CHAPTER 8

Supply Chain Management and Enterprise Resource Planning

LEARNING OBJECTIVES
After studying this chapter, you will be able to:

1. Understand the concept of the supply chain, its importance, and management.
2. Describe the problems of managing the supply chain and some innovative solutions.
3. Trace the evolution of software that supports activities along the supply chain and describe the need for software integration.
4. Describe ERP and understand the relationships between ERP and SCM software.
5. Describe order fulfillment problems and solutions in e-commerce and how EC solves other supply chain problems.
6. Describe the process and activities of partner relationship management.
7. Understand the process and issues of global supply chain management.
CHEVRONTEXACO’S MODERNIZED SUPPLY CHAIN

THE PROBLEM

ChevronTexaco (chevrontexaco.com) is the largest U.S. oil company and is multinational in nature. Its main business is drilling, refining, transporting, and selling petroleum products (oil and gasoline). In this competitive business a saving of even a quarter of a penny for each gallon totals up to millions of dollars. Two problems have plagued the industry: running out of gasoline when needed at each pump, and a delivery that is aborted because a tank at the gas station is too full (called “retain”). Run-outs and retains, known as the industry’s “twin evils,” have been a target for improvements for years, with little success.

The causes of the twin evils have to do with the supply chain: Gasoline flows in the supply chain, starting with the upstream part of the chain (Chapter 2) which includes oil hunting, drilling, and extracting. Then the oil is processed, and finally it goes to the downstream, customer-facing part of the supply chain. The difficulty is to match the three parts of the chain. ChevronTexaco own oil fields and refineries, but it also buys both crude and refined oil to meet demand. Purchases are of two types: those that have long-term contracts and those that are purchased “as needed,” in the spot market, at prevailing prices (which usually are higher than contract prices).

In the past ChevronTexaco acted like a mass-production manufacturing company, just trying to make products and sell them (a supply-driven strategy). The problem with this strategy is that each time you make too much or too little, you are introducing extra cost into the supply chain.

THE SOLUTION

The company decided to change its supply chain business model from supply-driven to demand-driven. Namely, instead of worrying about how much oil it would process and “push,” it started worrying about how much oil its customers wanted. This change necessitated a major transformation in the business and extensive support by information technologies.

To implement the IT support, the company is investing $15 million (each year, in the U.S. alone), in proprietary supply chain software that can capture data in real time. Each tank in each gas station is equipped with an electronic monitor that conveys real-time information about the oil level, through a cable, to the station’s IT-based management system, and then via a satellite, to the main inventory system at the company’s main office. There, an advanced DSS-based planning system processes the data to help refining, marketing, and logistics decisions. This DSS include also information collected at trucking and airline companies. Using an enterprise resource planning (ERP) and the business planning system, ChevronTexaco determines how much to refine, how much to buy at spot markets, and when and how much to ship to each of its retail stations.

The system uses demand forecasting to determine how much oil it would refine on a monthly basis, with weekly and daily checks. This way production is matched to customer demand. It is necessary to integrate the supply and demand information systems, and this is where the ERP software is useful. Planners at
various points across the supply chain (e.g., refineries, terminals, stations, transportation, and production) have to share data constantly.

Recent corporate IT projects that support the ChevronTexaco supply chain and extend it to a global reach are NetReady (which enables 150 e-business initiatives), Global Information Link (GIL2, which enables connectivity throughout the company), e-Guest (which enables sharing of information with business partners), and the Human Resources Information System.

**THE RESULTS**

The integrated system, which allows data to be shared across the company, has improved decision making at every point in the customer-facing and processing parts of the supply chain. Better decision making has increased the company’s profit by more than $300 million in 1999 and by more than an additional $100 million in 2000. Managers attribute the increase to various company initiatives, but mostly to the change in the supply chain.

According to Worthen, (2002), studies indicate that companies that belong to the top 20 percent in their industries operate their supply chains twice as efficiently as median companies. The successful companies carry half as much inventory, can respond to significant rise in demand (20 percent or higher) twice as fast, and know how to minimize the number of deliveries they must make to any retail outlets. ChevronTexaco belongs to this category.

Sources: Compiled from Worthen (2002) and from chevrontexaco.com (see “Information Technology”; site accessed May 2003).

**LESSONS LEARNED FROM THIS CASE**

The ChevronTexaco case illustrates the importance of supply chain management for the modern enterprise. It demonstrates the need to significantly improve the management of the supply chain (in this case from supply-driven to demand-driven). Such a drastic change was feasible only with the support of IT tools. In this case, IT is used to enable real-time communication between each tank at each gas station (many thousands) and the corporate management center, where DSS analysis can be done on a continuous basis. Also, knowing demand in real-time helps a company’s acquisition of raw materials (in this case, oil) and drives its production (refinery) operations. Finally, all decision makers along the supply chain share information and collaborate.

Supply chain management is not a simple task, as will be seen in this chapter, but IT solutions enable even a large multinational company like ChevronTexaco to tame the supply chain, increasing both its profits and customer satisfaction. Finally, we see that the company is extending its supply chain improvement to its business partners. We also cover a related topic, order fulfillment in EC.

**8.1 ESSENTIALS OF THE SUPPLY AND VALUE CHAINS**

Initially, the concept of a supply chain referred only to the flow of materials from their sources (suppliers) to the company, and then inside the company to places where they were needed. There was also recognition of a demand chain, which
described the process of taking orders and delivering finished goods to customers. Soon it was realized that these two concepts are interrelated, so they were combined under the single concept named the *extended supply chain*, or just *supply chain*.

The following concepts and definitions are helpful for the study of this chapter.

**SUPPLY CHAIN.** As defined in Chapter 2, *supply chain* refers to the flow of materials, information, payments, 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. It includes many tasks such as purchasing, payment flow, materials handling, production planning and control, logistics and warehousing, inventory control, and distribution and delivery.

**SUPPLY CHAIN MANAGEMENT.** The function of *supply chain management* (SCM) is to plan, organize, and coordinate all the supply chain's activities. Today the concept of SCM refers to a total systems approach to managing the entire supply chain. SCM is usually supported by IT (see Kumar, 2001; Hugos, 2002; and Vakharia, 2002). The topic of supply chain management was found to be the number 1 priority of chief information officers (CIOs) in 2001, and their number 3 priority in 2002 (see Morgan Stanley, 2001, 2002).

**SCM SOFTWARE.** *SCM software* refers to software intended to support specific segments of the supply chain, especially in manufacturing, inventory control, scheduling, and transportation. This software concentrates on improving decision making, optimization, and analysis.

**E-SUPPLY CHAIN.** When a supply chain is managed electronically, usually with Web-based software, it is referred to as an *e-supply chain*. As will be shown in this chapter, improvements in supply chains frequently involve an attempt to convert an organization’s supply chain to an e-supply chain—that is, to automate the information flow in the chain (see Poirier and Bauer, 2000).

**SUPPLY CHAIN FLOWS.** There are three flows in the supply chain: materials, information, and financial flows.

- **Materials flows.** These are all physical products, new materials, and supplies that flow along the chain. Included in the materials flows are returned products, recycled products, and materials or products for disposal.

- **Information flows.** All data related to demand, shipments, orders, returns, schedules, and changes in the above are information flows.

- **Financial flows.** Financial flows include all transfers of money, payments, credit card information and authorization, payment schedules, e-payments (Chapter 5), and credit-related data.

In service industries there may be no physical flow of materials, but frequently there is flow of documents (hard and/or soft copies). Service industries, according to the above definition, fit the definition of a supply chain, since the information flow and financial flow still exist. As a matter of fact the digitization of products (software, music, etc.) results in a supply chain without physical
flow. Notice however that in such a case, there are two types of information flows: one that replaces material flow (e.g., digitized software), and one that is the supporting information (orders, billing, etc).

In managing the supply chain it is necessary to coordinate all the above flows among all the parties involved in the supply chain (see Viswanadham, 2002).

**BENEFITS.** The goals of modern SCM are to reduce uncertainty and risks in the supply chain, thereby positively affecting inventory levels, cycle time, business processes, and customer service. All these benefits contribute to increased profitability and competitiveness, as demonstrated in the opening case. The benefits of supply chain management have long been recognized both in business and in the military.

In today’s competitive business environment, the efficiency and effectiveness of supply chains in most organizations are critical for their survival and are greatly dependent upon the supporting information systems.

**The Components of Supply Chains**

The term *supply chain* comes from a picture of how the partnering organizations in a specific supply chain are linked together. A typical supply chain, which links a company with its suppliers and its distributors and customers was shown in Figure 2.6 (page •••). The supply chain involves three segments: (1) *upstream*, where sourcing or procurement from external suppliers occur, (2) *internal*, where packaging, assembly, or manufacturing take place, and (3) *downstream*, where distribution or dispersal take place, frequently by external distributors.

A supply chain also involves a *product life cycle* approach from “dirt to dust.” However, a supply chain is more than just the movement of tangible inputs, since 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 part of the chain as well. As a matter of fact, the supply chain of a service or of a digitizable product may not include *any* physical materials.

Supply chains come in all shapes and sizes and may be fairly complex, as shown in Figure 8.1. As can be seen in the figure, the supply chain for a car manufacturer includes hundreds of suppliers, dozens of manufacturing plants (for parts) and assembly plants (for cars), dealers, direct business customers (fleets), wholesalers (some of which are virtual), customers, and support functions such as product engineering and purchasing. For sake of simplicity we do not show here the flow of information and payments.

Notice that in this case the chain is not strictly linear as it was in Figure 2.6. Here we see some loops in the process. In addition, sometimes the flow of information and even goods can be bidirectional. For example, not shown in this figure is *reverse logistics*, which is the *return* of products. For the automaker, that would be cars returned to the dealers in cases of defects or recalls by the manufacturer.

**Types of Supply Chains**

The supply chains shown in Figures 2.6 and 8.1 are those of manufacturing companies. Such companies may have warehouses in different locations, making the chain even more complex. As a matter of fact there are several major types of supply chain. These types can be classified into four categories: integrated
make-to-stock, continuous replenishment, build-to-order, and channel assembly. Details are provided in Online File W8.1.

The flow of goods, services, information, and financial resources is usually designed not only to effectively transform raw items to finished products and services, but also to do so in an efficient manner. Specifically, the flow must be followed with an increase in value, which can be analyzed by the value chain.

The Supply Chain and the Value Chain

In Chapter 3 we introduced the concepts of the value chain and the value system. A close examination of these two concepts shows that they are closely related to the supply chain. The primary activities of the value chain, corresponding to the internal part of the model are shown in Figure 2.6 (page •••). Some of the support activities of the value chains (such as moving materials, purchasing, and shipping) can be identified in Figure 8.1.

Porter's value chain (1985) emphasized that value is added as one moves along the chain. One of the major goals of SCM is to maximize this value, and this is where IT in general and e-commerce in particular enter the picture, as will be shown in Sections 8.3 and 8.4. But let us first see why it is difficult to optimize the value and supply chains.
Adding value along the supply chain is essential for competitiveness or even survival. Unfortunately, the addition of value is limited by many potential problems along the chain.

Supply chain problems have been recognized both in the military and in business operations for generations. Some even caused armies to lose wars and companies to go out of business. The problems are most evident in complex or long supply chains and in cases where many business partners are involved. For example, a well-known military case is the difficulties the German army in World War II encountered in the long supply chain to its troops in remote Russian territories, especially during the winter months. These difficulties resulted in a major turning point in the war and the beginning of the Germans’ defeat. Note that during the 1991 and the 2003 wars in Iraq, the allied armies had superb supply chains that were managed by the latest computerized technologies (including DSS and intelligent applications). These chains were a major contributor to the swift victories.

