E-COMMERCE AND SUPPLY CHAINS

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Opening Case: Boeing’s Global Supply Chain for the Dreamliner 787

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Managerial Issues

Closing Case: How Walmart Uses EC in Its Supply Chain

Learning Objectives

1. Describe the major concepts of supply chains and their management.
2. Understand the major problems along the supply chains.
3. Explain how supply chain management (SCM) works and how it solves supply chain problems.
The Problem
Designing and manufacturing an aircraft is an immensely complex undertaking; the 787 Dreamliner project is said to be one of the largest, most complex, and challenging engineering projects being undertaken in the world. The supply chain involved in the design and production of this aircraft involves millions of different parts and materials, and thousands of different suppliers, partners, contractors, and outsourcing vendors scattered across 24 countries working from 135 different sites. Absolute precision and meticulous attention to detail is required, and safety and quality are paramount. In addition to designing and producing new aircraft, the new production processes had to be designed, tested, and implemented. Close collaboration and communication among thousands of employees, information and knowledge management, and sound management of this complex global supply chain were essential to the project’s success. In addition, competitive pressures, rising oil prices, and enhanced security requirements forced Boeing to significantly improve old methods.

The Solution
Boeing had been increasingly relying on sophisticated information technology (IT) and EC solutions to support its operations. For example, it had been a user of CAD/CAM technologies since the early 1980s.

The Dreamliner, however, was to be a “paperless airliner,” with EC being employed to support many critical activities. Boeing teamed with Dassault Systèmes to create a Global Collaboration Environment (GCE), a product management lifecycle solution, in order to support the virtual rollout of the new aircraft. The GCE enabled Boeing to digitally monitor the design, production, and testing of every aspect of the aircraft before the actual production started.

In addition, Boeing decided to integrate all databases associated with the Dreamliner, teaming up with IBM to employ a DB2 Universal Database for this purpose and ensuring partners access to Dassault’s suite of systems.

Boeing is the final assembler and integrator, rather than the builder, of the components that are manufactured by many vendors across the globe. Excellent supply chain management was required to carefully coordinate the movement of components and systems across multiple-tier partners. Boeing teamed with Exostar to provide software to support its supply chain coordination challenges. The Exostar supply chain management solution enables all suppliers access to real-time demand, supply, and logistics information so that crucial components and systems arrive at Boeing’s production facilities just in time for assembly. The Exostar solution includes the following functionalities: planning and scheduling; order placement and tracking purchase order changes; exchanging shipping information; managing inventory consumption across suppliers; managing returns; and providing a consolidated view of all activities in the manufacturing process. Business process exceptions can also be monitored across partners, allowing for informed evaluation of the impacts of these exceptions to take place across affected parties.

Finally, radio frequency identification (RFID) technologies were deployed in the aircraft to support finding parts and materials and for the maintenance activities (see Online File W1.4). By tagging component parts, Boeing significantly reduced costs.

The Results
The goal of the Dreamliner project was to produce a fuel-efficient (and less polluting, hence environmentally responsible), cost-effective, quiet, and comfortable midsize aircraft that could travel long distances without stopping. It is a critical innovation for Boeing, which has in recent years struggled in the face of rising competition from Airbus. EC has played a critical role in supporting collaboration throughout this massive project, reducing the need for physical prototyping and testing, and making substantial impacts on the supply chain. EC has enabled faster decision making, better management of critical information and knowledge assets, increased sharing and exchange of product-related information and processes, reduced time-to-market, less rework, and reduced costs of manufacturing by reducing the final assembly time for the aircraft from 13 to 17 days to just 3 days.

Boeing had received nearly 840 orders for the plane by the end of 2009 and commitments in excess of $120 billion. The Dreamliner was not completed on schedule, mainly due to communication problems between different countries and the use of several languages. The new collaboration methods were just too new. By November 2009, Boeing’s first delivery of the Dreamliner was set for the fourth quarter of 2010.

A.1 E-SUPPLY CHAINS

Many people equate e-commerce with selling and buying on the Internet. However, although a company’s success is clearly dependent on finding and retaining customers, its success may be far more dependent on what is behind the Web page rather than on what is on the Web page. In other words, the company’s internal operations (the back end) and the company’s relationships with suppliers and other business partners are as critical, and frequently much more complex, than customer-facing applications such as taking an order online. In many cases, these noncustomer-facing applications are related to the company’s supply chain.

It has been well-known for generations that the success of many organizations—private, public, and military—depends on their ability to manage the flow of materials, information, and money into, within, and out of the organization. Such a flow is referred to as a supply chain. Croza (2008) regards the supply chain as the competitive differentiator. Because supply chains may be long and complex and may involve many different business partners, we frequently see problems in supply chain operation. These problems may result in delays, products not being where they are required at the right time, customer dissatisfaction, lost sales, and high expenses that result from fixing the problems once they occur. World-class companies such as Walmart, Dell, and Toyota and successful e-tailers such as Amazon.com and Zappos.com attribute much of their success to effective supply chain management (SCM), which is largely supported by IT and e-commerce technologies.

DEFINITIONS AND CONCEPTS

To understand e-supply chains, one must first understand nonelectronic supply chains. A supply chain is the flow of materials, information, money, and services from raw material suppliers through factories and warehouses to the end customers. A supply chain also includes the organizations and processes that create and deliver products, information, and services to the end customers. The term supply chain comes from the concept of how the partnering organizations are linked together.

As shown in Exhibit A.1, a simple linear supply chain links a company that manufactures or assembles a product (middle of the chain) with its suppliers (on the left) and distributors and customers (on the right). The upper part of the exhibit shows a generic supply chain. The bottom part of the exhibit shows a specific example of a toy manufacturer’s process. The solid links in the exhibit show the flow of materials among the various partners. Not shown is the flow of returned goods (e.g., defective products) and money, which are flowing in the reverse direction. The broken links, which are shown only in the upper (generic) part of Exhibit A.1, indicate the bidirectional flow of information.

A supply chain involves activities that take place during the entire product life cycle, “from dirt to dust,” as some describe it. However, a supply chain is more than that, because it also includes the movement of information and money and the procedures that support the movement of a product or a service. Finally, the organizations and individuals involved are considered part of the supply chain as well. When looked at very broadly, the supply chain actually ends when the product reaches its after-use disposal—to recycling or back to Mother Earth somewhere.

The supply chain shown in Exhibit A.1 is fairly simple. Supply chains can be much more complex, and there are different types of supply chains. When a supply chain is managed electronically, usually with Web-based technologies, it is referred to as an e-supply chain. As will be shown throughout this chapter, improvements in e-supply chain The flow of materials, information, money, and services from raw material suppliers through factories and warehouses to the end customers.

supply chain The flow of materials, information, money, and services from raw material suppliers through factories and warehouses to the end customers.
supply chains are a major target for EC applications. However, before examining how e-supply chains are managed, it is necessary to better understand the basic composition of supply chains.

