E-Supply Chain Orchestration

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INTRODUCTION

The world today is witnessing a growing interest in conducting supply chain business processes electronically. Different supporting technologies are emerging, and many are already available on the market. The adoption of these technologies is hampered by the fact that organizations constantly face new requirements, constraints and demands. Recent research has shown that service-oriented architectures and its supporting technology, Web services, can address many major issues encountered in complex supply chains. However, one of the largely unsolved issues is the orchestration of the variety of Web services in the supply chain. This chapter presents an investigation on orchestration of supply chain business processes using portals and Web service technologies. The portal-based orchestration concepts were carried out in a project for supporting end-to-end supply chain logistics in the United States Department of Defense. A second supply chain study looked at the added value of Web service orchestration.

BACKGROUND

Cheap transportation options and advanced use of information and communication technologies enable organizations to source and to sell globally, and to host their supporting services in any place of the world. As a result, organizations in the current business era create alliances with partners so as to form business networks (Bradley, Hausman, & Nolan, 1993; Nohria & Eccles, 1992). As a result, operational business processes tend not to be self-contained within an organization. When products or services are followed through the network, the successive steps of value addition in the network are often described with the term "supply chain" (Simchi-Levi, Kaminsky, & Simchi-Levi, 2003). The choice for the term supply chain is unfortunately because it leads to confusion. "Chains" evoke linear, unchanging, and powerless images. "Supply" feels pushy and savors of mass production rather than mass customization. Better names like "demand network" or "customer driven Webs" have been proposed. Yet, the name "supply chain" seems to have stuck (Johnson & Pyke, 2000). Strictly speaking, the supply chain is a network of multiple businesses and relationships (Lambert, Cooper, & Pagh, 1998). Because of globalization and short-term contracts, modern supply chains include external partner processes that have a limited visibility. This increases the difficulty for decision makers to understand and redesign the process orchestration in the business network. In addition, the dynamic nature of the business network, for instance changing numbers and types of partners, and an involvement in several networks, increases the difficulty and complexity to manage supply chain processes. Information and communication technologies that can help organizations to design, manage, and maintain these complex inter-organizational processes are urgently required.

In a pilot project for the U.S. Department of Defense (DoD), the authors were part of a large, multidisciplinary team that designed and tested prototype solutions for supply chain integration. The project showed the feasibility of portaled solutions for real-time support for end-to-end supply chain management in a complex organization. The next section illustrates how portaling technologies can be seen as a first step towards solving the management problems of DoD's complex supply chains (Boyson, Corsi, & Verbraeck, 2003; Boyson, Harrington, & Corsi, 2004).

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SOLUTIONS FOR E-SUPPLY CHAIN ORCHESTRATION

Portaling Technologies as the First Solution Step

In the project, a first version of a supply chain orchestration portal was built to provide Web-based business functionality, asset visibility, and total system intelligence to the supply chain managers of the U.S. Air Force (Boyson et al., 2003). A portal is an infrastructure providing secure, customizable, personalizable, integrated access to dynamic content from a variety of sources, in a variety of source formats, wherever it is needed (Smith, 2004). The study focused on providing timely information on spare parts for one of the engines used in the Air Force. Currently, mechanics who work on the engines use a paper-based system for requesting parts needed for maintenance. Once the mechanic has completed the assessment of the engine, he or she prepares a hard copy paper parts list of items needed to complete work on the engine. This article parts list is subsequently entered into a database, which is then processed by a parts manager, who searches existing inventory to determine availability. Based on the result of that search, a decision is made about how to transfer the part from one base to another or even from one location on a base to another location on that same base. If the part or parts are not available from existing bases, then a requisition process is initiated (Boyson et al., 2003).

As one can imagine, this sequential process is very inefficient. There are significant delays as one action must be completed before another one can be started. Furthermore, there is no central place for information about the mechanic's order once he or she completes the parts request list. Often, the mechanic has no further information about the order until the parts actually are delivered. There is no visibility to the mechanic about the status of the order as it moves from one step to another. Often, one organization is waiting for information from the other, and the phone is used often to clarify why delays occur. Consequently, planning and anticipation in both organizations is difficult, and most business process activities wait till a previous activity has been completed. When activities would have been carried out in parallel, and real-time information would have been used, much time and effort could have been saved. The main idea of the portal project for the U.S. Air Force supply chain has been to implement these ideas.

Using the U.S. Air Force spare parts supply chain as a reference model, a comprehensive electronic platform was built that combined real-time data from the field, ERP systems, advanced planning systems, and collaborative planning and forecasting systems in both organizations. A test portal was built for evaluation by participants in the supply chain in order to experiment with these kinds of online functionality.

The prototype showed how the current stovepiped decision-making and orchestration in the spare parts supply chain could be transformed into an integrated high-performance process (Boyson et al., 2004). Supporting benefits include improved financial performance, inventory availability and reduced life cycle costs by providing the right information to the right people to make the best decisions in near real time. The portal solution uses middleware to link systems and orchestrate processes, and to create a seamless supply chain for system users while hiding the transactional level processing complexity. The system integration relied on the Tibco message bus that made it possible for the diverse systems to talk to one another.

Linking the databases and information systems of the different organizations to the message bus took a lot of effort. Furthermore, the message bus in itself did not help much in streamlining the inter-organizational processes. The business processes of the participating organizations were analyzed by hand, and the Java-based software to link the different business processes was specifically written for this project. In order to carry out projects like this more effective and more efficient, the standardization of the middleware should take place on a higher level than the message bus. Ideally, the description of the business processes would take place on such a level that it could be used to automatically generate parts of the solution applications. The next three sections describe service-oriented architectures, and so-called orchestration standards that can help to overcome the labor-intensive activities to streamline inter-organizational business processes.

Service-Oriented Architectures and Web Services

Service-oriented architectures (SOA) based on Web services technology facilitates interactions and sharing of information in a heterogeneous environment, as it is based on the exchange of messages in XML. Supply chain process partners need to share and access information like stock levels and inventory. Web services can "glue together" applications running on two different platforms, enable database information to be accessible to others, and enable internal applications to be made available over the Internet (Kreger, 2003).

A Service-oriented architecture (SOA) is essentially an architecture that describes the communication pattern between services communicating with each other, func-

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