In the business world there are numerous examples of companies that were unable to meet demand, had too large and expensive inventories, and so on. Some of these companies paid substantial penalties; others went out of business. On the other hand, some world-class companies such as Wal-Mart, Federal Express, and Dell have superb supply chains with innovative IT-enhanced applications (see IT At Work 3.4, page •••, on how Dell does it).

An example of a supply chain problem was the difficulty of fulfilling orders received electronically for toys during the 1999 holiday season. During the last months of 1999, online toy retailers, including eToys (now kbkids.com), Amazon.com, and ToysRUs, conducted massive advertising campaigns to encourage Internet ordering. These campaigns included $20 to $30 discount vouchers for shopping online. Customer response was overwhelming, and the retailers that underestimated it were unable to get the necessary toys from the manufacturing plants and warehouses and deliver them to the customers’ doors by Christmas Eve. The delivery problems cost the toy retailers dearly, in terms of both money and goodwill. ToysRUs, for example, ended up offering each of its unhappy customers a $100 store coupon as compensation. Despite its generous gift, over 40 percent of the unhappy ToysRUs customers said they would not shop online at ToysRUs again (Conlin, 2000).

These and similar problems create the need for innovative solutions. For example, during the oil crises in the 1970s, Ryder Systems, a large trucking company, purchased a refinery to control the upstream of the supply chain and ensure availability of gasoline for its trucks. Such vertical integration is effective in some cases but ineffective in others. (Ryder later sold the refinery.) In the remaining portion of this section we will look closely at some of the major problems in managing supply chains and at some possible solutions, many of which are supported by IT.

Sources and Symptoms of Supply Chain Problems. Problems along the supply chain stem mainly from two sources: (1) from uncertainties, and (2) from the need to coordinate several activities, internal units, and business partners.
A major source of supply chain uncertainties is the demand forecast, as demonstrated by the 1999 toy season. The demand forecast may be influenced by several factors such as competition, prices, weather conditions, technological development, and customers' general confidence. Other supply chain uncertainties exist in delivery times, which depend on many factors, ranging from machine failures to road conditions and traffic jams that may interfere with shipments. Quality problems of materials and parts may also create production delays.

A major symptom of ineffective SCM is poor customer service, which hinders people or businesses from getting products or services when and where needed, or gives them poor-quality products. Other symptoms are high inventory costs, loss of revenues, extra cost of expediting shipments, and more. One of the most persistent SCM problems related to uncertainty is known as the bullwhip effect.

**THE BULLWHIP EFFECT.** The bullwhip effect refers to erratic shifts in orders up and down the supply chain (see Donovan, 2002/2003). This effect was initially observed by Procter & Gamble (P&G) with its disposable diapers product, Pampers. While actual sales in retail stores were fairly stable and predictable, orders from distributors to P&G (the manufacturer) had wild swings, creating production and inventory problems. An investigation revealed that distributors’ orders were fluctuating because of poor demand forecasting, price fluctuation, order batching, and rationing within the supply chain. All this resulted in unnecessary and costly inventories in various areas along the supply chain, fluctuations of P&G orders to their suppliers, and flow of inaccurate information. Distorted information can lead to tremendous inefficiencies, excessive inventories, poor customer service, lost revenues, ineffective shipments, and missed production schedules (Donovan, 2002/2003).

The bullwhip effect is not unique to P&G. Firms ranging from Hewlett-Packard in the computer industry to Bristol-Myers Squibb in the pharmaceutical field, have experienced a similar phenomenon (see Shain and Robinson, 2002). Basically, even slight demand uncertainties and variabilities 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 simultaneously occurring at as many as seven or eight places along the supply chain, leading in some cases to as many as 100 days of inventory—which is waiting, “just in case.” (versus 10–20 days’ inventory in the normal case).

A 1998 industry study projected that $30 billion in savings could materialize in the grocery industry supply chains alone through sharing information and collaborating. Thus, companies are trying to avoid the “sting of the bullwhip,” as well as to solve other SCM problems.

**SOLVING THE BULLWHIP PROBLEM.** A common way to solve the bullwhip problem is by sharing information along the supply chain (e.g., see Reddy, 2001). Such sharing can be facilitated by EDI, extranets, and groupware technologies. Information sharing among supply chain partners is part of interorganizational EC or e-commerce (Chapters 4 and 5), and is sometimes referred to as the collaboration supply chain (see Simatupang and Sridharan, 2002).

One of the most notable examples of information sharing is between Procter & Gamble and Wal-Mart. Wal-Mart provides P&G access to sales information for every item P&G supplies to Wal-Mart, everyday in every store. With that
information, P&G is able to manage the inventory replenishment for Wal-Mart. By monitoring inventory levels, P&G knows when inventories fall below the threshold for each product at any Wal-Mart store. This automatically triggers an immediate shipment. All this is part of a vendor-managed inventory (VMI) strategy. The benefit of the strategy for P&G is accurate and timely demand information. P&G has similar agreements with other major retailers. Thus, P&G can plan production more accurately, minimizing the “bullwhip effect.” P&G deployed in 2000 a Web-based “Ultimate-Supply System,” which replaced 4,000 different EDI links to suppliers and retailers in a more cost-effective way. Later on we will show how Warner-Lambert and other manufacturers are doing similar information sharing with wholesalers and retailers in order to solve the bullwhip effect and other supply problems.

OPTIMIZING INVENTORY LEVELS. Over the years organizations have developed many solutions to the supply chain problems. Undoubtedly, the most common solution used by companies is building inventories as an “insurance” against supply chain uncertainties. This way products and parts flow smoothly through the production process.

The main problem with this approach is that it is very difficult to correctly determine inventory levels for each product and part. If inventory levels are set too high, the cost of keeping the inventory will be very large. If the inventory is too low, there is no insurance against high demand or slow delivery times, and revenues (and customers) may be lost. In either event the total cost, including cost of keeping inventories, cost of lost sales opportunities, and bad reputation, can be very high. Thus, companies make major attempts to control and optimize inventory levels, as shown in the IT At Work 8.1.

SUPPLY CHAIN COORDINATION AND COLLABORATION. Proper supply chain and inventory management requires coordination of all different activities and links of the supply chain. Successful coordination enables goods to move smoothly and on time from suppliers to manufacturers to customers, which enables a firm to keep inventories low and costs down. Such coordination is needed since companies depend on each other but do not always work together toward the same goal.

As part of the coordination effort, business partners must learn to trust each other. The lack of trust is a major inhibitor of collaboration. Gibbons-Paul (2003) reports that 75 percent of senior IT managers cited the lack of trust as number one barrier to electronic collaboration. To overcome this problem Gibbons-Paul offers six strategies. One strategy, for example, is that both suppliers and buyers must participate together in the design or redesign of the supply chain to achieve their shared goals.

To properly control the uncertainties mentioned earlier, it is necessary to identify and understand their causes, determine how uncertainties in some activities will affect other activities, up and down the supply chain, and then formulate specific ways to reduce or eliminate the uncertainties. Combined with this is the need for an effective and efficient communication and collaboration environments among all business partners (see Chapter 4). A rapid flow of information along the supply chains makes them very efficient. For example, computerized point-of-sale (POS) information can be transmitted once a day, or even in real time, to distribution centers, suppliers, and shippers. (Recall the Dell case, in Chapter 2.)
8.2 SUPPLY CHAIN PROBLEMS AND SOLUTIONS

SUPPLY CHAIN TEAMS. The change of the linear supply chain to a hub (Chapters 1 and 5) shows the need for the creation of supply chain teams at times. According to Epner (1999), a supply chain team is a group of tightly integrated businesses that work together to serve the customer. Each task is done by the member of the team who is best positioned, trained, and capable of doing that specific task. For example, the team member that deals with the delivery will handle a delivery problem even if he or she works for a delivery company rather than for the retailer whose product is being delivered. This way, redundancies will be minimized. If the customer contacts the delivery company about a delivery problem, that specific employee will be dealt with, rather than passing the problem along to the retailer, and the retailer will not have to spend valuable resources following up on the delivery. The task assignment to team members as well as the team’s control is facilitated by IT tools such as workflow software and groupware (see Chapter 4).

PERFORMANCE MEASUREMENT AND METRICS. Measuring the supply chain performance is necessary for making decisions about supply chain improvements. IT provides for the data collection needed for such measurement. Some potential metrics for supply chain operations are: on-time delivery (%), quality

IT At Work 8.1
HOW LITTLEWOODS STORES IMPROVED ITS SCM

Littlewoods Stores (littlewoods.co.uk) is one of Britain’s largest retailers of high-quality clothing. It has about 140 stores around the U.K. and Northern Ireland. The retail clothing business is very competitive, and every problem can be expensive. A serious supply chain problem for the company was overstocking. So in the late 1990s the company embarked on an IT-supported initiative to improve its supply chain efficiency.

In order to better manage the supply chain, the company introduced a Web-based performance reporting system, using SCM software. The new system analyzes, on a daily basis, inventory, marketing and finance data, space allocation, merchandising, and sales data. For example, merchandising personnel can now perform sophisticated sales, stock, and supplier analyses to make key operational decisions on pricing and inventory. Using the Web, analysts can view sales and stock data in virtually any grouping of levels and categories. Furthermore, users can easily drill down to detailed sales and to access other data.

The system also uses a data warehouse-based decision support system and other end-user-oriented software, to make better decisions. The savings have been dramatic: The cost of buying and holding backup inventory was cut by about $4 million a year. For example, due to quicker replenishment, stock went down by 80 percent. In addition, reducing the need for stock liquidations that resulted from too high inventories saved Littlewoods $1.4 million each year. The ability to strategically price merchandise differently in different stores and improved communication and delivery abilities among stores saved another $1.2 million each year. Marketing distribution expenses were cut by $7 million a year, due to collaboration among sales, warehouses, suppliers and deliveries. And, finally, the company was able to reduce inventory and logistics-related staff from 84 to 49 people, a saving of about $1 million annually.

Within a year the number of Web-based users of the system grew to 600, and the size of the data warehouse grew to over 1 gigabyte. In November 1999 the company launched its Online Home Shopping Channel (shop-i.co.uk) and other e-commerce projects. Further improvements in SCM were recorded as of fall 2000.

Sources: Compiled from microstrategy.com (site accessed January 2000, Customers’ Success Stories), and from littlewoods.co.uk (site accessed March 25, 2003).

For Further Exploration: Explain how integrated software solved the excess inventory problem. Also, review the role of data warehouse decision support in this case.
at unloading area (number of defects), cost performance, lead time for procurement, inventory levels (or days of turning an inventory), shrinkage (%), obsolescence (% of inventory), cost of maintaining inventory, speed of finding needed items in the storeroom, availability of items when needed (%), the percentage of rush orders, percentage of goods returned, and a customers’ complaints rate.

Establishing such metrics and tracking them with business partners is critical to the success of one’s business. Companies that use such measures have the needed data to minimize supply chain problems. For a comprehensive discussion of metrics see Sterne (2002) and Bayles (2001).