**SUPPLY CHAIN PARTS**

A supply chain can be broken into three major parts: upstream, internal, and downstream, as was shown in Exhibit A.1:

- **Upstream supply chain.** The upstream part of the supply chain includes the activities of a company with its suppliers (which can be manufacturers, assemblers, or both, or service providers) and their connections with their suppliers (second-tier suppliers). The supplier relationship can be extended to the left in several tiers (third tier, fourth tier, etc.), all the way to the origin of the material (e.g., mining ores, growing crops). In the upstream supply chain, the major activity is _procurement_. _Procurement_ is the process made up of a range of activities by which an organization obtains or gains access to the resources (materials, skills, capabilities, facilities) it requires to undertake its core business activities.
Internal supply chain and value chain. The internal part of the supply chain includes all in-house processes used in transforming the inputs received from the suppliers into the organization’s outputs. It extends from the time the inputs enter an organization to the time that the products go to distribution outside the organization. In this part of the supply chain, the major concerns are production management, manufacturing, and inventory control. The activities along the internal supply chain are referred to as the company’s value chain (see en.wikipedia.org/wiki/Value_chain). The value chain is composed of a sequential set of primary activities (operations, outbound logistics, after-sales support and service, etc.) and support activities (administration, HR, finance, etc.) that an organization undertakes in order to deliver a good or service of value to its customers. The value chain can thus be seen as an integrator between customers (B2C) and suppliers (B2B) in that it transforms goods and services obtained from suppliers into goods and services of value to customers. The primary objective of the value chain is to add value along the internal supply chain.

Downstream supply chain. The downstream part of the supply chain includes all the activities involved in delivering the products to the final customers. In the downstream supply chain, attention is directed at distribution, warehousing, transportation, and after-sale service.

A company’s supply chain and its accompanying value chain encompass an array of business processes that create value by delivering goods or services to customers.

MANAGING SUPPLY CHAINS
Supply chain management (SCM) is a complex process that requires the coordination of many activities so that the shipment of goods and services from suppliers right through to customers is done efficiently and effectively for all parties concerned. SCM aims to minimize inventory levels, optimize production and increase throughput, decrease manufacturing time, optimize logistics and distribution, streamline order fulfillment, and overall reduce the costs associated with these activities (SupplyChainManagement101 2009). Managing supply chains can be difficult due to the need to coordinate several business partners, often in different countries and different time zones; several internal corporate departments; numerous business processes; and possibly many customers. In addition, complexity is added in industries where huge numbers of goods flow rapidly along the supply chain (think of supermarkets and the number and rate of items that flow on and off modern supermarket shelves). Managing medium to large supply chains manually is almost impossible. Information technology provides two types of software solutions: (1) SCM (including e-procurement) and (2) enterprise resource planning systems (ERP) (including e-business infrastructure, data warehouses, and the like) and its predecessors, material requirements planning (MRP) and manufacturing resource planning (MRP II). (These types of software are defined and described at Wikipedia.org.) A major requirement for any medium- to large-scale company that is moving to EC is integration among all activities conducted on the Web and the ERP/MRP/SCM solutions—in other words, creating an e-supply chain and managing it.

E-Supply Chains and Their Management
Internet capabilities are having a profound impact on organizations’ supply chains. Increasingly, companies are recognizing that the efficient and effective flow of information and materials along their supply chains is a source of competitive advantage and differentiation. E-supply chain management (e-SCM) is the collaborative use
Appendix A: E-Commerce and Supply Chains

information visibility
The process of sharing critical data required to manage the flow of products, services, and information in real time between suppliers and customers along the supply chain.

e-procurement
The use of Web-based technology to support the key procurement processes, including requisitioning, sourcing, contracting, ordering, and payment. E-procurement supports the purchase of both direct and indirect materials and employs several Web-based functions such as online catalogs, contracts, purchase orders, and shipping notices.

The ability of all supply chain partners to view partner collaboration as a strategic asset. Tight integration and trust among the trading partners generate speed, agility, and lower cost.

A well-defined supply chain strategy. This includes a clear understanding of existing strengths and weaknesses, articulating well-defined plans for improvement, and establishing cross-organizational objectives for supply chain performance. Senior executives’ commitment is also essential and must be reflected through appropriate allocation of resources and priority setting.

Information visibility along the entire supply chain. Information visibility refers to the information about inventories at various segments of the chain, demand for products, capacity planning and activation, synchronization of material flows, delivery times, and any other relevant information that must be visible to all members of the supply chain at any given time. To enable visibility, information must be managed properly—with strict policies, discipline, and daily monitoring. It must also be shared properly.

Speed, cost, quality, and customer service. These are the metrics by which supply chains are measured. Consequently, companies must clearly define the measurements for each of these four metrics, together with the target levels to be achieved. The target levels should be attractive to the business partners.

Integrating the supply chain more tightly. An e-supply chain will benefit from tighter integration, both within a company and across an extended enterprise made up of suppliers, trading partners, logistics providers, and the distribution channel.

Activities and Infrastructure of E-SCM

E-supply chain management processes and activities include the following:

Supply Chain Replenishment. Supply chain replenishment encompasses the integrated production and distribution processes. Companies can use replenishment information to reduce inventories, eliminate stocking points, and increase the velocity of replenishment by synchronizing supply and demand information across the extended enterprise. Real-time supply and demand information facilitates make-to-order and assemble-to-order manufacturing strategies across the extended enterprise. Supply chain replenishment is a natural companion to Web-enabled customer orders.

E-Procurement. E-procurement is the use of Web-based technology to support the key procurement processes, including requisitioning, sourcing, contracting, ordering, and
Appendix A: E-Commerce and Supply Chains

payment. E-procurement supports the purchase of both direct and indirect materials and employs several Web-based functions, such as online catalogs, contracts, purchase orders, and shipping notices. E-procurement can improve the operation of the supply chain in various ways:

- Online catalogs can be used to eliminate redesign of components in product development.
- Visibility of available parts and their attributes enables quick decision making.
- Online purchase orders expedite the ordering process.
- Advanced-shipping notifications and acknowledgments streamline delivery.

From the purchaser’s perspective, e-procurement can help better manage supplier relationships and accounts and allows for more effective tracking of orders. From the supplier’s perspective, e-procurement enables them to respond more rapidly and effectively to the requirements of purchasers. Both purchasers and suppliers report that e-procurement can assist them in better managing their business process and cash flows.

Supply Chain Monitoring and Control Using RFID. This is one of the most promising applications of RFID. We will return to this topic later in Section A.3.

Inventory Management Using Wireless Devices. Many organizations are now achieving improvements in inventory management by using combinations of bar-coding technologies (or RFID) and wireless devices.

Collaborative Planning. Collaborative planning is a business practice that combines the business knowledge and forecasts of multiple players along a supply chain to improve the planning and fulfillment of customer demand. Collaborative planning requires buyers and sellers to develop shared demand forecasts and supply plans for how to support demand. These forecasts and supply plans should be updated regularly, based on information shared over the Internet. Such collaborative planning requires B2B workflow across multiple enterprises over the Internet, with data exchanged among partners dynamically. This topic is discussed further in Section A.4.

Collaborative Design and Product Development. Collaborative product development involves the use of product design and development techniques across multiple companies to improve product launch success and reduce time to market (as demonstrated in the Boeing opening case). During product development, engineering and design drawings can be shared over a secure network among the contract firm, testing facility, marketing firm, and downstream manufacturing and service companies. Other techniques include sharing specifications, test results, and design changes and using online prototyping to obtain customer feedback. Development costs can be reduced by tightly integrating and streamlining communication channels. Lately, social networking has been used to solicit feedback from customers.

