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Building Workflow Engines for Commerce Logic Automation

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1. Introduction

Literally speaking, *workflow* means flow of work, which requires the coordination of potentially complex sequences of tasks among many agents. *Coordination of tasks* involves modeling of the process linking the tasks, specification of the tasks performed by various agents, assignment of the roles each agent may play, and definition of the rules governing how agents should behave in various circumstances. The basic goal of *workflow management* is to automate the coordination activities via networked computing devices that agents use to perform the tasks. The information system that is designed to assist workflow management is referred to as *workflow management system* (Georgakopoulos et al., 1995; Kumar and Zhao, 1999).

Workflow management systems integrate the people, the organizational structure, and the information resources such as databases, emails, document repositories, and desktop applications (Stohr and Zhao, 1997). The commercial activities in the area of workflow management have increased dramatically in the last few years since the start of the Workflow Management Coalition in 1993 (WfMC-1, 1996). Currently, there are 150 corporate members in the coalition. Workflow management has evolved from various platforms and applications such as groupware, group decision support systems, database management systems, document management systems, image processing systems, telephony systems, and smart email systems.

As envisioned in recent years by many IS researchers, enterprise information systems are deployed increasingly to "house much of its on-going business logic" (Swanson 1996). Workflow management systems are ideal for automating business logic because they provide the basic mechanisms needed for modeling and enacting business processes. In this minitrack, we stress the importance of automating business logic by applying workflow technologies in electronic commerce.

There are two recent trends in workflow management. First, workflow technologies originally developed under the umbrella of workflow management systems are being adopted into enterprise systems such as ERP systems to support vertical applications in a tightly integrated manner. Second, workflow engines consisting of the core workflow management components are being deployed in the electronic commerce environment to automate the commerce logic, or the inter-organizational processes such as online purchasing, e-procurement.

The theme of this minitrack -- Workflow Technology and E-Commerce Applications is therefore to promote research in "building workflow engines for commerce logic automation".

2. E-Commerce Workflow Systems

Workflow occurs in various electronic commerce settings, involving two or more organizations. In this section, two cooperative workflow scenarios, OBI workflows and supply chain workflows are presented, and two cooperative workflow systems, Virtual Enterprise Coordinator and Vortex coordination system, are outlined.

2.1. OBI Workflow

Corporate buyers and suppliers are looking for Internet based solutions to streamline the supply chain and to reduce costs of trading transactions. Open Buying on the Internet (OBI) is a promising standard in meeting the need for interoperable electronic commerce systems. OBI is an open and flexible framework for business-to-business Internet commerce solutions and is intended for the high volume and low dollar transactions that account for 80% of the company purchasing transactions.

An OBI system involves four business entities, the buying organization, the requisitioner from the buying organization, the supplier that offers services and products, and the payment organization that handles payment and other settlement activities. The OBI workflow specifies the interactions among the four entities (Tian, 1998).

2.2. Supply Chain Workflow

Supply chain management requires four basic business processes (Anderson and Allen, 1999): **planning** for demand, production, inventory, and transportation; **sourcing** involving material ordering, scheduling delivery, and order processing; **making** the products; and **delivering** the finished goods through the value chain.

In the make-to-order mode of production, a simple supply chain involves a retailer, a manufacturer, and a transport company. The supply chain workflow involves inter-organizational processes since they require handoffs of information from one organization to another. Furthermore, the transport company's process can be modeled as a *nested subprocess* of the manufacturer's one since the transport process provides information back to the manufacturer's process.

3. Multi-Organizational Nature of EC Workflow

The generic framework of workflow management systems is based on the four perspectives of business process representation, i.e., functional, behavioral, organizational, and informational (Curtis et al., 1992; Bussler and Jablonski, 1994; Gruhn, 1995; Kwan and Balasubramanian, 1997).