OTHER IT-ASSISTED SOLUTIONS TO SCM PROBLEMS. Here are some other generic IT-assisted solutions to solve SCM problems:

- Use wireless technology to expedite certain tasks in the supply chain (e.g., vehicle location and sales force automation; see Chapter 6).
- Configure optimal shipping plans. Use quantitative analysis, DSS, and intelligent systems for the configuration. (See Keskinocak and Tayur, 2001.)
- Create strategic partnerships with suppliers. Use DSS to determine which partnerships, and which suppliers to use.
- Use the just-in-time approach, in which suppliers deliver small quantities whenever supplies, materials, and parts are needed.
- Use outsourcing rather than do-it-yourself especially during demand peaks. Use DSS models to decide what and when to outsource.
- Similarly, buy rather than make production inputs whenever appropriate. Use DSS to make appropriate decisions.
- Reduce the lead time for buying and selling by proper planning. Use business intelligence models.
- Use fewer suppliers. Use business intelligence models to decide on how many and which suppliers.
- Improve supplier-buyer relationships by using CRM and PRM software solutions.
- Manufacture only after orders are in, as Dell does with its custom-made computers and servers.
- Achieve accurate demand by working closely with suppliers, using online collaboration tools (Chapter 4).
- Automate materials flow, information flow, and partner relationships (Viswanadham, 2002).

For more specific IT solutions, see Table 8.1 and Kumar (2001).

Large companies, such as Dell Computer, employ several methods to achieve supply-chain superiority (see IT At Work 3.4 and Online Minicase W8.1). Wal-Mart is another company that is well-known for its ability to combine information from companies across its supply chain, with demand inventory data from its stores, to minimize operating cost and reduce prices. This requires lots of collaboration with business partners. Nestlé USA, for example, created a vice-president-level position exclusively to manage business with Wal-Mart (Worthen, 2002). For a comprehensive example of global
supply chain improvements at another large company, John Deere, see Nelson (2002).

### Table 8.1 IT Solutions to Supply Chain Problems

<table>
<thead>
<tr>
<th>Supply Chain Problem</th>
<th>IT Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear sequence of processing is too slow.</td>
<td>Parallel processing, using workflow software.</td>
</tr>
<tr>
<td>Waiting times between chain segments are excessive.</td>
<td>Identify reason (DSS software) and expedite communication and collaboration (intranets, groupware).</td>
</tr>
<tr>
<td>Existence of non-value-added activities.</td>
<td>Value analysis (SCM software), simulation software.</td>
</tr>
<tr>
<td>Slow delivery of paper documents.</td>
<td>Electronic documents and communication system (e.g., EDI, e-mail).</td>
</tr>
<tr>
<td>Repeat process activities due to wrong shipments, poor quality, etc.</td>
<td>Electronic verifications (software agents), automation; eliminating human errors, electronic control systems.</td>
</tr>
<tr>
<td>Batching: accumulate work orders between supply chain processes to get economies of scale (e.g., save on delivery).</td>
<td>SCM software analysis, digitize documents for online delivery.</td>
</tr>
<tr>
<td>Learn about delays after they occur, or learn too late.</td>
<td>Tracking systems, anticipate delays, trend analysis, early detection (intelligent systems).</td>
</tr>
<tr>
<td>Excessive administrative controls such as approvals (signatures). Approvers are in different locations.</td>
<td>Parallel approvals (workflow), electronic approval system. Analysis of need.</td>
</tr>
<tr>
<td>Lack of information, or too-slow flow.</td>
<td>Internet/intranet, software agents for monitoring and alert. Bar codes, direct flow from POS terminals.</td>
</tr>
<tr>
<td>Poor coordination, cooperation, and communication.</td>
<td>Groupware products, constant monitoring, alerts, collaboration tools.</td>
</tr>
<tr>
<td>Delays in shipments from warehouses.</td>
<td>Use robots in warehouses, use warehouse management software.</td>
</tr>
<tr>
<td>Redundancies in the supply chain. Too many purchasing orders, too much handling and packaging.</td>
<td>Information sharing via the Web, creating teams of collaborative partners supported by IT (see Epner, 1999).</td>
</tr>
<tr>
<td>Obsolescence of parts and components that stay too long in storage.</td>
<td>Reducing inventory levels by information sharing internally and externally, using intranets and groupware.</td>
</tr>
<tr>
<td>Scheduling problems, manufacturing lack of control.</td>
<td>Intelligent agents for B2B modeling (see gensym.com).</td>
</tr>
</tbody>
</table>

8.3 **Computerized Systems: MRP, MRPII, SCM, and Integration**

The concept of the supply chain is interrelated with the computerization of its activities, which has evolved over 50 years. Historically, many of the supply chain activities were managed with paper transactions, which can be very inefficient. Therefore, since the time when computers first began to be used for business, people have wanted to automate the processes along the supply chain.

The first software programs, which appeared in the 1950s and early 1960s, supported short segments along the supply chain. Typical examples are inventory management systems, scheduling, and billing. The supporting software
was called supply chain management (SCM) software. The major objectives were to reduce cost, expedite processing, and reduce errors. Such applications were developed in the functional areas, independent of each other, and they became more and more sophisticated with the passage of time (as was shown in Chapter 7). Of special interest were transaction processing systems and decision support procedures such as management science optimization and financial decision-making formulas (e.g., for loan amortization).

In a short time it became clear that interdependencies exist among some of the supply chain activities. One early realization was that production scheduling is related to inventory management and purchasing plans. As early as the 1960s, the material requirements planning (MRP) model was devised. This model essentially integrates production, purchasing, and inventory management of interrelated products (see Chapter 7). It became clear that computer support could greatly enhance use of this model, which may require daily updating. This resulted in commercial MRP software packages coming on the market.

While MRP packages were and still are useful in many cases, helping to drive inventory levels down and streamlining portions of the supply chain, they failed in as many (or even more) cases. One of the major reasons for the failure was the realization that schedule-inventory-purchasing operations are closely related to both financial and labor resources, which were not represented in MRP packages. This realization resulted in an enhanced MRP methodology (and software) called manufacturing resource planning (MRP II), which adds labor requirements and financial planning to MRP (see Sheikh, 2002).

During this evolution there was more and more integration of functional information systems. This evolution continued, leading to the enterprise resource planning (ERP) concept, which integrates the transaction processing and other routine activities of all functional areas in the entire enterprise. ERP initially covered all routine transactions within a company, including internal suppliers and customers, but later it was expended to incorporate external suppliers and customers in what is known as extended ERP software. A typical ERP includes dozens of integrated modules, in all functional areas; a listing of typical modules can be viewed in Online File W8.2 at our Web site. We’ll look at ERP, which is also known as an enterprise software, again in a bit more detail later in this section.

The next step in this evolution, which started in the late 1990s, is the inclusion of business intelligence and other application software (such as CRM software). At the beginning of the twenty-first century, the integration expanded to include entire industries and the general business community. (See mySAP.com for details.) This evolution of integrated systems is shown in Figure 8.2.

Notice that throughout this evolution there have been more and more integrations along several dimensions (more functional areas, combining transaction processing and decision support, inclusion of business partners). Therefore, before we describe the essentials of ERP and SCM software it may be beneficial to analyze the reasons for software and activities integration.

**Systems Integration**

Creating the twenty-first-century enterprise cannot be done effectively with twentieth-century computer technology, which is functionally oriented. Functional systems may not let different departments communicate with each other in the same language. Worse yet, crucial sales, inventory, and production data
often have to be painstakingly entered manually into separate computer systems every time a person who is not a member of a specific department needs ad hoc information related to the specific department. In many cases employees simply do not get the information they need, or they get it too late.

Sandoe et al. (2001) list the following major benefits of systems integration (in declining order of importance):

- **Tangible benefits:** inventory reduction, personnel reduction, productivity improvement, order management improvement, financial-close cycle improvements, IT cost reduction, procurement cost reduction, cash management improvements, revenue/profit increases, transportation logistics cost reduction, maintenance reduction, and on-time delivery improvement.
- **Intangible benefits:** information visibility, new/improved processes, customer responsiveness, standardization, flexibility, globalization, and business performance.

Notice that many of both the tangible and intangible benefits cited above are directly related to improved supply chain management.

Integration of the links in the supply chain has been facilitated by the need to streamline operations in order to meet customer demands in the areas of product and service cost, quality, delivery, technology, and cycle time brought by increased global competition. Furthermore, new forms of organizational relationships and the information revolution, especially the Internet and e-commerce, have brought SCM to the forefront of management attention. Upper-level management has therefore been willing to invest money in hardware and software that are needed for seamless integration.

For further discussion of the improvements that integration provides to SCM, see Novell.com (look for Novell Nterprise).
TYPES OF INTEGRATION: FROM SUPPLY TO VALUE CHAIN. There are two basic types of systems integration: internal and external. Internal integration refers to integration between applications, and or between applications and databases, inside a company. For example, one may integrate the inventory control with an ordering system, or a CRM suite with the database of customers.

External integration refers to integration of applications and/or databases among business partners. An example of this is the suppliers’ catalogs with the buyers’ e-procurement system. External integration is especially needed for B2B and for partner relationship management (PRM) systems (Section 8.6). The most obvious external integration is that of linking the segments of the supply chain, and/or connecting the information that flows among the segments. We discussed this topic earlier and will discuss it further in this chapter.

But there is another type of integration, and this is the integration of the value chain. Traditionally, we thought of supply chain in terms of purchasing, transportation, warehousing, and logistics. The integrated value chain is a more encompassing concept. It is the process by which multiple enterprises within a shared market channel collaboratively plan, implement, and (electronically as well as physically) manage the flow of goods, services, and information along the entire chain in a manner that increases customer-perceived value. This process optimizes the efficiency of the chain, creating competitive advantage for all stakeholders in the value chain. Whereas the supply chain is basically a description of flows and activities, the value chain expresses the contributions made by various segments and activities both to the profit and to customers’ satisfaction. (For a survey see Drickhamer, 2002.)

Another way of defining value chain integration is as a process of collaboration that optimizes all internal and external activities involved in delivering greater perceived value to the ultimate customer. A supply chain transforms into an integrated value chain when it does the following:

- Extends the chain all the way from subsuppliers (tier 2, 3, etc.) to customers
- Integrates back-office operations with those of the front office (see Figure 8.3)
- Becomes highly customer-centric, focusing on demand generation and customer service as well as demand fulfillment and logistics
- Seeks to optimize the value added by information and utility-enhancing services

![Value is added](image-url)
● Is proactively designed by chain members to compete as an “extended enterprise,” creating and enhancing customer-perceived value by means of cross-enterprise collaboration

**Collaboration Along the Supply Chain**

Presently only a few large companies are successfully involved in a comprehensive collaboration to restructure the supply and value chains. One such effort is described in *IT At Work 8.2.*

For a special report on supply chain collaboration, see ASCET (2000), where such collaboration is called **collaborative commerce networks** or simply **collaborative commerce** (see Chapter 4 and 5).

Another example of supply chain collaboration that requires system integration is product-development systems that allow suppliers to dial into a client’s intranet, pull product specifications, and view illustrations and videos of a manufacturing process. (For further discussion, see Selland, 1999a and 1999b; and Hagel, 2002).

A popular solution to the integration problems in large companies is to use integrated application, in what is known as enterprise resource planning.

## 8.4 ENTERPRISE RESOURCE PLANNING (ERP)

One of the most successful tools for managing supply chains is enterprise resource planning (ERP). ERP systems are in use in thousands of large and medium companies worldwide. As this section will show, some ERP systems are producing dramatic results (see erpassist.com).