E-Logistics. E-logistics is the use of Web-based technologies to support the material acquisition, warehousing, and transportation processes. E-logistics enables distribution to couple routing optimization with inventory-tracking information. For example, Internet-based freight auctions enable spot buying of trucking capacity. Third-party logistics providers offer virtual logistics services by integrating and optimizing distribution resources. A company may even consider collaboration with its competitors to improve its supply chain.
Appendix A: E-Commerce and Supply Chains

Infrastructure for E-SCM
The key activities just described use a variety of infrastructure and tools. The following are the major infrastructure elements and tools of e-supply chains:

- **Electronic data interchange (EDI).** EDI (see Online File W5.5) is the major tool used by large corporations to facilitate supply chain relationships. Many companies are shifting from traditional EDI to Internet-based EDI.
- **Extranets.** These are described in Online File W5.4. Their major purpose is to support interorganizational communication and collaboration. For details on success factors for using extranets in e-SCM, see [en/Wikipedia.org/wiki/Extranet](en/Wikipedia.org/wiki/Extranet).
- **Intranets.** These are the corporate internal networks for communication and collaboration.
- **Corporate portals.** These provide a gateway for external and internal collaboration, communication, and information search.
- **Workflow systems and tools.** These are systems that manage the flow of information in organizations.
- **Groupware and other collaborative tools.** Many tools facilitate collaboration and communication between two parties and among members of small as well as large groups. Various tools, some of which are collectively known as *groupware*, enable such collaboration. Blogs and wikis are beginning to play an important role (see the Eastern Mountain Sports opening case in Chapter 2). A major purpose of these tools is to provide *visibility* to all, namely, let people know where items are and when they arrive at certain locations.
- **Identification and tracking tools.** These tools are designed to identify items and their location along the supply chain. From a traditional bar code system, we are moving to RFID, as we will describe in Section A.3. Wireless and GPS technologies (Chapter 8) are also increasing in popularity.

Section A.1 REVIEW QUESTIONS
1. Define the e-supply chain and list its three major parts.
2. Describe success factors of e-supply chain management.
3. List the eight processes or activities of e-supply chains.
4. List the major e-supply chain management infrastructures and enabling tools.
5. Describe a digital supply chain.
6. Describe visibility and tracking along the supply chain.

A.2 SUPPLY CHAIN PROBLEMS AND SOLUTIONS
Supply chains have been plagued with problems, both in military and business operations, for generations. These problems have sometimes caused armies to lose wars and companies to go out of business. The problems are most apparent in complex or long supply chains (e.g., global ones) and in cases where many business partners are involved. Complex and long supply chains involving multiple business partners are becoming more common in the contemporary business world as globalization and offshoring of manufacturing operations continue to intensify. Thus, the problems faced by those managing supply chains are becoming both more complex and more critical to company...
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The bullwhip effect

The bullwhip effect refers to erratic shifts in orders up and down supply chains (see en.wikipedia.org/wiki/Bullwhip_effect). This effect was initially observed by Procter & Gamble (P&G) with their disposable diapers in offline retail stores. Although actual sales in stores were fairly stable and predictable, orders from distributors had wild swings, creating production and inventory problems for P&G and their suppliers. An investigation revealed that distributors’ orders were fluctuating because of poor demand forecasts, price fluctuations, order batching, and rationing within the supply chain. All of this resulted in unnecessary inventories in various places along the supply chain, fluctuations in P&G orders to its suppliers, and the flow of inaccurate information. Distorted or late information can lead to tremendous inefficiencies, excessive inventories, poor customer service, lost revenues, ineffective shipments, and missed production schedules.

The bullwhip effect is not unique to P&G. Firms from HP in the computer industry to Bristol-Myers Squibb in the pharmaceutical field have experienced a similar phenomenon. Basically, even slight demand uncertainty and variability become magnified when viewed through the eyes of managers at each link in the supply chain. If each distinct entity makes ordering and inventory decisions with an eye to its own interest above those of the chain, stockpiling may be occurring simultaneously at as many as seven or eight different places along the supply chain as assurance against shortages. Such stockpiling can lead to as many as 100 days of inventory waiting “just
in case.” Companies may avoid the “sting of the bullwhip” if they take steps to share information along the supply chain. Such information sharing is implemented and facilitated by EDI, extranets, and collaborative technologies—topics discussed later in this chapter.

**The Need for Information Sharing Along the Supply Chain**

Information systems are the links that enable communication and collaboration along the supply chain. They represent one of the fundamental elements that link the organizations of the supply chain into a unified and coordinated system. In today’s competitive business climate, EC and information technology are keys to the success, and perhaps even the survival, of any SCM initiative.

Case studies of some world-class companies, such as Walmart, Dell, and FedEx, indicate that these companies have created very sophisticated information systems, exploiting the latest technological developments and creating innovative solutions. However, even world-class companies, such as Nike, may suffer from inappropriate information sharing resulting in poor forecasting and then severely underestimating the complexity of automating aspects of the supply chain.

**EC SOLUTIONS ALONG THE SUPPLY CHAIN**

The connection between EC and supply chains has become more evident in recent years according to a survey conducted by Holsapple and Jin (2007). EC presents a new environment for managing the dynamics of supply chain relationships. The survey identified two main factors that differentiate the EC environment from the traditional business settings of supply chains: the greater scope of connectivity of organizations with their suppliers and customers, and the faster speed at which business activities occur. These two factors provide more visibility across the supply chain and engender new market structure and greater sense of uncertainty. According to Holsapple and Jin, this connection is facilitated by collaborative decision making in supply chains and by the support EC provides to collaborative decision making.

The following is a representative list of the major solutions provided by an EC approach and technologies for supply chain problems.

- **Visibility** increases along the supply chain. It is critical to know where materials and parts are at any given time. This is referred to as *visibility*. Such knowledge can help in solving problems such as delay, combining shipments, and more. Visibility is provided by several tools, such as bar codes, RFID, collaborative devices, and portals. Visibility implies creating information transparency through effective integration of information flows across the multiple e-marketplaces that comprise the chain. Such visibility allows organizations to coordinate supply chain interactions efficiently in dynamic market conditions.

- **Order taking** can be done over the Internet, by EDI, by EDI/Internet, or over an extranet, and may be fully automated. For example, in B2B, orders are generated and transmitted automatically to suppliers when inventory falls below certain levels. The result is a fast, inexpensive, and more accurate (no need to rekey data) order-taking process. In B2C, Web-based ordering using electronic forms expedites the process, makes it more accurate (intelligent agents can check the input data and provide instant feedback), and reduces processing costs.
Order fulfillment can become instant if the products can be digitized (e.g., software). In other cases, EC order taking interfaces with the company’s back-office systems, including logistics. Such an interface, or even integration, shortens cycle time and eliminates errors.

Electronic payments can expedite both the order fulfillment cycle and the payment delivery period. Payment processing can be significantly less expensive, and fraud can be better controlled. (See Chapter 10 for more on electronic payments.)

Managing risk to avoid supply chain breakdown can be done in several ways. Carrying additional inventories is effective against the risk of stock-outs, and hence poor customer service, but can be expensive. Also, in certain cases the risk increases because products may become obsolete.

Inventories can be minimized by introducing a build-to-order manufacturing process as well as by providing fast and accurate information to suppliers. By allowing business partners to electronically track and monitor orders and production activities, inventory management can be improved and inventory levels and the expense of inventory management can be minimized. Inventories can be better managed if we know exactly where parts and materials are at any given time (e.g., by using RFID). Inventories of retailers can be managed electronically by their suppliers.

Collaborative commerce among members of the supply chain can be done in many areas ranging from product design to demand forecasting. The results are shorter cycle times, minimal delays and work interruptions, lower inventories, and lower administrative costs. A variety of tools exist ranging from collaborative hubs and networks to collaborative planning.

