchers and vendors have been focused mainly on the process logic and IT infrastructure dimensions of workflow and often neglected the linkage between the organizational elements and process activities. The complete relationship among the three dimensions of workflow and especially the critical role played by the organization

dimension are not well studied (Zur Muehlen, 2004). However, as a technology that roots in office automation of the 1970s (History of Workflow Research, 2004), workflow should support human-centric business processes and therefore must include the modeling of dynamic business roles and human activities. The importance of human involvement in workflow applications has recently been pointed out by (Moore, 2002), who has identified the excessive activity automation and poor design of work assignment strategies as critical issues in workflow projects.

The enforcement of task assignment relies on an authorization model, which is expressed in terms of roles rather than in terms of specific individuals in order to reduce the number of authorizations necessary in the system and to simplify their maintenance (Casati et al., 2001). However, this role-based model alone is inadequate to meet all the requirements of processes within an organization. Such requirements may include: (1) role delegation (Akhil and Zhao, 2002), for example, when a worker is not available, a workflow system should be able to locate (and possibly assign) appropriate alternate workers to prevent excessive delays; (2) binding of roles (Akhil and Zhao, 2002), for example, a customer's complaint should be handled by the person who sold the product originally, and (3) separation of duties (Botha and Eloff, 2001), for example, individuals may not be allowed to approve his or her own travel expenses or supply requisitions.

A business process in an organization can be quite complex and dynamic (Chung et al., 2003). However, current workflow

* Corresponding author. Tel.: +86 21 34204426; fax: +86 21 34204398.
E-mail address: cao-jian@cs.sjtu.edu.cn (J. Cao).

systems can typically only support simple and predictable processes, but not the dynamically changing processes (van der Aalst and Jablonski, 2000). The dynamic business process brings additional challenges to the authorization strategy. For example, as most business processes involve team work, authorization strategy should not only be role based but also be team based (van der Aalst, 2001). Furthermore, each organization in an enterprise usually enforces its specific management policies; authorization strategies from different management policies should be coordinated.

In this paper a policy-based authorization model for workflow-enabled dynamic business processes is proposed. A policy is specified in a Task Authorization Policy Language (TAPL), which can be easily translated into SQL query sentences so that the policy can be directly executed by a database management system. Based on the TAPL, a policy modeling and enforcement framework to support dynamic business processes is proposed.

The remainder of the paper is organized as follows. Section 2 gives a brief review of workflow management and introduces a workflow-enabled dynamic process management framework. Section 3 presents an organizational model for dynamic business processes. Section 4 defines the syntax of TAPL and discusses the policy modeling and management problem in an organization. Section 5 introduces a framework together with some key techniques to support policy enforcement within a workflow management system. Section 6 describes briefly the implementation of a demonstration system. Section 7 discusses related work. Finally, Section 8 provides some concluding remarks.

2. A workflow-enabled dynamic business process management framework

There are many process model representations for workflow management implemented by different vendors and proposed by researchers (van der Aalst et al., 2003). To facilitate discussion, a brief introduction to a generic process model for workflow management is first given.

A process consists of a set of activities and the dependencies among the activities. The dependencies prescribe the ordering relationships between activities within a process. According to the workflow management coalition (WfMC) (Workflow Management Coalition, 2004), six ordering structures may appear in a business process (Workflow Management Coalition, 1999): (1) SEQUENCE—an activity has a single subsequent activity; (2) AND-SPLIT—an activity leads to multiple parallel activities that will all be executed, (3) XOR-SPLIT—an activity leads to multiple but mutually exclusive alternative activities and only one of which will be executed; (4) AND-JOIN—multiple parallel executing activities join into a single activity; (5) XOR-JOIN—multiple but mutually exclusive alternative activities join into a single activity; and (6) LOOP—one or more activities are repeatedly executed until the exit condition is satisfied.

A process can be graphically depicted as a directed graph in which each node represents an activity and each directed edge the dependency (Duenren and Minxin, 2003). Furthermore, a solid arrow is used to represent direct dependencies between two activities; a blank arrow is employed to denote a cyclic dependency and to construct a loop structure. For example, process models are shown in Fig. 1, where Fig. 1(a) depicts a serial workflow process for software system development and Fig. 1(b) is an iterative workflow process model for software component development.

Many approaches have been proposed to improve the adaptability of workflow process to accommodate changes. However, most approaches focus on how to adapt changes for a single workflow, which is inadequate for modeling a dynamic business process that may include tens or hundreds of activities (van der Aalst and Jablonski, 2000).

Researchers have proposed process reuse and activity decomposition as effective ways to support the dynamic business process (Chung et al., 2003; Myungjae et al., 2002). Fig. 2 shows a workflow-enabled dynamic process management framework that employs process reuse and activity decomposition. In this framework, a workflow library stores a set of process models that are designed to meet the business requirements. First, a workflow model is selected to model the entire business process and the high-level ordering constraints of the business process. For example, an organization may select the workflow model shown in Fig. 1(a) for a software system development project and incorporate the workflow into the project model.

Each activity in the project model can be a sub-process, which can be instantiated from another workflow model stored in the workflow library or defined as a set of activities, which can in turn be decomposed further as sub-processes. For example, during the activity “system design” of the software development project, it is discovered that the software system could be divided into two components: (1) the login user interface component and (2) the accounts management component. The two activities can be incorporated into the “system development” node of the process model, and each activity can in turn be instantiated as a particular

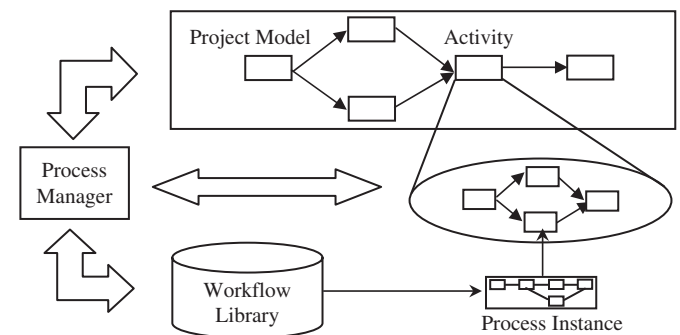


Fig. 2. A workflow-enabled dynamic process management framework.

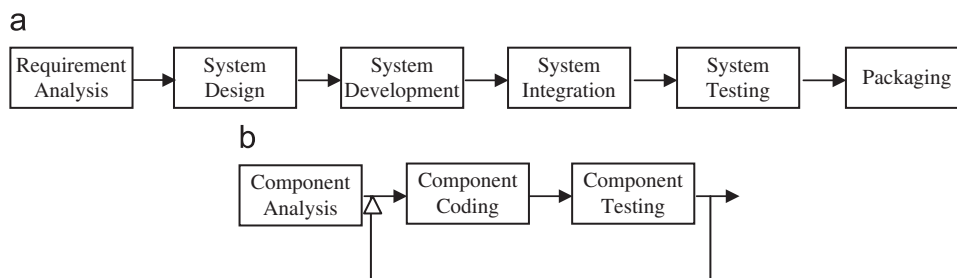


Fig. 1. Some examples of process model of workflow. (a) A process model for software system project and (b) a process model for component development.

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