### What Is ERP?

With the advance of enterprisewide client/server computing comes a new challenge: how to control all major business processes with a single software architecture in real time. Such an integrated software solution, known as **enterprise resource planning (ERP)** or just **enterprise systems**, is a process of planning and managing all resources and their use in the entire enterprise. It is a software comprised of a set of applications that automate routine back-end operations, such as financial, inventory management, and scheduling, to help enterprises handle jobs such as order fulfillment (see O’Leary, 2000). For example, in an ERP system there is a module for cost control, for accounts payable and receivable, for fixed assets and treasury management. ERP promises benefits ranging from increased efficiency to improved quality, productivity, and profitability. (See Ragowsky and Somers, 2002, for details.)

The term **enterprise resource planning** is misleading because the software does not concentrate on either planning or resources. ERP’s major objective is to integrate all departments and functions across a company onto a single computer system that can serve all of the enterprise’s needs (see Stratman and Roth, 2002). For example, improved order entry allows immediate access to inventory, product data, customer credit history, and prior order information. This availability of information raises productivity and increases customer satisfaction. ERP, for example, helped Master Product Company increase customers’ satisfaction and, consequently, sales by 20 percent and decrease inventory by 30 percent, thus increasing productivity (Caldwell, 1997).

For businesses that want to use ERP, one option is to self-develop an integrated system by using existing functional packages or by programming one’s own systems. The other option is to use commercially available integrated ERP systems.
CHAPTER 8  SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

The leading ERP software is **SAP R/3**. Oracle, J.D. Edwards, Computer Associates, and PeopleSoft also make similar products. These products include Web modules.

Another alternative is to lease systems from **application service providers (ASPs)**. This option is described later in this chapter and at length in Chapters 13 and 14. A major advantage of this approach is that even a small company can enjoy ERP since users can lease only the modules they need, rather than buying the entire package. Some ERP vendors are willing now (2003) to sell only relevant modules.

An ERP suite provides a single interface for managing all the routine activities performed in manufacturing—from entering sales orders, to coordinating shipping, to after-sales customer service. As of the late 1990s, ERP systems were extended along the supply chain to suppliers and customers. They can incorporate functionality for customer interaction and for managing relationships with suppliers and vendors, making the system less inward-looking.

Large companies have been successful in integrating several hundred applications using ERP software, saving millions of dollars and significantly increasing...
into parts, giving manufacturers, suppliers, distributors, and retailers a framework within which to evaluate the effectiveness of their processes along the same supply chains.

For Further Exploration: Why would Listerine have been a target for the pilot CPFR collaboration? For what industries, besides retailing, would such collaboration be beneficial?

In whatever form it is implemented, ERP has played a critical role in getting manufacturers to focus on business processes, thus facilitating business process changes across the enterprise. By tying together multiple plants and distribution facilities, ERP solutions have also facilitated a change in thinking that has its ultimate expression in an enterprise that is better able to expand operations and in better supply chain management. (For a comprehensive treatment of ERP, its cost, implementation problems, and payback, see Koch et al., 1999; James and Wolfe, 2000; Jacobs and Whybark, 2000; and Lucas and Bishop, 2001. Palaniswamy and Frank (2002) describe positive results of Oracle ERP and discuss its implementation process. But ERP originally was never meant to fully support supply chains. ERP solutions are centered on business transactions. As such, they do not provide the computerized models needed to respond rapidly to real-time changes in supply, demand, labor, or capacity, nor to be effectively integrated with e-commerce. This deficiency has been overcome by the second generation of ERP.

First-generation ERP aimed at automating routine business transactions. And indeed ERP projects do save companies millions of dollars. A report by Merrill Lynch noted that nearly 40 percent of all U.S. companies with more than $1 billion in annual revenues have implemented ERP systems. However, by the late 1990s the major benefits of ERP had been fully exploited. It became clear that with the completion of the Y2K projects that were an integral part of many ERP implementations, the first generation of ERP was nearing the end of its useful life.

But the ERP movement was far from over. A second, more powerful generation of ERP development started. Its objective is to leverage existing systems in order to increase efficiency in handling transactions, improve decision making, and further transform ways of doing business into e-commerce. (See James and Wolf, 2000.) Let’s explain:

The first generation of ERP has traditionally excelled in its ability to manage administrative activities like payroll, inventory, and order processing. For example, an ERP system has the functionality of electronic ordering or the best way to bill the customer—but all it does is automate the transactions. Palaniswamy and Frank (2000) cite five case studies indicating that ERP significantly enhances the performance of manufacturing organizations as a result of automating transactions.

The reports generated by first-generation ERP systems gave planners statistics about what happened in the company, costs, and financial performance. However, the planning systems with ERP were rudimentary. Reports from first-generation ERP systems provided a snapshot of the business at a point in time. But they did not support the continuous planning that is central to supply chain planning, which continues to refine and enhance the plan as changes and events occur, up to the very last minute before executing the plan. Attempting to come up with an optimal plan using first-generation ERP-based systems has been compared to steering a car by looking in the rear-view mirror. Therefore, the need existed for planning systems oriented toward decision making. As discussed in A Closer Look 8.1, SCM software vendors set out to meet this need.

From the list of the solutions in A Closer Look 8.1, it is clear that SCM differs from ERP, and companies need both of them, as illustrated next.

COMBINING ERP WITH SCM-SOFTWARE. To illustrate how ERP and SCM may work together, despite their fundamentally different approaches, let’s look at the
**A CLOSER LOOK**

### 8.1 SCM SOFTWARE VERSUS ERP SOFTWARE

**SCM software** refers to software specifically designed to improve decision making along the supply chain, such as what is the best way to ship to your customer, or what is the optional production plan inside your own manufacturing system. This decision-making focus is in contrast with **ERP software**, which streamlines the flow of routine information along the supply chain (such as order taking, inventory levels reporting, or sales data). Data collected by ERP system are frequently used as input data for analysis done with ERP software (Latamore, 2000).

To better understand the differences between SCM software and ERP software, let’s look at the functionalities of products offered by two SCM vendors, i2 and Manugistics.

**i2’s Optimization Solutions.** The i2 Corporation (i2.com) offers a set of five integrated optimization solutions, which are shown in the upper part of the attached figure (shown between “Suppliers” and “Customers”). Notice that all are SCM optimization tools, to help with decision making: For example, logistics optimization enables companies to procure, plan, execute, and monitor freight movements across multiple modes, borders, and enterprises. Optimization is usually built on DSS models, such as linear programming and simulation, as well on other analytical tools (see Chapter 11 and 12).

**Manugistics Supply Chain Management Solutions.** Manugistics offers the following integrated solution suites:

- Network design and optimization
- Manufacturing planning and scheduling
- Sales and operations planning
- Order fulfillment management
- Collaborative VMI and CPFR
- Private Trading Intelligent Hub (for external integration)
- Service and parts management
- Logistics management
- Profitable Order Management
- Profitable Demand Management
- Enterprise Profit Optimization

Each suite has several applications (see manugistics.com).
task of order processing: The ERP approach is, “How can I best take or fulfill your order?” In contrast, the question for SCM software is, “Should I take your order?” The SCM and ERP software are actually information systems and will be referred to as such.

Thus, the analytical SCM systems have emerged as a complement to ERP systems, to provide intelligent decision support or business intelligence capabilities (e.g., see Keskinocak and Tayur, 2001). An SCM system is designed to overlay existing systems and to pull data from every step of the supply chain. Thus it is able to provide a clear, global picture of where the enterprise is heading.

An example of a successful SCM effort is that of IBM. IBM has restructured its global supply chain in order to achieve quick responsiveness to customers and to do so with minimal inventory. To support this effort, IBM developed an extended-enterprise supply-chain analysis tool, called the Asset Management Tool (AMT). AMT integrates graphical process modeling, analytical performance optimization, simulation, activity-based costing, and enterprise database connectivity into a system that allows quantitative analysis of inter-enterprise supply chains. IBM has used AMT to analyze and improve such issues as inventory budgets, turnover objectives, customer-service targets, and new-product introductions. The system was implemented at a number of IBM business units and their channel partners. AMT benefits include savings of over $750 million in materials costs and price-protection expenses each year. (For details, see Yao et al., 2000.) The system was also a prerequisite to a major e-procurement initiative at IBM.

Creating an ERP/SCM integration model allows companies to quickly assess the impact of their actions on the entire supply chain, including customer demand. Therefore, it makes sense to integrate ERP and SCM.

**ALTERNATIVE WAYS TO INTEGRATE ERP WITH SCM.** How is integration of ERP with SCM done? One approach is to work with different software products from different vendors. For example, a business might use SAP as an ERP and add to it Manugistics’ manufacturing-oriented SCM software, as shown in the Warner-Lambert (Pfizer) case. Such an approach requires fitting different software, which may be a complex task unless special interfaces known as “adapters” and provided by middleware vendors exist (see Linthicum, 1999).

The second integration approach is for ERP vendors to add decision support and analysis capabilities. Collectively, these capabilities are known as business intelligence. **Business intelligence** refers to analysis performed by DSS, ESS, data mining, and intelligent systems (see Chapters 2, 11, and 12). Using one vendor and a combined product solves the integration problem. However, most ERP vendors offer such functionalities for another reason: It is cheaper for the customers. The added functionalities, which create the second-generation ERP, include not only decision support but also CRM, electronic commerce (Section 8.5), and data warehousing and mining (Chapter 11). Some systems include a knowledge management component (Chapter 10) as well. In 2003, vendors started to add product life cycle management (PLM, Chapter 7) in an attempt to optimize the supply chain (Hill, 2003).

An example of an ERP application that includes an SCM module is provided in **IT At Work 8.3**.

The inclusion of business intelligence in supply chain software solutions is called by some **supply chain intelligence (SCI)**. SCI applications enable
8.4 ENTERPRISE RESOURCE PLANNING (ERP)

IT At Work 8.3
COLGATE-PALMOLIVE USES ERP TO SMOOTH ITS SUPPLY CHAIN

Colgate-Palmolive is the world leader in oral-care products (mouthwashes, toothpaste, and toothbrushes) and a major supplier of personal-care products (baby care, deodorants, shampoos, and soaps). In addition, the company’s Hill’s Health Science Diet is a leading pet-food brand worldwide. Foreign sales account for about 70 percent of Colgate’s total revenues.

To stay competitive, Colgate continuously seeks to streamline its supply chain, where thousands of suppliers and customers interact with the company. At the same time, Colgate faces the challenges of new-product acceleration, which has been a factor in driving faster sales growth and improved market share. Also, Colgate is devising ways to offer consumers a greater choice of better products at a lower cost to the company, which creates complexities in the manufacturing and the supply chains. To better manage and coordinate its business, Colgate embarked on an ERP implementation to allow the company to access more timely and accurate data and to reduce costs. The structure of the ERP is shown in the attached figure.

An important factor for Colgate was whether it could use the ERP software across the entire spectrum of the business. Colgate needed the ability to coordinate globally but to act locally. Colgate’s U.S. division installed SAP R/3 for this purpose.

Source: Compiled from Kalakota and Robinson (2001).

For Further Exploration: What is the role of the ERP for Colgate-Palmolive? Who are the major beneficiaries?

Strategic decision making by analyzing data along the entire supply chain. This so-called intelligence is provided by the tools and capabilities discussed in Chapters 11 and 12. A comparison of SCI with SCM is provided in Online File W8.3.