The Role of Mobility

Synchronizing supply chains with mobility is gaining in popularity. With increasing competition and globalization, companies are searching for solutions to have leaner supply chains. Mobility eliminates wasted time hidden in business processes.

Through mobility, computing power is moved from a stationary desktop computer to mobile devices—the tools workers need to automate business processes and capture data in real time—right at the point of work. Manual processes are replaced with real-time computing. Instead of issuing paperwork orders to employees, an electronic work order can be issued instantly and automatically by mobile-supported business systems. For a comprehensive review and list of dozens of activities along the supply chain that support mobility, see Motorola (2007) and motorola.com/Business/US-EN/Enterprise+Mobility. One major tool of mobility is RFID.

Section A.2 REVIEW QUESTIONS

1. Describe some typical problems along the supply chain.
2. Describe the reasons for supply chain–related problems.
3. Describe the bullwhip effect.
4. Describe the benefits of information sharing along the supply chain.
5. List some EC solutions to supply chain problems.
A.3 RFID AS A KEY ENABLER IN SUPPLY CHAIN MANAGEMENT

RFID has the potential to revolutionize supply chain management.

THE RFID REVOLUTION

One of the newest and most revolutionary solutions to supply chain problems is RFID (see Online File W1.7). Given these developments, what effect will RFID have on supply chains? Let’s look at Exhibit A.2, which shows the relationship between a retailer (Walmart), a manufacturer (such as P&G), and P&G’s suppliers. Note that the tags are read as merchandise travels from the supplier to the retailer (steps 1 and 2). Note that the RFID transmits real-time information on the location of the merchandise. Steps 3–6 show the use of the RFID at the retailer, mainly to confirm arrivals (step 3) and to locate merchandise inside the company, control inventory, prevent theft, and expedite processing of relevant information (steps 4–6). It is no longer necessary to count inventories, and all business partners are able to view inventory information in real time. This transparency can go several tiers down the supply chain. Additional applications, such as rapid checkout, which eliminates the need to scan each item, will be provided by RFID in the future.

RFID technology is presented at en.wikipedia.org/wiki/Radio-frequency_identification. The major applications are in the supply chain.

EXHIBIT A.2 RFID at Walmart and Its Suppliers: The Seven-Step Process

1. Walmart’s Suppliers’ (e.g., P&G) products are ready to be shipped and are packed in cases (pallets). The RFID’s tags are attached to each case (pallet) by hand or automatically. Cases are then loaded on trucks.

2. Trucks leave for Walmart’s warehouses (or stores). RFID readers record the time of departure and the destination of each truck.

3. Trucks arrive at Walmart’s destinations. RFID reader records the time of arrival of each case (pallet).

3A. RFID information is delivered to Walmart destinations.

4. Cases/pallets are moved to storage; RFID readers clock their exact storage location at Walmart.

4A. Suppliers can track arrival data using Walmart Retail Link System.

5. Cases (pallets) are moved to stores (sales floor). RFID readers clock arrival.

5A. Data enter VMI system.

6. Empty cases (pallets) are moved to storage. RFID records location and arrival time.

7. Walmart’s CPFR and other planning.
RFID APPLICATIONS IN THE SUPPLY CHAIN

Many potential and actual applications exist in enterprises using RFID (e.g., see Niederman et al. 2007). The following are examples of how RFID can be used in the supply chain.

RFID at METRO

METRO, a huge retailer from Germany, is using RFID tags in an attempt to speed the flow of goods from manufacturers in China to their arrival in Europe at the port of Rotterdam to distribution centers in Germany. Passive tags (see Online File W1.7) are being applied to cartons and cases of goods; active tags are also being applied to the containers in which those goods are packed for shipping. At various points en route to Germany, the active tags are read and record the arrival of the cargo, enabling a record to be kept of where goods are located at any point in time. This gives METRO greater insights into the flow of goods along its supply chain, with bottlenecks or points that slow the delivery of goods becoming quickly evident. This allows for a review of business processes and work practices to ensure speedier handling and delivery. In addition, these RFID tags are equipped with intrusion sensors, which give an indication of whether any attempt has been made to open the sealed containers during the journey. If the container is tampered with, the tags can trigger flashing lights or a siren to alert staff. Thus, METRO is able to detect any attempts to tamper with or pilfer stock (see Heinrich 2005).

The benefits of the RFID system to METRO are substantial. It is calculated that eliminating a single day from the supply chain will save METRO hundreds of thousands of dollars annually by reducing the amount of stock held in inventory. Estimates are that for large retailers (in excess of $1 billion in sales annually) each one-day reduction in inventory can free up to $1 million in working capital. For details, see future-store.org.

RFID at Deutsche Post

Deutsche Post owns 6 million shipping containers that it uses to hold and transport about 70 million letters and other items that pass through its distribution centers daily. In order to process these crates, Deutsche Post prints in excess of 500 million thick paper labels, all of which are thrown away after a single use. It was environmental concerns, rather than purely economic ones, that drove Deutsche Post’s RFID initiative.

Deutsche Post uses passive RFID tags with a bi-stable display, meaning that the text displayed remains on-screen after power is removed and does not change until power is restored and the text is rewritten by an RFID interrogator. Tags on the crates must be readable from all angles and in all types of weather, requiring a robust tag. Furthermore, the tags need to last about five years in order for the application to be financially viable.

Deutsche Post developed a custom tag and RFID reader, and uses specialized software in this innovative application. Several other post offices around the world use RFID (e.g., Canada). For other applications and more details, refer to Loebbecke (2006).

RFID at Atlantic Beef Products (Ontario, Canada)

Cow’s ears are tagged with RFID tags. After a cow is killed, its ear tags are scanned for food traceability. The carcass goes onto two leg hooks, each equipped with an RFID chip. They are synced to each animal’s database record. The RFIDs replace bar codes, which could get contaminated with E. coli on the slaughter floor. The RFID helps track the movement of each cow and the meat produced at any time. The system won a gold medal from the Canadian IT organization.
RFID in Pharmaceuticals

MIT and SAP are examining the use of RFID in various industries, including pharmaceuticals and health care delivery, as well as the necessary IT architecture to support such use. The goal is to be able to know where everything or anything is at any given time. The challenge, however, is in determining how such a scenario would play out—what the actual network would look like once companies up and down the supply chain collaboratively start exchanging information among trading partners and their partners’ partners.

The Food and Drug Administration (FDA), for example, is interested in using RFID to find counterfeit drugs in the supply chain. An RFID chip with patient information (called SurgiChip, approved by the FDA) goes with the patient into surgery to help prevent errors. RFID tags are also used for patient identification throughout hospitals. Finally, many hospitals use RFID tags to find the whereabouts of pieces of portable equipment. Theoretically, RFID can be used in many places along the supply chain, as illustrated in Exhibit A.3.

For a successful implementation at Airbus, see Case A.1.

Because it is in constant competition with Boeing, the European aircraft manufacturer Airbus is looking for every opportunity to increase productivity, reduce costs, and make its production process more efficient. One of its latest efforts is the use of RFID technology, both in manufacturing and in maintenance of its airplanes. The initial deployment focused on automating the sourcing, logistics, manufacturing, and maintenance of the Airbus A380, the world’s largest commercial aircraft, with IBM’s RFID infrastructure software. The basic idea is to use RFID to track parts and tools, which are scattered over a large area; such information can eliminate delays. (Airbus had major delays in completing its A380, the double-decker, 525-seat airplane in 2008.)

