

# A document-process association model for workflow management

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## Abstract

A WorkFlow Management System (WFMS) is a software system to support an automatic, efficient execution of business processes. A business process often involves document processing. Although, many traditional WFMSs can support the document processing to some extent, they are concerned mainly with document delivery. We propose an XML-based approach to WFMS for form document processing on the Web. Taking advantage of XML, we can partition a document into several meaningful segments, each of which in this approach becomes a unit of work that can be performed by some activities in a workflow process. Based on this document partition, we develop a formal model, called document-process association model, which can associate the units of work with process activities. The model not only provides a tight control over document-related processes, but it also enables various useful services, such as customization of document monitoring and contents-based interaction between WFMS and other application programs. A prototype system has been implemented to demonstrate the usefulness of the proposed model. © 2002 Elsevier Science B.V. All rights reserved.

*Keywords:* Business process; Workflow; XML; Form document

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## 1. Introduction

Today's business environment makes it indispensable for a company to deal with complex business processes. A workflow management system is a software system to support an automatic, efficient execution of the business processes [14,18]. Such a business process often involves document processing. In this paper, we consider a WorkFlow Management System (WFMS) that can manage the document flow over a workflow process. An essential ability in such a WFMS is to keep track of the documents' trace and

to control their dependency with the underlying workflow process.

Many traditional WFMSs can support document processing to some extent [27]. However, the WFMSs are concerned mainly with document delivery. While controlling a business process, a WFMS identifies a document that the process should deal with, and simply conveys the document to a relevant user. Consider typical documents, such as purchase order, engineering change order, and cost estimation sheet, and so on. Most such documents in a business process have a certain format, that is, it is composed of a number of fields with some kind of structures. We call such a document a form document.

In a typical business process, an activity is often associated with filling in a form document. It may involve inserting new values into some fields of the

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document or modifying those values. This indicates that document processing may not be considered separately from the process flow. Such a notion leads us to consider the necessity of associating form document elements with process activities, so that WFMS can provide a more tight control over document-related processes. Although, existing form-based WFMS's support such activities, they are significantly limited as follows. First, the existing approaches consider a whole document as a unit work. This means that it is hard for an activity to deal with a part of one document. Second, most commercial form-based WFMS's use their own proprietary format. This requires that to understand the document contents a client application should know the format. Using XML [34] as a form document format, we have been able to develop an effective method that can resolve the above problems.

We propose, an XML-based approach to WFMS for form document processing on the Web. Taking advantage of XML, we can partition a document into several meaningful segments. A segment is a unit of work that can be performed by some activities in a workflow process. We develop a formal model that associates those units of work with process activities. The proposed model not only supports the execution of document processing with respect to the document flow, but it also enables various useful services during the document processing. A prototype system has been implemented to demonstrate some important document-related functions.

## 2. Backgrounds

### 2.1. Workflow management system

A WFMS in general is a software system that defines, creates, and manages automated business processes [2,11,21,23]. The WFMS helps users involved in a business process to carry out their tasks following certain business logic [19]. This means that the WFMS should have a process model representing the business logic. A process model consists of a number of activities and their precedence relations [4,10]. Once a process model is set up, the WFMS automatically assigns activities to individual users based on the model [24]. By logging in the system, a user can

identify a task list that the user has to carry out. The system assists the user by delivering task related information including due date, process name, priority and status of task, input and output files, and so on. These are presented on a user interface for WFMS clients. On completing the task assigned, the user notifies the WFMS of the task results. Then, the WFMS proceeds to the remained part of the process by assigning the subsequent tasks to other relevant users.

Workflow Management Coalition (WfMC), an international standard organization on WFMS, has proposed a Workflow Reference Model (WRM) [14,29–33]. Fig. 1 presents the general architecture of WRM, which is adopted by most existing WFMSs.

WRM consists of five components: workflow engine, process definition tools, monitoring tools, workflow clients, and invoked applications. The central part of the system is the engine that interprets process definitions, controls process execution, and manages work items in user's work lists. It also interacts with workflow participants, and invokes some required applications. The process definition tools create process models and store them in a proper format. There are two types of workflow clients: workflow client applications and invoked applications. While both perform workflow activities, the former are controlled by human clients, and the latter are software programs that perform the activities automatically. The administration and monitoring tools provide a user interface for administration and supervision of workflow management.

Many recently released commercial WFMSs are Web-based systems [13,27]. Such a system provides location transparency by allowing a user to access the system simply using a Web browser. Almost all the Web-based WFMSs use HTML as client user interfaces. This, however, has several limitations particularly in interfacing the workflow engine with the other components in Fig. 1. As an alternative, we use eXtensible Markup Language (XML), which is further discussed in the next section.

### 2.2. XML

HTML has been popularized as the standard for Web documents due to its simplicity and ease of use. It therefore has been adopted in many Web-based WFMSs. However, the use of HTML is limited in that the tags are predefined and inextensible, deal with

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