HOW ARE SCI CAPABILITIES PROVIDED? The following are common ways to provide SCI capabilities:

- Use an enhanced ERP package that includes business intelligence capabilities. For example, see Oracle and SAP products of 2001 or later.
- Integrate the ERP with business intelligence software from a specialized vendor, such as Brio, Cognus, or Information Builders, or Business Objects.
A CLOSER LOOK
8.2 EVEN THE BEST-PLANNED ERP SOMETIMES FAILS

The complexity of ERP projects causes some of them to fail. Here are several examples:

**EXAMPLE 1.** Hershey’s chocolate bars and its other products were not selling well in late 1999. Hershey Foods Corporation (hersheys.com) reported a 19 percent drop in third-quarter net earnings, due to computer problems. The problems continued for several months, causing Hershey to lose market share and several hundred million dollars. The major problem, according to the company, was its new order-and-distribution system, which uses software from both SAP (the ERP) and Siebel Systems (the CRM). Since the integrated system went live in July 1999, Hershey had been unable to fill all orders and get products onto shelves on time. It took many months to fix the problem.

**EXAMPLE 2.** In November 1999, Whirlpool Corp. (whirlpool.com) reported major delays in shipment of appliances due to “bugs” in its new ERP. Orders for quantities smaller than one truckload met with snags in the areas of order processing, tracking, and invoicing. According to Collett (1999), SAP gave Whirlpool a red light twice prior to the date on which the project would go live, saying the supply chain was not ready, but Whirlpool ignored the signals.

**EXAMPLE 3.** FoxMeyer, a major distributor of prescription drugs to hospitals and pharmacies, which filed for bankruptcy in 1996. In August 2001, FoxMeyer sued both SAP and Accenture Consulting for $500 million each, claiming that the ERP system they constructed led to its demise. Many customers sued FoxMeyer as well. All cases are still pending (May 2003). For the complete case, see Online File W8.4 at the book’s Web site.

**EXAMPLE 4.** W.L. Gore and Associates (gore.com), a multinational manufacturer of industrial products, filed a lawsuit against PeopleSoft and Deloitte & Touche, because the ERP project that the two companies developed for the company cost twice the original estimate. Note: In both the FoxMeyer and the W.L. Gore cases, the ERP vendors and consultants blamed their clients’ poor management teams for the ERP problems. Both cases were in court at the time this was written.

Sources: Compiled Davenport, (2000); cnet.com; cio.com; and Business Courier (miscellaneous dates).

- Use Web services (see Chapter 14).
- Create a best-of-breed system by using components from several vendors that will provide the required capabilities. (For component-based application development, see Chapter 14.)

**ERP Failures and Justification**

Despite improvements such as second-generation ERP and supply chain intelligence, ERP projects, especially large ones, may fail, as shown in the Nike case of Chapter 1. A Closer Look 8.2 discusses some additional examples of ERP failures.

In order to avoid failures and ensure success, according to thespot4sap.com, it is necessary for the partners involved in ERP implementation to hold open and honest dialogue at the start of each project, and to nail down the critical success factors of the implementation. Included in this initial dialogue should be consideration of the following factors: the customer’s expectations; the ERP product capabilities and limitations; the level of change the customer has to go through to make the system fit; the level of commitment within the customer’s organization to see the project through to completion; the risks presented by politics within the organization, and (if applicable) the implementing consultant’s capabilities, responsibilities, and role.

Various other considerations can affect the success or failure of an ERP project. For example, failures can be minimized if appropriate cost-benefit and cost justification is done in advance (Oliver and Romm, 2002; O’Brien, 2002; and
As noted above, a popular option today for businesses that need ERP functions is to lease applications rather than to build systems. An application service provider (ASP) is a software vendor that offers to lease applications to businesses. In leasing applications, the vendor takes care of the functionalities and the internal integration problems. This approach is known as the “ASP alternative.” ASP is considered a risk-management strategy, and it best fits small- to midsize companies. (See Chapters 13 and 14 for further details.) The delivery of the software is usually done effectively via the Internet.

ASP offer ERP systems as well as ERP-added functions such as electronic commerce, CRM, desktop productivity, human resources information systems (HRISs), and other supply-chain-related applications.

The ASP concept is useful in ERP projects, which are expensive to install, take a long time to implement, and require additional staffing. Flexibility to the renter is a major benefit: you pay only for the ERP models used, and for a specific time period.

The use of an ASP has its downside. First, ASP vendors typically want a five-year commitment. Some companies may not want to lock themselves in for that long, reasoning that within five years ERP may be simplified and easier to implement in house. Second, organizations lose some flexibility with the use of an ASP. Rented systems are fairly standard and may not fit the organization’s specific needs. (For other benefits and limitations of ASPs, see Chapters 13 and 14 and Segev and Gebauer, 2001.)

8.5 E-COMMERCE AND SUPPLY CHAINS

E-commerce is emerging as a superb tool for providing solutions to problems along the supply chain. As seen earlier in this chapter and in Chapter 5, many supply chain activities, from taking customers’ orders to procurement, can be conducted as part of an EC initiative. In general, EC can make the following contributions to supply chain management:

1. EC can digitize some products, such as software, which expedites the flow of materials in the chain. It is also much cheaper to create and move electronic digits than physical products.

2. EC can replace all paper documents that move physically with electronic documents. This change improves speed and accuracy, and the cost of document transmission is much cheaper.

3. A single business transaction could involve many messages, totaling thousands of messages per week or even per day for a company. E-commerce can replace related faxes, telephone calls, and telegrams with an electronic messaging system at a minimal cost.

4. EC can change the nature and structure of the supply chain from linear to a hub (see the Orbis case in Chapter 1). Such restructuring enables faster, cheaper, and better communication, collaboration, and discovery of information.
CHAPTER 8  SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

5. EC enhances several of the activities discussed in the previous sections, such as collaboration and information sharing among the partners in the supply chain. These enhancements can improve cooperation, coordination, and demand forecasts.

6. EC typically shortens the supply chain and minimizes inventories. Production changes from mass production to build-to-order as a result of the “pull” nature of EC. The auto industry, for example, is expected to save billions of dollars annually in inventory reduction alone by moving to e-commerce-supported build-to-order strategy.

7. EC facilitates customer service. Of special interest is the reduced customer-service staffing needs due to innovations such as FAQs and self services such as self-tracking of shipments.

8. EC introduces efficiencies into buying and selling through the creation of e-marketplaces and e-procurement, as we saw in Chapter 5.

Let’s look now at some specific buying and selling activities along the supply chain.

A major role of EC is to facilitate buying and selling along all segments of the supply chain. The major activities are: upstream, internal supply chain activities, downstream, and combined upstream/downstream activities.

UPSTREAM ACTIVITIES. There are many innovative EC models that improve the upstream supply chain activities. These models are generally described as e-procurement. Several were presented in Chapter 5: reverse auctions, aggregation of vendors’ catalogs at the buyer’s site, procurement via consortia and group purchasing. (For others, see Mitchell, 2000; Adamson, 2001; and Varley, 2000.)

INTERNAL SUPPLY ACTIVITIES. Internal SCM activities include several intra-business EC activities. These activities, from entering orders of materials, to recording sales, to tracking shipments, are usually conducted over a corporate intranet. The ChevronTexaco case illustrates several EC internal applications. Details and examples are provided in Chapters 5 and 7.

DOWNSTREAM ACTIVITIES. Typical EC models of downstream supply chain activities are provided in Chapters 5 and 7. Some examples follow.

Selling on Your Own Web Site. Large companies such as Intel, Dell, Cisco, and IBM use this model. At the selling company’s Web site, buyers review electronic catalogs from which they buy. Large buyers get their own pages and customized catalogs. Companies sell their standard products from their corporate site, and many (e.g., Cisco, National Semiconductor Corp.) allow customers to configure customized products.

Auctions. As discussed in Chapter 5, large companies such as Dell conduct auctions of products or obsolete equipment on their Web sites. Electronic auctions can shorten cycle time and sometimes save on logistics expenses.

For example, in the United States more than 2.5 million “pre-owned” cars are sold in auctions. Many of these auctions are offered online, supplied by car rental companies, government agencies, banks, and some large organizations that replace their fleets frequently. One pure online B2B auctioneer, for example, is manheimauctions.com. The buyers are car dealers who then resell the cars...
to individuals. Traditional car auctions are done on large lots, where the cars are displayed and physically auctioned. In the electronic auction, the autos do not need to be transported to a physical auction site, nor do buyers have to travel to an auction site. Savings of up to $500 per car are realized as a result.

**Exchanges.** Considerable support to B2B supply chains can be provided by electronic exchanges (Chapter 5). Such exchanges are shown in Figure 8.4. Notice that in this example there are three separate exchanges. In other cases there may be only on exchange for the entire industry.

**UPSTREAM AND DOWNSTREAM ACTIVITIES COMBINED.** It is sometimes advisable to combine upstream and downstream EC supply chain activities. These can be done in **B2B exchanges**, where many buyers and sellers meet, as discussed in Chapter 5. Most of these exchanges are centered one in each industry, so they are referred to as **vertical exchanges**. A typical vertical portal is the one organized by ChemConnect. Similar markets exist for metals, electricity (which is sold among electricity-generating companies), and many commodities. Some vertical exchanges use auctions and reverse auctions, as described in Chapter 5.

In previous sections of this chapter we described how e-commerce can solve some problems of non-EC companies that are selling and buying in a traditional way along the supply chain. However, some applications of EC, especially B2C and sometimes B2B, may have problems with their own supply chains. These problems usually occur in order fulfillment. Examining the characteristics of EC supply chains will help us understand the problems and the potential solutions.
THE CHARACTERISTICS OF EC SUPPLY CHAINS. EC supply chains need to deliver small quantities to a very large number of customers. Also, it is very difficult to forecast demand due to lack of experience and to the fact that many vendors sell some or mostly customized products. New dot-com companies do not have any existing supply chain operations; they are “starting from scratch.” (Click-and-mortar companies, in contrast, have existing supply chains and so have a bit of a head start.)

When a company sells online direct to customers it must take care of the following activities: quickly find the products to be shipped, and pack them; arrange for the packages to be delivered quickly to the customer’s door; collect the money from every customer, either in advance, COD (collect on delivery), or by billing the individual; and handle the return of unwanted or defective products. It may be difficult to fulfill these activities both effectively and efficiently. For this reason, both online companies and click-and-mortar companies have difficulties in their online-related supply chains. Let’s begin by looking at order fulfillment.

ORDER FULFILLMENT. Order fulfillment refers not only to providing what customers ordered and doing it on time, but also to providing all related customer service. For example, the customer must receive assembly and operating instructions for the appliance he or she just purchased. This can be done by including a paper document with the product or by providing the instructions on the Web. (A nice example is available at livemanuals.com.) In addition, if the customer is not happy with a product, an exchange or return must be arranged. Thus, while order fulfillment is basically a part of the back-office operations, it is strongly related to front-office operations as well.

When dot-com operations were still quite new, e-tailers faced continuous problems with order fulfillment, especially during the holiday season. The problems included inability to deliver on time, delivering wrong items, paying too much for deliveries, and heavily compensating unhappy customers. Taking orders over the Internet for some e-tailers proved to be the easy part of B2C e-commerce. Fulfillment to customers’ doors was the harder part. The e-tailers who have survived have proved that they have learned from past mistakes and are learning how to solve their order fulfillment problems.

As a matter of fact, many e-tailers have experienced fulfillment problems since they started EC. Amazon.com, for example, which initially operated as a totally online company, added physical warehouses in order to expedite deliveries and reduce its order fulfillment costs. Woolworths of Australia, a large supermarket that added online services, had serious difficulties with order fulfillment and delivery of fresh foods, and had to completely restructure its delivery system.