Airbus hopes that RFID will become “as everyday as bar coding.” The company experimented with the technology for three years before signing a multimillion-dollar deal with vendors to implement the technology. It also created a value chain visibility and RFID unit to implement the biggest private sector RFID deal ever.

Airbus has implemented process-improvement projects involving RFID to track parts inside warehouses as they move from one region to another, and as they are built into aircrafts, as well as to track how and where tools are used for manufacturing and maintenance. The new RFID software infrastructure lets Airbus employees and systems exchange information collected by RFID readers. The infrastructure also integrates RFID data with business systems such as Airbus’ core ERP system.

The software also manages data collected by bar codes, which remains an important part of Airbus’ supply chain. RFID tags can hold more information and they do not require a line-of-sight reader, but they typically cost more than $1 per tag. So Airbus uses them only on rolling cages, pallets, cases, and high-cost parts.

Airbus expects RFID to augment ongoing supply chain process improvements, saving money by reducing time spent searching for parts, reducing inventory, and improving employees’ productivity.

Airbus is assessing a few pilot projects with suppliers tagging parts before shipping them, and the new software makes it possible to extend parts tracking from the supplier side to Airbus.

To close its RFID deal, Airbus had to navigate a still highly fragmented RFID industry. There are hundreds of vendors; each tells a different story, with different architectures and different payoffs. To sort it out, Airbus assigned a 25-person team of IT, business, and process analysts for about two years to develop a company-side RFID strategy and plans.

Airbus is employing RFID across two main categories: nonflyable and flyable.

- **Nonflyable** consists of ground-based processes, such as supply chain, transportation, logistics, manufacturing, and assembly-related applications.
- **Flyable** refers to all in-service processes, including operational, maintenance, and payload-tracking applications.

**Sources:** Compiled from Hayes-Weier (2008a), RFID Journal (2007), and Manufacturing Executive (2009).

**Questions**

1. What are the drivers of the RFID project?
2. What information technologies were used in this project?
3. What categories of people are supported by RFID?
4. How can RFID provide visibility to Boeing’s supply chain?
5. Go to the links provided in the case sources and search for the Webcast that provides you with a virtual tour of Airbus’ supply chain. Report on how RFID provides real-time visibility in the key processes.

**LIMITATIONS AND CONCERNS OF RFID**

RFID does have a number of limitations. For small companies, the cost of the system may be too high (at least for the near future). The lower-frequency systems (300 to 500 kHz) required for passive tags are much cheaper but offer a decreased range. Radio frequency interference and the limited range of passive RFID tags also may be problematic, especially because passive tags are the most economically viable option for some businesses. These
limitations should be minimized in the future as the cost of both passive and active RFID decreases and functionality increases. However, to date, many organizations have struggled to demonstrate the ROI of their RFID initiatives, raising the question of how long organizations will continue to invest in such technologies without gaining adequate returns.

Another major limitation of RFID currently is the restriction of the environments in which RFID tags are easily read. RFID tags do not work well in “harsh” environments, where reads are required in or around liquids and metals or around corners, for example. This means that RFID may not, in some cases, readily be used underwater or near items that are largely liquid (such as human beings and livestock, which are mostly water), nor do they function well in warehouses or areas where large amounts of metals are present (e.g., metal-lined deep freezers or metal shelving). Another issue has arisen in real-world implementations of RFID—the accuracy of the readers. Some (but not all) organizations have reported achieving only 70 to 90 percent accuracy in their read rates and, of additional concern, achieving different levels of accuracy at different points along the supply chain. Using active tags with a relatively large read range on individual items can prove problematic where there are many other items stocked near the reader but not part of the shopping cart. However, accuracy is improving with time.

Concern over customer privacy is another issue that remains a significant point of contention in arguments about the appropriateness of wide-scale implementation of RFID. First and foremost are security concerns related to the potential of RFID tags to be tracked long after their SCM purpose has been served. Following are some concerns regarding customer privacy and RFID tags:

- The customer buying an item with an RFID tag may not be able to remove the tag or may be unaware that an RFID tag is attached to the item.
- The presence of a tag might mean that it would still be capable of being read from some distance away without the knowledge of the purchaser or user of that item.
- If a purchase is made using a credit card, then the potential exists for the tag details to be linked directly to the personal details of the credit cardholder.

Such concerns have led to comments such as a California state senator’s remarking that “one day you realized your underwear was reporting your whereabouts!” (reported at en.wikipedia.org/wiki/Radio-frequency_identification).

Public concern has not been allayed in this regard, with various incidents reported by the media involving linking RFID on products with smart shelves equipped with cameras, thus directly identifying the person buying an item (using a photographic record).

As with most immature technologies, agreeing on universal standards, as well as connecting the RFIDs with existing IT systems, is yet another issue. In 2008, however, the Gen 2 standard (a protocol for the exchange of information between the RFID tag and the reader) appears to be the major RFID standard. However, some feel that Gen 2 is inadequate technically with the increased adoption of RFID technologies, and they thus argue that Gen 3 will require a huge volume of item-level tagging and the alleviation of consumers’ security concerns. In addition to technical standards, the players along the supply chain need to agree on how particular items are to be labeled and categorized. Take, for example, a common product such as aspirin. Aspirin is manufactured by a pharmaceutical company but distributed to major supermarkets and retailers, such as Walmart, pharmacies, and other convenience stores. The supermarket may categorize aspirin as a fast-moving consumer good (FMCG), and the pharmacist would consider it a pharmacy item, thus posing problems for the manufacturer as to how to categorize and
hence identify the item. The manufacturer may prefer to use HF RFID tags, the supermarket UHF RFID tags. Unless agreement on these sorts of issues can be reached by all key players along a supply chain, significant problems may occur. For more RFID implementation issues, see Niederman et al. (2007). For an assessment on RFID progress and prospect along the supply chain see Hayes-Weier (2009).

Section A.3  REVIEW QUESTIONS
1. Describe how RFID can be used to improve supply chains.
2. Explain how RFID works in a supplier–retailer system.
3. Briefly explain the differences between active and passive RFID tags. (Note: See Online File W 1.7 and en.wikipedia.org/wiki/Radio-frequency_identification.)
4. In what circumstances would it be better to use passive RFID tags? And in what circumstances might it be better to use active RFID tags?
5. What are some of the major limitations of RFID technology?

A.4  COLLABORATION ALONG THE SUPPLY CHAIN

A major strategy to improve supply chain operation is to have the involved partners collaborating on various managerial issues. Such collaboration is illustrated in Exhibit A.4. The rectangles designate the primary partners along the supply chain and the oval the support services and some of the methods described here and in the next section.

EXHIBIT A.4  The Collaborative Supply Chain

Collaboration agents and efforts are shown as ovals.

Source: Drawn by E. Turban.
There are many examples of e-collaboration along the supply chain. Here, we present some major ones.

**Vendor-Managed Inventory**

With **vendor-managed inventory (VMI)**, retailers make their suppliers fully responsible for determining when to order and how much to order. A third-party logistics provider (3PL) can also be involved by organizing the shipments as needed. The retailer provides the supplier with real-time information (e.g., point-of-sale data), inventory levels, and a threshold below which orders are replenished. The reorder quantities also are predeter-mined and usually recommended by the supplier. With this approach, the retailer is no longer burdened with inventory management, demand forecasting becomes easier, the supplier can see the potential need for an item before the item is ordered, there are no purchase orders, inventories are kept low, and stock-outs become infrequent. Today, it can be supported by CPFR (see the description in the next section) and special software. VMI software solutions are provided by Sockeye Solutions (sockeyesolutions.com) and JDA Software (jda.com). For details, see Haines (2008). This method was initiated by Walmart in the 1980s and has become popular. Let’s look at an example.

