Chapter 2.2
A Web-Enabled, Mobile Intelligent Information Technology Architecture for On-Demand and Mass Customized Markets

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ABSTRACT

This chapter presents a web-enabled, intelligent agent-based information system model to support on-demand and mass customized markets. The authors present a distributed, real-time, Java-based, mobile information system that interfaces with firms' existing IT infrastructures, follows a build-to-order production strategy, and integrates order-entry with supply chain, manufacturing, and product delivery systems. The model provides end-to-end visibility across the entire operation and supply chain, allows for a collaborative and synchronized production system, and supports an event-based manufacturing environment. The system introduces four general purpose intelligent agents to support the entire on-demand and mass customization processes. The adoption of this approach by a semiconductor manufacturing firm resulted in reductions in product lead time (by half), buffer inventory (from five to two weeks), and manual transactions (by 80%). Application of this approach to a leading automotive manu-

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facturer, using simulated data, resulted in a 51% total inventory reduction while increasing plant utilization by 30%. Adoption of this architecture by a pharmaceutical firm resulted in improving accuracy of trial completion estimates from 74% to 82% for clinical trials resulting in reduced trial cost overruns. These results verify that the successful adoption of this system can reduce inventory and logistics costs, improve delivery performance, increase manufacturing facilities utilization, and provide a higher overall profitability.

INTRODUCTION

The globalization of businesses and the infusion of information technology (IT) into every aspect of operations have introduced a strong demand for product variety and transformed business environments from a production-centric model to one that is information and customer-centric (Arjmand & Roach, 1999). Although the Internet has strengthened business with its convenience and 24x7global accessibility, it has also dramatically shifted the traditional business model to a new, competitive market space. People can now purchase anything, anywhere, at any time, and both product customization and customer requirements are increasing exponentially, making sales and inventory prediction a challenge. Meeting the wants and needs of such a heterogeneous customer population, in a global market, inevitably calls for product variety, while every efficiency-seeking supply chain prefers to process as few "flavors" as possible.

Mass customization seeks an economical resolution of this fundamental conflict. Taking mass production as a foil implies that a mass customized product should not cost end customers much more than a mass produced near-equivalent, and that the customization process should not create too much of a delay. We believe that this can be realized with consistency and at scale only with a *customer-centric production system*. This is one that enables an end-customer to configure (partially design) the product online and provides real-time visibility of the resulting order directly to the manufacturing floor and throughout the supply chain. In such a production system, businesses focus on their core competencies and outsource activities that are not essential to this core. Improvements in information technology infrastructures and worldwide acceptance of the internet have strengthened this transition. As a result, complex products in the market can be the result of collaborative efforts of many companies (Anderson & Lee, 1999). The auto industry is an excellent example of such a collaborative effort. A car can have over 10,000 parts, with multiple stages of production, many suppliers, high degree of product complexity, and high degree of customization. The manufacturing operation of such a business often requires a high production rate, time and space constraints and often long cycle time. High technology is another example. Fabrication-less firms that design new components are common. These firms now concentrate on their core business of designing a new component and outsource the manufacturing to specialized semiconductor and PC board manufacturing contractors. Transportation and logistics systems are additional examples in which the Internet and online commerce have facilitated rapid movements of products and material in a time-sensitive production environment. Pharmaceutical companies are yet another example in which trials for new drugs are often conducted globally and concurrently and can significantly benefit from an on-demand, real-time production control environment.

The participants in these markets include suppliers, retailers and transportation services providers. The efficient operation of such markets requires extensive collaboration among its many members.

There are several common themes that characterize these markets. The first theme is the time-sensitive nature of the demand in such markets. The order stream for these markets can change