Several factors can be responsible for delays in deliveries. They range from inability to accurately forecast demand, to ineffective supply chains of the e-tailers. Similar problems exist also in off-line businesses. However, one EC is more typically based on the concept of “pull” operations, which begin with an order, frequently a customized one. (This is in contrast with traditional retailing that begins with a production to inventory, which is then “pushed” to customers.) In the pull case, it is more difficult to forecast demand, due to unique demands of customized orders and lack of sufficient years of experience (see Appendix 3.1).

Another order fulfillment problem in e-commerce is that the goods need be delivered to the customer’s door, with small quantities to each customer, whereas in brick-and-mortar retailing, the customers come to the stores to get
the products. The costs of shipping merchandise can quickly add up, and many customers do not like to pay them.

**INNOVATIVE SOLUTIONS TO THE ORDER FULFILLMENT PROBLEM.** In the last few years companies have developed interesting solutions to both B2C and B2B order fulfillment (e.g., see Robb, 2003). Here are two examples:

- **Garden.com**, a retailer of plants and flowers, developed proprietary software that allowed it to collaborate with its 70 suppliers efficiently and effectively. Orders were batched and organized in such a way that pullers were able to find, pack, and deliver the plants and flowers efficiently. Customers were able to track the status of their orders in real time (Kaplan, 2002). However, despite its efficient supply chain, the company went out of business in December 2000 due to an insufficient number of customers.

- **SkyMall.com** (now a subsidiary of Gem-Star TV Guide International) is a retailer selling from catalogs on board of airplanes, over the Internet, and by mail order. It relies on catalog partners to fill the orders. For small vendors that do not handle their own shipments, and for international shipments, SkyMall contracts distribution centers owned by fulfillment outsourcer Sykes Enterprise. To coordinate the logistics of sending orders to thousands of customers, SkyMall uses an EC order management integrator called Order Trust. As orders come in, SkyMall conveys the data to Order Trust, which disseminates it to the appropriate vendor, or to a Sykes distribution center. A report is then sent to SkyMall, and SkyMall pays Order Trust the transaction fees. This arrangement has allowed SkyMall to increase its online business by 3 percent annually (skymall.com).

Despite these and many other innovative solutions (e.g., see Bayles, 2001; Johnston et al., 2000; Rigney, 2000), most e-tailers are choosing to outsource order fulfillment to avoid problems.

**OUTSOURCING ORDER FULFILLMENT.** A most common solution in B2C is to outsource the delivery and possibly other logistics activities to companies such as FedEx and UPS. Especially if customers pay directly for the delivery, this is a viable solution to the selling company, as described in *IT At Work 8.4*.

**SAME-DAY, EVEN SAME-HOUR DELIVERY.** In the digital age, next-morning delivery may not be fast enough. Today we talk about same-day delivery, and even delivery within an hour. Quick delivery of pizza has been practiced for a long time (e.g., by Domino’s Pizza). Today, pizza orders in many places are accepted online. Delivering groceries is another area where speed is important. An example is groceryworks (now part of shop.safeway.com).

Many restaurants also accept orders online, and approach known as “dine online.” Some companies (e.g., dialadinner.com.hk in Hong Kong) offer aggregating services, which process orders for several restaurants and also make the deliveries.

Here is how dine online works: Customers click on the online menu to indicate dishes they want (which sometimes can be mixed and matched from two or more restaurants), and they then submit their request electronically. Order processors at the aggregating company receive the order, and forward the orders electronically to the participating restaurants (faxes orders to those that do not use computers). (A staff member phones first-time customers to check appropriate
Bikeworld (San Antonio, Texas) is a small company (16 employees) known for its high-quality bicycles and components, expert advice, and personalized service. The company opened its Web site (bikeworld.com) in February 1996, using it as a way to keep customers from using out-of-state mail-order houses.

Bikeworld encountered one of Internet retailing’s biggest problems: fulfillment. Sales of its high-value bike accessories over the Internet steadily increased, including global markets, but the time spent processing orders, manually shipping packages, and responding to customers’ order status inquiries were overwhelming for the company. In order to focus on its core competency, Bikeworld decided to outsource its order fulfillment to FedEx. FedEx offered reasonably priced quality express delivery, exceeding customer expectations while automating the fulfillment process. “To go from a complete unknown to a reputable worldwide retailer was going to require more than a fair price. We set out to absolutely amaze our customers with unprecedented customer service. FedEx gave us the blinding speed we needed,” says Whit Snell, Bikeworld’s founder.

The nearby figure shows the five steps in the process. Explanations are provided in the figure.

Four years after venturing online, Bikeworld’s sales volume has more than quadrupled, and the company was on track to surpass $8 million in 2003. The company is consistently profitable; has a fully automated and scalable fulfillment system; has access to real-time order status, enhancing customer service and leading to greater customer retention; and has the global capacity to service customers.

Source: Compiled from FedEx (2000).

For Further Exploration: Is outsourcing the only alternative for a small business like Bikeworld? Why or why not? Why is logistics a critical success factor?
AUTOMATED WAREHOUSES. Traditional warehouses are built to deliver large quantities to a small number of stores and plants. In B2C EC, companies need to send small quantities to a large number of individuals. The picking and packing process therefore is different, and usually more labor-intensive.

Large-volume EC fulfillment requires special warehouses. Automated warehouses, for example, may include robots and other devices that expedite the pickup of products. Several e-tailers, such as Amazon.com, operate their own warehouses. Most B2C is probably shipped via outsourcers, mainly UPS, FedEx, and the U.S. Post Office. One of the largest EC warehouses in the United States was operated by a mail-order company, Fingerhut (fingerhut.com). This company handled the logistics of all types of mail orders (including online orders) for Wal-Mart, Macy’s, and many others. The company (now owned by Pettess Group LLC) temporarily suspended warehousing operation but is now back in operation; the process they use is described in Online File W8.5. A similar warehouse is operated by L. L. Bean, which ships up to 150,000 packages a day (El Sawy, 2001).

Other companies (e.g., submitorder.com) provide similar services. The key for all such services is speed and efficiency. Plumbing wholesaler Davis & Warshow uses several IT tools to enhance their newly constructed central warehouse as shown in Online File W8.6.

DEALING WITH RETURNS. Returning unwanted merchandise and providing for product exchanges or refunds are necessary activities for maintaining customers’ trust and loyalty. The Boston Consulting Group found that the “absence of good return mechanism” was the second-biggest reason shoppers cited for refusing to buy on the Web frequently.

For their part, merchants face the major problem of how to deal with returns. Several options exist (e.g., see Trager, 2000):

- **Return an item to the place where it was purchased.** This is easy to do in a brick-and-mortar store, but not in a virtual one. To return an item to a virtual store, you need to get authorization, pack everything up, pay to ship it back, insure it, and wait up to two billing cycles for a credit to show up on your statement. The buyer is not happy, and neither is the seller, who must unpack the item, check the paperwork, and try to resell the item, usually at a loss. This solution is good only if the number of returns is small.

- **Separate the logistics of returns from the logistics of delivery.** Returns are shipped to an independent unit and handled there. This solution may be more efficient from the seller’s point of view, but is no better for the buyer.

- **Allow the customer to physically drop the returned items at collection stations** (such as convenience stores or physical stores of the same company if they exist; e.g., ToyRUs or Staples), from which the returns can be picked up in bulks. This method is used at 7-Eleven stores in some countries, at BP Australia Ltd. (gasoline service stations), which teamed up with wishlist.com.au, and at Caltex Australia in their convenience stores. This solution requires good collaboration among retailers and the collection stations.

- **Completely outsource returns.** Several outsourcers, including FedEx and the United Postal Service (UPS), provide such services. The services they offer deal not only with shipments, but also with the entire logistics process of returns. This can be efficient and the customer may be happier, but the cost may be high.
CHAPTER 8  SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

IT At Work 8.5
INTEGRATING EC WITH ERP AT CYBEX

Cybex International, a global maker of fitness machines (cybex.com) was unable to meet the demand for its popular fitness machines, which increased dramatically in the late 1990s. To maintain its market share, the company had to work with rush orders from its close to 1,000 suppliers, at an extremely high cost. This was a result of a poor demand forecast for the machine’s components. This forecast was done by using three different legacy systems that Cybex inherited from merger partners.

After examining the existing vendor’s supply chain software, Cybex decided to install an ERP system (from PeopleSoft Inc.) for its supply chain planning and manufacturing applications. In conjunction with the software installation, Cybex analyzed its business processes and made some needed improvements. It also reduced the number of suppliers from 1,000 to 550.

Here is how Cybex’s new system works: Customer orders are accepted at the corporate Web site and are instantly forwarded to the appropriate manufacturing plant (the company has two specialized plants). The ERP uses its planning module to calculate which parts are needed for each model. Then, the ERP’s product configurator constructs, in just a few seconds, a component list and a bill-of-materials needed for each specific order.

The ERP system helps with other processes as well. For example: Cybex can e-mail a vendor detailed purchase orders with engineering changes clearly outlined. These changes are visible to everyone, so if one engineer is not at work, or has left the company, his or her knowledge is in the system and is easy to find. Furthermore, dealers now know that they will get deliveries in less than two weeks instead of the previous one to four weeks. They can also track the status of each order.

The system also helps Cybex to better manage its 550 suppliers. For example, the planning engine looks at price variations across product lines, detecting opportunities to negotiate price reductions by showing suppliers that their competitors offer the same products at lower prices. Also, by giving their suppliers projected long- and short-term production schedules, Cybex is making sure that all parts and materials are available when needed; it is also reducing the inventory level it must hold at Cybex. Furthermore, suppliers that cannot meet the required dates are replaced after quarterly reviews.

Despite intense industry price-cutting over the last year, Cybex remained very profitable, mainly due to its e-supply chain. Some of the most impressive results were: Cybex cut its bill-of-materials count (the number of items that might be included on a bill of materials) from 15,200 items to 200; reduced the number of vendors from 1,000 to 550; cut paperwork by two-thirds; and reduced build-to-order time from four to two weeks.

Introducing the system costs money of course. In addition to the cost of the software, the technology staff has increased from three to twelve. Yet, the company feels that the investment was more than justified, especially because it provided for much greater harmony between Cybex and its suppliers and customers.

Sources: Compiled from Sullivan et al. (2002); Paulson (2000); and peoplesoft.com (2003).

For Further Exploration: What are the relationships between Cybex’s EC applications and ERP? What is the role of the planning module? What are the critical success factors for implementation?

Integration of EC with ERP

Since many middle-sized and large companies already have an ERP system, or are installing one, and since EC needs to interface with ERP, it makes sense to tightly integrate the two. Such interface is needed mainly for order fulfillment and for collaboration with business partners, as in the case of inventory managed by suppliers (the P&G-WalMart situation, cited earlier).

Efforts to integrate EC with ERP are still in their infancy in many organizations. ERP vendors started to integrate EC with ERP only since 1997 on a small scale and only since 2000 as a major initiative (see Siau and Messersmith, 2002). For example, SAP started building some EC interfaces in 1997, and in 1999 introduced mySAP.com as a major initiative. The mySAP initiative is a multifaceted Internet product that includes EC, online trading sites, an information portal, application hosting, and more user-friendly graphical interfaces (see Online File W8.7).