**Example: VMI and Information Sharing Between a Retailer (Walmart) and a Supplier (P&G).** Walmart provides P&G access to sales information on every item P&G makes for Walmart. The sales information is collected by P&G on a daily basis (or made visible to P&G) from every Walmart store, and P&G uses the information to manage inventory replenishment for Walmart. By monitoring the inventory level of each P&G item in every Walmart store, P&G knows when the inventories fall below the threshold that triggers an automatic order and a shipment. Everything is done electronically. The benefit for P&G is accurate demand information; the benefit for Walmart is adequate inventory. P&G has similar agreements with other major retailers; Walmart has similar agreements with other major suppliers. For a more detailed study of Walmart’s use of VMI and other supply chain enablers, see the closing case at the end of this appendix.

**Retailer–Supplier Collaboration: Target Corporation**

Target Corporation (targetcorp.com) is a large retail conglomerate. It conducts EC activities with more than 20,000 trading partners. In 1998, then operating under the name Dayton–Hudson Corporation, the company established an extranet-based system for those partners that were not connected to its value-added network (VAN)–based EDI. The extranet enabled the company not only to reach many more partners but also to use many applications not available on the traditional EDI. The system (based on GXS’s InterBusiness Partner Extranet platform; gxs.com) enabled the company to streamline its communications and collaboration with suppliers. It also allowed the company’s business customers to create personalized Web pages that were accessible via either the Internet or GXS’s EDI, as shown in Exhibit A.5. Target now has a Web site called Partners Online (partnersonline.com), which it uses to communicate with and provide an enormous amount of information to its partners.

**Lower Transportation and Inventory Costs and Reduced Stock-Outs: Unilever**

Unilever is a large global manufacturer of leading brands in food, home care, and personal care (unilever.com). Its 30 contract carriers deliver 250,000 truckloads of shipments every day. Unilever’s Web-based database, the Transportation Business
Appendix A: E-Commerce and Supply Chains

EXHIBIT A.5  Target’s Extranet

<table>
<thead>
<tr>
<th>Connection Via</th>
<th>GE Private VAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Internet</td>
<td>Private line secure</td>
</tr>
<tr>
<td>VPN, encryption, global reach</td>
<td></td>
</tr>
<tr>
<td>added</td>
<td></td>
</tr>
</tbody>
</table>

Web Applications
- Customer service
- Portal services
- Inventory management
- Quality assurance
- Supply chain
- Process design
- New products
- Budget control
- E-procurement

Security
- Access control
- Registration
- Authentication
- Digital signature
- Certification

Legacy Systems
- EDI
- ERP

GXS InterBusiness Partner Extranet

Source: Drawn by E. Turban.

EXHIBIT A.5: Target’s Extranet provides the carriers with site-specification requirements when they pick up a shipment at a manufacturing or distribution center or when they deliver goods to retailers. TBC gives carriers all the vital information they need: contact names and phone numbers, operating hours, the number of dock doors at a location, the height of the dock doors, how to make an appointment to deliver or pick up shipments, pallet configuration, and other special requirements. All mission-critical information that Unilever carriers need to make pickups, shipments, and deliveries is now available electronically 24/7. TBC also helps Unilever organize and automate its carrier selection processes based on contract provisions and commitments. When a primary carrier is unable to accept a shipment, TBC automatically recommends alternative carriers.

Reduction of Product Development Time: Caterpillar, Inc.

Caterpillar (caterpillar.com) is a multinational, heavy-machinery manufacturer. In the traditional mode of operation, cycle time along the supply chain was long because the process involved the transfer of paper documents among managers, salespeople, and technical staff. To solve the problem, Caterpillar connected its engineering and manufacturing divisions with its suppliers, dealers, distributors, overseas factories, and customers through an extranet-based global e-collaboration system. By means of the collaboration system, a request for a customized tractor component, for example, can be transmitted from a customer to a Caterpillar dealer and on to designers and suppliers, all in a very short time.
Customers also can use the extranet (accessible with wireless devices) to retrieve and modify detailed order information while the vehicle is still on the assembly line.

Remote collaboration capabilities between the customer and product developers have also decreased cycle time delays caused by rework time. In addition, suppliers also are connected to the system so that they can deliver materials or parts directly to Caterpillar's shops or directly to the customer, if appropriate. The system also is used for expediting maintenance and repairs. Other companies are also using EC technologies to reduce the time needed for product development.

Section A.4 REVIEW QUESTIONS
1. Define VMI and list its benefits.
2. How can EC facilitate retailer-supplier collaboration?
3. How can EC reduce inventory cost?
4. How can EC reduce product development time?

A.5 COLLABORATIVE PLANNING, FORECASTING, AND REPLENISHMENT (CPFR)

In collaborative planning, business partners—manufacturers, suppliers, distribution partners, and other partners—create initial demand (or sales) forecasts, provide changes as necessary, and share information, such as actual sales, and their own forecasts. Thus, all parties work according to a unified schedule aligned to a common view, and all have access to order and forecast performance that is globally visible through electronic links. Schedule, order, or product changes trigger immediate adjustments to all parties' schedules.

Collaborative planning is designed to synchronize production and distribution plans and product flows, optimize resource utilization over an expanded capacity base, increase customer responsiveness, and reduce inventories. It can be a complex process (see Exhibit A.6). Collaborative planning is a necessity in e-SCM (see vics.org/committees/cpfr). The planning process is difficult because it involves multiple parties and activities.

This section examines several aspects of collaborative planning and collaborative design.

COLLABORATIVE PLANNING, FORECASTING, AND REPLENISHMENT

Collaborative planning, forecasting, and replenishment (CPFR) is a business practice in which suppliers and retailers collaborate in planning and demand forecasting in order to ensure that members of the supply chain will have the right amount of raw materials and finished goods when they need them. The goal of CPFR is to streamline product flow from manufacturing plants all the way to customers' homes. Large manufacturers of consumer goods, such as P&G, have superb supply chains resulting from their use of CPFR.

The essentials of CPFR are shown in Exhibit A.6. Note that this is a cyclical process in which sellers, buyers, and end customers are considered. The process starts with strategy and planning, followed by demand and supply management, which results in execution. The results are analyzed, leading to reexamination of the strategy.
EXHIBIT A.6  CPFR Model


An interesting application of CPFR is that of West Marine, presented in Case A.2. CPFR can be used with a company-centric B2B and with sell-side or buy-side marketplaces. For more on the benefits of CPFR, see vics.org/committees/cpfr. Also, see en.wikipedia.org/wiki/Planning.

CASE A.2
EC Application
WEST MARINE: A CPFR SUCCESS STORY

West Marine is the largest boating-supply company in the United States. It has 400 stores and annual sales of $690 million. The company sells more than 50,000 different products, ranging from stainless-steel propellers and anchors to lifejackets and wetsuits, through its stores, Web site, catalog, and commercial sales arm.

West Marine has a dramatic story when it comes to its effective supply chain, which was guided and directed through its deep, intensive, and effective implementation of CPFR. West Marine is now regarded as having a showcase CPFR implementation; however, it wasn’t always that way.

In 1997, West Marine acquired its East Coast competitor E&B Marine. As a result of the challenges of integrating the two companies, sales fell by almost 8 percent, and during the peak season stock-outs rose by more than 12 percent over the previous year. Income dropped from $15 million in 1997 to little more than $1 million in 1998.