E-commerce workflows are unique in the four perspectives stemming from the inter-organizational nature:

- In the *functional perspective,* e-commerce workflows require the specification of tasks across organizational boundaries. Very often, the workflow designers have limited understanding of extra-organizational functions and do not have the authority to alter existing tasks in outside organizations.
- From the *behavioral perspective,* the provision of rules for specifying when and how the tasks are performed is also more difficult since inter-organizational coordination is required for such specification and execution.
- The *organizational perspective* seeks to answer the question of who performs what tasks and with what tools, involving actors, roles, and resources. Significant difficulties may occur for inter-organizational design or coordination.
- The *informational perspective* relates to the business data and documents that are the subjects of workflow activities. In e-commerce workflow systems, information access requires inter-organizational coordination and integration. It is well known that accessing multi-organizational databases is a hard and open issue.

In sum, e-commerce workflow systems must be able to support the collaboration, design, implementation, and enactment of multi-organizational processes. As a result, the workflow modeling approaches and tools, workflow monitoring and routing algorithms, and workflow implementation and maintenance architectures must adopt to the multi-organizational constraints.

4. Integration of E-Commerce Processes

Electronic commerce requires the integration of processes across organizational boundaries and calls for component-based e-commerce systems (Bichler, Segev, and Zhao, 1998; Misic and Zhao, 1999). Workflow technologies have been identified as one of the important components.

4.1. Integration of Heterogeneous Workflows

In an e-commerce environment, it is conceivable that *workflows with various levels of automation* must coexist. Some workflow systems can be completely automated with possibly sophisticated software agents, while other workflow systems may be completely manually coordinated. These heterogeneous workflow systems must be integrated seamlessly to support e-commerce transactions.

This requires new modeling paradigms that can specify the levels of automation in various workflow segments. Mechanisms are needed to allow the *mapping of conceptual models* that can be understood by humans to logical models that can be interpreted by computing devices and software agents.

The enactment of heterogeneous workflow systems will require the *application of temporal concepts* since the speed of reaction can be dramatically different in a manual process from a computerized process. Existing paradigms must be extended for this purpose.

4.2. Highly Inter-operable Architecture

High interoperability is imperative for business-to-business electronic commerce because open trading transactions require cooperative workflows between buying, selling, and intermediary organizations (Fu et al., 1999; Laopodis, Conte, and Elefteriadou, 1998). While many have stressed the importance of interoperability in electronic commerce systems, little work has been done to specify interoperability requirements in electronic commerce.

There are currently three workflow inter-operation standards, namely SWAP (Swenson, 1998; Bolcer and Kaiser, 1999), WfMC IF4 (WfMC-2, 1996; WfMC-3, 1998), and jFLOW OMG (OMG, 1998), which have been proposed recently to address issues of interorganizational workflow management. A new theoretical paradigm has been proposed for describing interoperability requirements consisting of four levels of workflow interoperability, including connectivity, expressivity, visibility, and flexibility. However, the interoperability requirements for managing interorganizational workflows in the context of business-to-business electronic commerce remain an important and open research issue.

4.3. Cross-System Process Mediation

Several recent attempts have been documented in the literature to develop systems, specifically for e-commerce workflows. Vortex-based Coordination Systems proposed in (Hall and Su, 1999) advocate the implementation of coordination interface in workflow systems, and a central coordination system can then integrate these workflow systems for passing information, querying status and history of workflow instances, and coordinating participating workflows. Virtual Enterprise Coordinator (VEC) is a method for the setup and management of workflow processes for outside organizations on the basis of simple agreements (Ludwig and Whittingham, 1999). Using VEC, organizations can provide external partners with

a controlled way of accessing workflow processes, while retaining the freedom to change the internal details of those processes.

5. Concluding Remarks

In short, workflow management in e-commerce requires unique modeling features and enactment services because of its multi-organizational nature. Many research issues need to be addressed to integrate heterogeneous workflow systems and to provide cross-organization interoperability. This calls for open architecture, high flexibility, high security, and high availability that are yet to be addressed by the research community.

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The 'Introduction' paper is about literature review, current reserach/pedagoy issues, and description of research directions and activities (journals, conferences, and R&D center works, etc.) on the minitrack topics. The primary purpose of the paper is to inform and to educate. The length of the paper can be either seven or three pages. Please send your Introductory paper to amcis2000@csulb.edu (Subject Line: AMCIS 2000 Minitrack Introductory Paper) for review by March 20th (five days after the general paper deadline).