An example of EC/ERP integration is presented in IT At Work 8.5.
The logic behind integrating EC and ERP is that by extending the existing ERP system to support e-commerce, organizations not only leverage their investment in the ERP solution, but also speed up the development of EC applications.

The problem with this approach is that the ERP software is very complex and inflexible (difficult to change), so it is difficult to achieve easy, smooth, and effective integration. One other potential problem is that ERP systems deal more with back-office (e.g., accounting, inventory) applications, whereas EC deals with front-office applications such as sales and order taking, customer service, and other customer relationship management (CRM) activities. This problem may be solved by using Web services.

Every company that has business partners has to manage the relationships with them. Partners need to be identified, recruited, and maintained. Communication needs to flow between the organizations. Information needs to be updated and shared. Actually, all that efforts are made to apply CRM to all types of business partners can be categorized as partner-relationship management (PRM).

Before the spread of Internet technology, there were few automated processes to support partnerships. Organizations were limited to manual methods of phone, fax, and mail. EDI was used by large corporations, but usually only with their largest partners. Also, there were no systematic ways of conducting PRM. Internet technology changed the situation by offering a way to connect different organizations easily, quickly, and affordably.

PRM solutions connect vendors with their business (suppliers, customers, services) partners using Web technology to securely distribute and manage information. At its core, a PRM application facilitates partner relationships. According to Business Wire (2003), a Gartner Group survey conducted in late 2002 showed that of all sales-related applications, PRM programs had the highest return on investment.

Specific PRM functions include: partner profiles, partner communications, lead management (of clients), targeted information distribution, connecting the extended enterprise, partner planning, centralized forecasting, group planning, e-mail and Web-based alerts, messaging, price lists, and community bulletin boards. As described in Chapter 4, many large companies offer suppliers or partners customized portals for improved communication and collaboration. (For more on PRM, see channelwave.com, and it-telecomsolutions.com.)

One of the major categories of PRM is supplier-relationship management (SRM). For many companies, such as retailers and manufacturers, working properly with suppliers is a major critical success factor.

PeopleSoft.Inc. (peoplesoft.com) developed a model for managing supplier relationships in real time. The model is generic and could be considered by any large company. It includes 13 steps, which are illustrated in Figure 8.5. The details of the steps are shown in Online File W8.8.

The core idea of this SRM model is that an e-supply chain is based on integration and collaboration (Sections 8.3–8.5). In this model, the supply chain process is connected, decisions are made collectively, performance metrics are based on common understanding of the partners, information flows in real time
The only thing a new partner needs in order to join an SRM system is just a Web browser.

8.7 Global Supply Chain

Supply chains that involve suppliers and/or customers or other business partners, are referred to as Global Supply Chains.

Companies go global for a variety of reasons. The major reasons are: lower costs (of materials, products, services and labor); availability of products that are unavailable domestically; the firm’s global strategy; technology available in other countries; high quality of products; intensification of global competition, which drives companies to cut costs; the need to develop a foreign presence to increase sales; and fulfillment of counter trade.

Supply chains that involve suppliers and/or customers in other countries are referred to as global supply chains (e.g., see Harrison, 2001, Handfield and Nichols, 1999) E-commerce has made it much easier to find suppliers in other countries (e.g., by using electronic bidding) as well as to find customers in other countries (see Handfield et al., 2002, and Turban et al., 2004).

Global supply chains are usually longer than domestic ones, and they may be complex. Therefore, additional uncertainties are likely. Some of the issues that may create difficulties in global supply chains are legal issues, customs fees and taxes, language and cultural differences, fast changes in currency exchange rates, and political instabilities. An example of difficulties in a global supply chain can be seen in IT At Work 8.6.

Information technologies are found to be extremely useful in supporting global supply chains (Harrison, 2001). For example, TradeNet in Singapore...
connects sellers, buyers, and government agencies via electronic data interchange (EDI). (TradeNet is described in detail in Online File W5.11 at the book’s Web site.) A similar network, TradeLink, operates in Hong Kong, using both EDI and EDI/Internet attempting to connect about 70,000 trading partners. Promising as global supply chains are, one needs to design them carefully to optimize their functioning.

IT provides not only EDI and other communication options, but also online expertise in sometimes difficult and fast-changing regulations. IT also can be instrumental in helping businesses find trade partners (via electronic directories and search engines, as in the case of alibaba.com and chemconnect.com). IT also allows for automatic Web pages translation to many languages. Finally, IT facilitates outsourcing of products and services, especially computer programming, to countries with a plentiful supply of labor, at low cost.

Lego Company of Denmark (lego.com) is a major producer of toys, including electronic ones. It is the world’s best-known toy manufacturer (voted as the “toy of the century”) and has thousands of Web sites created by fans all over the world.

In 1999 the company decided to market its Lego Mindstorms on the Internet. This product is a unique innovation. Its users can build a Lego robot using more than 700 traditional Lego elements, program it on a PC, and transfer the program to the robot. Lego sells its products in many countries using several regional distribution centers. When the decision to do global e-commerce was made, the company had to face the following concerns and issues:

- It did not make sense to go to all countries, since the company’s sales are very low in some countries and some countries offer no logistical support services. Lego had to choose where to market Mindstorms.
- A supportive distribution and service system would be needed, including software support and returns from around the globe.
- There was an issue of merging the offline and online operations versus creating a new centralized unit, which seemed to be a complex undertaking.
- Existing warehouses were optimized to handle distribution to commercial buyers, not to individual customers.
- Lego products were selling in different countries in different currencies and at different prices. Should the product be sold on the Net at a single price? In which currency? How would this price be related to the offline prices?

- How should the company handle the direct mail and track individual shipments?
- Invoicing had to comply with the regulations of many countries.
- Should Lego create a separate Web site for Mindstorms? What languages should be used there?
- Some countries have strict regulations regarding advertisement and sales to children. Also laws on consumer protection vary among countries.
- How to handle restrictions on electronic transfer of individuals’ personal data.
- How to handle the tax and import duty payments in different countries.

In the rush to get its innovative product to market, Lego did not solve all of these issues before the direct marketing was introduced. The resulting problems forced Lego to close the Web site for business in 1998. It took about a year to solve all global trade-related issues and eventually reopen the site. By 2001 Lego was selling online many of its products, priced in U.S. dollars, but the online service was available in only 15 countries. By 2003 Lego.com was operating as an independent unit. It offers many Web-only deals and allows online design of many products (e.g., see “Train Configurator”). The site is visited by over 4 million visitors each day.

For Further Exploration: Visit Lego’s Web site (lego.com) and see the latest EC activities. Also, investigate what the competitors are doing. Do you think that the Web was a good way for Lego to go global?
CHAPTER 8 SUPPLY CHAIN MANAGEMENT AND ENTERPRISE RESOURCE PLANNING

MANAGERIAL ISSUES

1. Ethical issues. Conducting a supply chain management project may result in the need to lay off, retrain, or transfer employees. Should management notify the employees in advance regarding such possibilities? And what about those older employees who are difficult to retrain? Other ethical issues may involve sharing of personnel information, which may be required for a collaborative organizational culture.

2. How much to integrate? While companies should consider extreme integration projects, including ERP, SCM, and e-commerce, they should recognize that integrating long and complex supply chain segments may result in failure. Therefore, many times companies tightly integrate the upstream, inside-company, and downstream activities, each part by itself, and loosely connect the three.

3. Role of IT. Almost all major SCM projects use IT. However, it is important to remember that in most cases the technology plays a supportive role, and the primary role is organizational and managerial in nature. On the other hand, without IT, most SCM efforts do not succeed.

4. Organizational adaptability. To adopt ERP, organization processes must, unfortunately conform to the software, not the other way around. When the software is changed, in a later version for example, the organizational processes must change also. Some organizations are able and willing to do so; others are not.

5. Going global. EC provides an opportunity to expand markets globally. However, it may create long and complex supply chains. Therefore, it is necessary to first check the logistics along the supply chain as well regulations and payment issues.

ON THE WEB SITE... Additional resources, including an interactive running case; quizzes; additional resources such as cases; tables and figures; updates; additional exercises; links; and demos and activities can be found on the book’s Web site.

KEY TERMS

Application service provider (ASP) •••
Bullwhip effect •••
Business intelligence •••
Collaborative commerce networks •••
Collaborative commerce •••
E-supply chain •••
Enterprise resource planning (ERP) •••
Enterprise systems •••
Global supply chain •••
Material requirements planning (MRP) •••
Manufacturing resource planning (MRP II) •••
Order fulfillment •••
Partner relationship management (PRM) •••
Reverse logistics (returns) •••
SAP® R3 •••
Supply chain •••
Supply chain intelligence (SCI) •••
Supply chain management (SCM) •••
Supply chain teams •••
Vendor-managed inventory (VMI) •••
Vertical exchanges •••
CHAPTER HIGHLIGHTS (Numbers Refer to Learning Objectives)

1. It is necessary to properly manage the supply chain to ensure superb customer service, low cost, and short cycle time.
2. The supply chain must be completely managed, from the raw materials to the end customers.
3. It is difficult to manage the supply chain due to the uncertainties in demand and supply and the need to coordinate several business partners’ activities. A major inventory problem along the chain is known as the bullwhip effect.
4. Innovative approaches to SCM require cooperation and coordination of the business partners, facilitated by IT innovations such as inventory optimization and VMI over extranets, which allow suppliers to view companies’ inventories in real time and manage them for their customers.
5. Software support for supply chain management has increased both in coverage and scope, from MRP to MRP II, to ERP, to enhanced ERP (with business partners), and to an ERP/SCM software integration.
6. ERP is an integrated software (known also as an enterprise software) that manages all transformation-type information processing in the enterprise.
7. Today, ERP software, which is designed to improve standard business transactions, is enhanced with business intelligence and decision-support capabilities as well as Web interfaces.
8. Electronic commerce is able to provide new solutions to problems along the supply chain by integrating the company’s major business activities with both upstream and downstream entities via an electronic infrastructure.
9. E-commerce tools, such as e-procurement and collaborative commerce, are used to solve supply chain problems.
10. Order fulfillment in EC is difficult due to the need to ship many small packages to customers’ doors. Outsourcing the logistics and delivery jobs is common, but it can be expensive.
11. Special large and automated warehouses help in improving the EC order fulfillment, but they can be expensive to build and operate.
12. PRM should be approached as a comprehensive topic, like the life cycle approach of PeopleSoft (see Figure 8.5). While supply chain interactions are a major part of PRM, collaboration and joint venture should be nourished as well.
13. Global supply chains are usually long and can be complex. Therefore they must be carefully analyzed before a decision to go global is finalized.

QUESTIONS FOR REVIEW

1. Define supply chain and supply chain management (SCM).
2. Describe the components of a supply chain.
3. What is an e-supply chain?
4. Describe the bullwhip effect.
5. Describe some solutions to supply chain problems.
6. Define MRP and MRP II.
7. Describe SCM software
8. Define ERP and describe its major characteristics.
9. How can integration can solve supply chain problems?
10. Define order fulfillment in EC.
11. List the major difficulties of order fulfillment in EC.
12. Define reverse logistics.
13. Describe some solutions to the order fulfillment problem.
14. Define PRM and SRM.
15. Describe the major SRM activities according to the PeopleSoft model.
16. Describe a global supply chain and some difficulties in going global.

QUESTIONS FOR DISCUSSION

1. Identify the supply chain(s) and the flow of information described in the opening case.
2. Relate the concepts of supply chain and its management to Porter’s value chain and value system model.
3. Discuss the Warner-Lambert (Pfizer) Listerine case, and prepare a chart of the product’s supply chain.
4. Distinguish between ERP and SCM software. In what ways do they complement each other?