The situation was quite different when in 2003 West Marine purchased its largest competitor, BoatUS. West Marine successfully integrated BoatUS’s distribution center in just 30 days. BoatUS’s in-store systems were integrated into West Marine in just under 60 days. Further, supply chain performance and the bottom line were not affected.

(continued)
MANAGERIAL ISSUES

Some managerial issues related to this appendix are as follows.

1. **Who benefits from vendor-managed inventory?**
   The vendor-managed inventory (VMI) system combined with collaborative planning, forecasting, and replenishment (CPFR) requires the supplier side to take the high level of responsibility. However, small suppliers may not have the ability to systematically manage inventories well. In this case, the large buyer will need to support the inventory management system on behalf of the suppliers. Sensitive issues must be agreed upon when initiating VMI. One such issue is who takes responsibility for unsold items due to the wrong jointly done demand forecast.

2. **What are the costs and benefits of RFID?** RFID in supply chain management has big potential, but the benefits and costs should be well designed. The cost of tagging and managing individual items rather than containers or pallets can be costly; so, at present, the combination of RFID and bar code is the most cost-effective.
SUMMARY
In this appendix, you learned about the following EC issues as they relate to the appendix’s learning objectives.

1. **The e-supply chain, its characteristics, and its components.** Digitizing and automating the flow of information throughout the supply chain and managing it via the Web results in an entity called the e-supply chain. The major parts of the e-supply chain are the upstream (to suppliers), internal (in-house processes), and downstream (to distributors and customers) components. E-supply chain activities include replenishment, procurement, collaborative planning, collaborative design/development, e-logistics, and the use of exchanges or supply webs—all of which can be Internet based.

2. **Supply chain problems and their causes.** The major supply chain problems are: too large or too small inventories, lack of supplies or products when needed, the need for rush orders, deliveries of wrong materials or to wrong locations, and poor customer service. These problems result from uncertainties in various segments of the chain (e.g., in transportation), from mistrust of partners, from a lack of collaboration and information sharing, and from difficulties in forecasting demand (e.g., the bullwhip effect). Also, lack of appropriate logistics infrastructure can result in inefficiencies.

3. **Solutions to supply chain problems provided by EC.** EC technologies automate and expedite order taking, speed order fulfillment, provide for e-payments, properly control inventories, provide for correct forecasting and thus better scheduling, and improve collaboration among supply chain partners. Of special interest are the emerging RFID technologies that could revolutionize supply chain management.

4. **RFID tags.** Replacing bar codes with wireless technologies can greatly improve locating items along the supply chain quickly. These technologies have many benefits and few limitations. They will revolutionize supply chain management.

5. **Collaborative planning and CPFR.** Collaborative planning concentrates on demand forecasting and on resource and activity planning along the supply chain. Collaborative planning tries to synchronize partners’ activities. CPFR is a business strategy that attempts to develop standard protocols and procedures for collaboration. Its goal is to improve demand forecasting by collaborative planning in order to ensure delivery of materials when needed. In addition to forecasting, collaboration in design is facilitated by IT, including groupware. Product life-cycle management (PLM) enables manufacturers to plan and control product-related information.

KEY TERMS

| Collaborative planning | A-7 | E-supply chain management (e-SCM) | A-5 | Vendor-managed inventory (VMI) | A-18 |
| Collaborative planning, forecasting, and replenishment (CPFR) | A-20 | Information visibility | A-6 | Visibility | A-10 |
| E-procurement | A-6 | Procurement | A-4 | | |
| | | Supply chain | A-3 | | |

QUESTIONS FOR DISCUSSION BY INDIVIDUAL STUDENTS

1. Define e-supply chain, and discuss its importance in supporting organizational performance.

2. Does a company’s supply chain include the movement of money, materials, and information within the company? How are they interrelated?

3. Discuss the major considerations that must be taken into account when implementing VMI.

4. Discuss the contribution of Web-enabled ERP systems to effective supply chain management.
A-24

Appendix A: E-Commerce and Supply Chains

5. Discuss the need for workflow systems as a companion to e-commerce.
6. It is said that e-commerce signifies a move from a transaction focus to a relationship focus among supply chain members. Discuss.
7. Discuss the need for virtual meetings.
8. Discuss how CPFR can lead to more accurate forecasting and how it can resolve the bullwhip effect.
9. Describe the advantages of RFID over a regular bar code in light of supply chain management.

TOPICS FOR CLASS DISCUSSION

1. Describe how the advent of the Internet has affected supply chain management. Include in your answer the contribution of the Internet to the following aspects and challenges:
   a. Globalization
   b. Outsourcing, including business process outsourcing
   c. Increasingly demanding customers
   d. Diminishing product life cycles
2. Discuss the proposition that competition in contemporary business is best described and conceptualized as competition between industry supply chains rather than between that of individual corporations.
3. Discuss the importance of taking a holistic view of supply chain management rather than simply approaching supply chain management from a business-process and EC viewpoint.
4. What is the strategic value of mobile collaboration in managing supply chains?

INTERNET EXERCISES

2. Investigate the status of CPFR. Start at vics.org/committees/cpfr, google.com, and bing.com. Also enter supply-chain.org and find information about CPFR. Write a report on the status of CPFR.
3. Enter i2.com and review its products. Explain how some of the products facilitate collaboration.
4. Enter lotus.com and find the collaboration-support products. How do these products support groups?
5. Enter supplyworks.com and clickcommerce.com. Examine the functionalities provided for supply chain improvements (the inventory management aspects).
6. Enter electronicsupplychain.org, then click “Resources.” Find new information on supply chain automation.
7. Enter future-store.org and find the progress on the use of RFID and other tools in supply chain improvements in retailing.

TEAM ASSIGNMENTS AND PROJECTS

1. Each team is assigned to an organization. The team members will attempt to identify several supply chains, their components, and the partners involved. Draw the chains and show which parts can be treated as e-supply chain parts.
2. Each team is assigned to a company. Members will interview key employees in order to find existing problems in the supply chains. Then the teams will propose solutions using EC technologies.
Walmart Stores, Inc., is the world’s largest public corporation by revenue and the largest private employer in the world (about 2.1 million employees in 2008). In 2008, the company operated about 4,000 stores in the United States (discount, supercenters, neighborhood markets, and Sam’s Clubs) as well as more than 2,200 stores in other countries, mostly in Mexico, Canada, Brazil, and the United Kingdom. Its revenue exceeded $400 billion, with net income of about $15 billion. For further details, see en.wikipedia.org/wiki/Wal-Mart and walmartfacts.com. A major determinant of the success of Walmart is its IT and EC-driven supply chain.

Walmart’s Supply Chain

Walmart pioneered the world’s most efficient technology-driven supply chain. Let’s look at some of its components and innovations.

Walmart invited its major suppliers to codevelop profitable supply chain partnerships. These partnerships are intended to amplify product flow efficiency and, in turn, Walmart’s profitability. A case in point is Walmart’s supplier relationship with P&G, a major supplier of consumer products. This relationship enables interoperation between the companies’ systems at transactional, operational, and strategic levels. Since 1988, the relationship has evolved to yield tremendous value to both companies, and their mutual business has grown manifold. Examples of intercompany innovations are vendor-managed inventory (VMI), CPFR, and RFID. Let’s look closer at Walmart and some of its supply chain–related initiatives.

Inventory Management

Inventory management is done at the corporate and individual store levels. In both cases, computerized systems facilitate proper inventory levels and reordering of goods. Stores manage their inventories and order goods as needed instead of the company using a centralized control. By networking with suppliers, a quick replenishment order could be placed via Walmart’s own satellite communication system. This way, suppliers can quickly deliver the goods directly to the store concerned or to the nearest distribution center. The suppliers are able to reduce costs and prices due to better coordination. Walmart invested $4 billion in a retail

Managing Distribution Centers and Forklift Management

Walmart uses hundreds of distribution centers worldwide. Goods are transported to these centers from suppliers and then stored. When needed, goods are reorganized in trucks and delivered to the stores. Walmart uses a computerized warehouse management system (WMS) to track and manage the flow of goods through its distribution centers. This system manages not only the forklifts within the distribution center, but also Walmart’s fleet of trucks.

Wireless Industrial Vehicle Management System

Forklifts and other industrial vehicles are the workhorses of material handling within the distribution centers and thus are critical factors in facility productivity. In each center, Walmart installs a comprehensive wireless Vehicle Management System (VMS).

The major capabilities of this system (from I.D. Systems, Inc., id-systems.com) are listed here and organized by productivity and safety features:

Productivity Features

- A two-way text messaging system that enables management to divert material-handling resources effectively and quickly to the point of activity where they are needed the most.
- Software that displays a graphical facility map, which enables not only near real-time visibility of vehicle/operator location and status, but also the ability to play back the trail of a vehicle movement over any slice of time. The system also helps to locate vehicles in real time.

Closing Case

HOW WALMART USES EC IN ITS SUPPLY CHAIN
Appendix A: E-Commerce and Supply Chains

**Fleet and Transportation Management**

Several thousands of company-owned trucks move goods from the distribution centers to stores. Walmart uses several EC and IT tools for managing the trucks. These include a decision support system (DSS) for optimal scheduling, dispatching, and matching of drivers with vehicles; a computerized system for efficient purchasing and use of gasoline; a computerized preventive maintenance management system for efficient maintenance and repairs procedures; and a system that helps maximize the size of truck necessary for any given shipment. The company is experimenting with the use of a wireless GPS/GIS system for finding the trucks’ locations at any given time.

Decisions about cross-docking are computerized. Cross-docking involves the elimination of the distribution center and instead uses a direct delivery to the customer after picking and sorting the goods from the suppliers. This is possible only if the suppliers ensure delivery within a specified time frame.

**Going Green**

Walmart is spending $500 million a year to increase fuel efficiency in Walmart’s truck fleet by 25 percent over the next 3 years and plan to double it within 10 years.

**Walmart and RFID Adoption**

One of Walmart’s major initiatives in the supply chain area is pioneering the use of RFID. In the first week of April 2004, Walmart launched its first live test of RFID tracking technology. Using one distribution center and seven stores, 21 products from participating vendors were used in the pilot test.

Walmart set a January 2005 target for its top 100 suppliers to place RFID tags on cases and pallets destined for Walmart stores. The system expanded to all major suppliers during 2006 through 2009, especially in the B2B Sam’s Club stores. It improves flow along the supply chain, reduces theft, increases sales, reduces inventory costs (by eliminating overstocking), and provides visibility and accuracy throughout Walmart’s supply chain.

To encourage more suppliers to cooperate, in January 2008 Walmart started to charge $2 per case or pallet not tagged (see Hayes-Weier 2008b). In addition to requiring RFID tags from its suppliers, Walmart is installing the technology internally. According to Scherago (2006), more than 2,000 Walmart stores were RFID-enabled with gate readers and handhelds at loading docks, facility entrances, stock rooms, and sales floors by the end of 2006. According to Songini (2007), the emphasis now is on the use of RFID in stores rather than in distribution hubs.

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**Warehouse Management System**

A warehouse management system (WMS) is a key part of the supply chain that primarily aims to control the movement and storage of material within a warehouse and process the associated transactions including receiving, shipping, and in-warehouse picking. The system also optimizes stock levels based on real-time information about the usage of parts and materials.

Warehouse management systems often utilize information technologies, such as bar code scanners, mobile computers, Wi-Fi, and RFID to efficiently monitor the flow of products. Once data has been collected, there is either a batch synchronization with, or real-time wireless transmission to, a central database. The database can then provide useful reports about the status of goods in the warehouse.

Warehouse management systems can be standalone systems, or modules in an ERP system (e.g., at SAP and Oracle) or in a supply chain management suite. The role and capabilities of WMS are ever-expanding. Many vendors provide WMS software (e.g., see qssi-wms.com). For a comprehensive coverage of WMS, see Piasecki (2006).

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**Safety Features**

- Unique data on peak vehicle utilization that enables optimal computerized fleet “right sizing.” It also helps work assignments and communication, especially in response to unexpected changes and needs.

- Electronic safety checklist system for identifying and responding to vehicles’ problems.

- Access authorization to drive certain vehicles by trained drivers only.

- Impact sensing that provides a broad choice of automated management responses, from alerting a supervisor with visual or audible alarms, to generating a warning icon on a graphical software display of the facility, to sending an e-mail or text message to management.

- Automatic reporting and prioritization of emergency repair issues that are identified on electronic safety checklists, where operator responses are flagged by severity of the vehicle condition.

- Wireless, remote lock-out of vehicles that are unsafe or in need of repair.

For further details, see the Walmart case at id-systems.com.
The RFID initiative is an integral part of improving the company’s supply chain (Scherago 2006). RFID along with a new EDI improves collaboration with the suppliers and helps reduce inventories. Companies that conformed early to Walmart’s RFID mandate enjoy benefits, too. For example, Daisy Brand, the manufacturer of sour cream and cottage cheese, started shipping RFID-tagged cases and pallets to Walmart in fall 2004. Daisy says its investment in RFID has been a boon, helping it better manage the flow of its perishable products through Walmart stores and ensuring that marketing promotions proceed as planned (Hayes-Weier 2008b).

The next step in Walmart’s pilot is to mark each individual item of large goods with a tag. This plan raises a possible privacy issue: What if the tags are not removed from the products? People fear that they will be tracked after leaving the store. Walmart can also use RFID for many other applications. For example, it could attach tags to shoppers’ children, so when they are lost in the megastore, they could be tracked in seconds.

**Conclusion**

Walmart’s competitiveness and its future success depend on EC and IT ability to deliver applications and systems that are agile and easy to adopt to changing market conditions, especially along the supply chain. Special attention needs to be paid to global operation and transportation. It is still difficult to find items in stores due to the lack of Walmart associates, as well as to check prices due to poor labeling in some cases. The future use of RFID can help the company overcome many of these problems.

Walmart is using EC in many other applications. For example, the company has more than 30 million shoppers each day, which generates 800 million transactions (each item you buy adds one transaction regarding inventory levels and sale volume). Walmart operates a huge data warehouse and uses business intelligence (BI) for reporting and analysis purposes.

Finally, Walmart introduces more and more innovations. To increase the efficiency of money flow and customer service, Walmart has introduced a smart network (Birchall 2008).

**Sources:** Birchall (2008), Hayes-Weier (2008b), Piasecki (2006), Scherago (2006), and Songini (2007).

**Questions**

1. Why is Walmart concentrating on supply chain projects?
2. Walmart mandates RFID tags from all its large suppliers. Why are some suppliers not in compliance?
3. Investigate the options for international customers on the Walmart Web site.
5. Envision how transaction processing systems (TPSs) are used in Walmart stores. Go to Walmart and pay with a check. How has EC improved the old way of paying with checks?

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Appendix A: E-Commerce and Supply Chains