5. It is said that SCM software created more changes in logistics than 100 years of continuous improvement did. Discuss.

6. Discuss what it would be like if the registration process and class scheduling process at your college or university were restructured to an online, real-time, seamless basis with good connectivity and good empowerment in the organization. (If your registration is already online, find another manual process that can be automated.) Explain the supply chain in this situation.

7. Relate ERP to software integration.

8. Compare MRP to MRP II to ERP.

9. Discuss how cooperation between a company that you are familiar with and its suppliers can reduce inventory cost.

10. Find examples of how organizations improve their supply chains in two of the following: manufacturing, hospitals, retailing, education, construction, agriculture, shipping.

11. The normal way to collect fees from travelers on expressways is to use tollbooths. Automatic coin-collecting baskets can expedite the process, but do not eliminate the long waiting lines during rush hours. About 80 percent of the travelers are frequent users of the expressways near their homes. The money collection process on some highways has been reengineered by using smart cards that can be scanned. Lately, further improvement has been made. The smart ID cards can be read wirelessly from 30–40 feet, so cars do not have to stop. Fees are charge to travelers’ accounts, which reduces travelers’ waiting time by 90 percent and money processing cost by 80 percent. (See details in Chapter 6.)

a. Identify the supply chain.

b. Several new information technologies including smart cards are used in the process. Find information on how this is accomplished.

12. Discuss the problem of reverse logistics in EC. What kind of companies may suffer the most? (View some solutions offered by FedEx.)

13. Explain why UPS defines itself as a “technology company with trucks” rather than a “trucking company with technology.”

14. Discuss the meaning of the word intelligence in the term supply chain intelligence.

15. It is said that supply chains are essentially “a series of linked suppliers and customers; every customer is in turn a supplier to the next downstream organization, until the ultimate end-user.” Explain. Use a diagram to make your point.

16. Explain the bullwhip effect. In which type of business it is likely to occur most? How can the effect be controlled?

**EXERCISES**

1. Draw the supply chain of the Davis & Warshow plumbing parts business (Online File W8.6). Show the use of IT in various places of the chain.

2. Draw the supply chains of Warner-Lambert (Pfizer) and Dell Computer (see Online Minicase 8.1). What are the similarities? The differences?

3. Draw the supply chain of Lego (see additional description at lego.com). Include at least two countries.

4. Enter supplychain.aberdeen.com and observe its “online supply chain community”. Most of the information there is free. Prepare an outline of the major resources available in the site.

5. Automated warehouses play a major role in B2C and mail order fulfillment. Find material on how they operate. (Use google.com and findarticles.com for more information.) Try to find information about Lands’ End’s warehouse.

6. Examine the functionalities of ERP software from SAP or other vendors.

7. Kozmo.com was a company that rented videos and delivered them to customers within 30 to 60 minutes. Find out what you can about why it failed. Was there a problem with the company’s order-fulfillment promises? Were there any drawbacks in Kozmo’s alliances with Starbucks and Amazon.com? Explain.

8. Read the opening case and answer the following

a. The company business is not to make the product, but “to sell the product.” Explain this statement.

b. Why was it necessary to use IT to support the change?

c. Identify all the segments of the supply chain.

d. Identify all supporting information systems in this case.

**GROUP ASSIGNMENTS**

1. Each group in the class will be assigned to a major ERP/SCM vendor such as SAP, PeopleSoft, Oracle, J. D. Edwards, etc. Members of the groups will investigate topics such as: (a) Web connections, (b) use of business intelligence tools, (c) relationship to CRM and to EC, (d) major capabilities, and (e) availability of ASP services by the specific vendor.
INTERNET EXERCISES

1. Enter ups.com. Examine some of the IT-supported customer services and tools provided by the company. Write a report on how UPS contributes to supply chain improvements.

2. Enter supply-chain.org; cio.com, findarticles.com, and google.com and search for recent information on supply chain management integration.

3. Enter logictool.com. Find information on the bullwhip effect and on the strategies and tools used to lessen the effect.


5. The U.S. Post Office provides EC logistics. Examine its services and tracking systems at uspsprioritymail.com. What are the potential advantages for EC shippers?

6. Enter brio.com and identify Brio's solution to SCM integration as it relates to decision making for EC. View the demo.

7. Enter rawmart.com and find what information they provide that supports logistics. Also find what shipment services they provide online.


9. Enter efulfillmentservice.com. Review the products you find there. How does the company organize the network? How is it related to companies such as FedEx? How does this company make money?

10. Enter KeWill.com. Find the innovations they offer that facilitate order fulfillment. Compare it to meloworlwide.com. Write a report on your findings.

11. Enter submitorder.com and find out what they offer. Comment on the uniqueness of the services.

Each group will prepare a presentation for the class, trying to convince the class why the group’s software is best for a local company known to the students (e.g., a supermarket chain).

2. Each team should investigate the order fulfillment process of an e-tailer, such as amazon.com, staples.com, or landsend.com. Contact the company, if necessary, and examine related business partnerships if they exist. Based on the content of this chapter, prepare a report with suggestions for how the company can improve its order fulfillment process. All the groups’ findings will be discussed in class. Based on the class’s findings, draw some conclusions about how order fulfillment can be improved.

3. FedEx, UPS, the U.S. Postal Service, and others are competing in the EC logistics market. Each team should examine one such company and in investigate the services it provides. Contact the company, if necessary, and aggregate the findings into a report that will convince classmates or readers that the company in question is the best. (What are its best features?)
Quantum Corporation (quantum.com) is a major U.S. manufacturer of hard-disk drives and other high-technology storage components. Quantum faced two key challenges in its manufacturing process.

The first challenge was streamlining its component supply process in order to reduce on-hand inventory. Quantum’s traditional ordering process was labor-intensive, involving numerous phone calls and manual inventory checks. To ensure that production would not be interrupted, the process required high levels of inventory. Quantum needed a solution that would automate the ordering process to increase accuracy and efficiency, reduce needed inventory to 3 days’ supply, and provide the company’s purchasing agents with more time for non-transactional tasks.

Quantum’s second challenge was to improve the quality of the components’ data in its material requirements planning (MRP) system. Incomplete and inaccurate data caused delays in production. Quantum’s solution of manually reviewing reports to identify errors was labor intensive and occurred too late; problems in production were experienced before the reports were even reviewed. Quantum needed a technology solution that would enable it to operate proactively to catch problems before they caused production delays.

The solution that Quantum chose to automate its component supply process was an interenterprise system that automatically e-mails reorders to suppliers. Initiated in 1999, the system uses an innovative event detection and notification solution from Categoric Software (categoric.com). It scans Quantum’s databases twice daily, assessing material requirements from one application module against inventory levels tracked in another. Orders are automatically initiated and sent to suppliers as needed, allowing suppliers to make regular deliveries that match Quantum’s production schedule. The system not only notifies suppliers of the quantity of components required in the immediate orders, but also gives the supplier a valuable window into the amount of inventory on hand and future weekly requirements.

The system also provided other improvements. It enabled Quantum to tap into multiple data sources to identify critical business events. To elevate data quality, Quantum implemented Categoric Alerts to proactively catch any data errors or omissions in its MRP database. The systems’ notifications are now sent whenever any critical MRP data fall outside the existing operational parameters.

The system has produced the desired results. For example, the estimated value of the improved ordering process using the new system is millions of dollars in inventory reductions each year. The buyers have reduced transaction tasks and costs, and both Quantum and its buyers get a lot more information with a lot less work. Before the implementation of Categoric Alerts, Quantum’s analysts would search massive reports for MRP data errors. Now that the new system is implemented, exceptions are identified as they occur. This new process has freed the analysts from the drudgery of scanning reports and has greatly increased employee satisfaction.

Data integrity of the MRP increased from 10 percent to almost 100 percent, and Quantum is now able to quickly respond to changing customer demand. The system paid for itself in the first year.

Sources: Compiled from an advertising supplement in CIO Magazine (November 1, 1999), from information at categoric.com (accessed May 28, 2000), and from quantum.com (accessed June 10, 2003).

Questions for Minicase 1

1. Identify the internal and external parts of the supply chain that were enhanced with the system.
2. Enter categoric.com and find information about Categoric Alerts. Describe the capability of the product.
3. Explain how purchasing was improved.
4. Describe how Quantum’s customers are being better served now.
5. Identify the EC solutions used in this case.
Minicase 2
Green Mountain Coffee Roasters Integrates Electronic Commerce and Supply Chain Management

Green Mountain Coffee Roasters (GMCR) (gmcr.com), a medium-sized distributor of quality coffee in the United States, experienced a high growth rate in recent years (from $34 million in 1996 to about $100 million in 2002). Sales are made through over 5,000 wholesalers and resellers, including supermarkets, restaurants, and airlines. In addition, mail-order shipments are made to over 40,000 loyal individual customers.

The rapid expansion of the business made it necessary to provide all employees access to the latest data so they could make better decisions regarding demand forecast, inventory management, and profitability analysis. To meet this need the company decided to install an ERP software.

In 1997, GMCR replaced its custom legacy information system with an ERP from PeopleSoft. The ERP includes functional modules such as production and inventory control, financial management, and human resources management. GMCR decided in 1998 to hook the ERP to the Internet for the following reasons:

- The company expected to double its online sales to individual customers. This was going to be done by displaying the culture and image of the company, allowing customers to learn more about coffee, and creating a “GMCR coffee community.” This goal was not reached.
- The existing coffee tours and coffee club were well adapted to the Internet.
- The company estimated that at least 30 percent of its 5,000 business partners prefer to do business online.
- The company needed a better mechanism for CRM and PRM. The company wanted to get quick feedback, be able to solve customer and partners’ problems quickly, and provide an efficient and easy order-taking facility.

The integration of the Web with ERP provided the following capabilities:

- Many of the business customers are small proprietor-managed shops. They are busy during the day, so they prefer to place orders in the evenings when GMCR’s call center is closed.
- The customers like to know, immediately, if a product is in stock and when it will be shipped.

- Customers want to see their order histories, including summaries such as a most-frequently ordered product list.
- Customers want to track the status of their orders.

All of the above capabilities can be done by customers themselves, any time and from anywhere. In addition, the system can support the requests of GMCR’s sales force for instant information about customers, inventory levels, prices, competition, overnight delivery services, and so forth.

PeopleSoft’s eStore, an Internet storefront that is tightly integrated with the ERP suite (from order fulfillment to the rest of the supply chain management), was implemented in 1999. GMCR benefited not only from improved customer service and efficient online marketing, but also from providing access to the latest data to all employees. Some of the results so far: Forecasts have improved, inventory is minimized (using the just-in-time concept), and profitability analysis by product and/or customer is done in minutes.


Questions for Minicase 2

1. Enter gmcr.com and identify the major customer-related activities. How are such activities supported by information technology?
2. Coffee club members make up about 90 percent of all the company’s direct mail business. Why? (Check the Web site.)
3. How can the ERP system improve GMCR’s inventory system?
4. It is said that “Internet sales data must be taken into account by enterprise planning, forecast demand, and profitability studies.” Explain why.
5. It is said that “Because the customer’s account and pricing information are linked to the order, accurate invoicing will flow automatically from the Internet transaction.” Explain, and relate to the concept of the supply chain.
You’ve reached the halfway point in your internship at The Wireless Cafe (TWC), and you feel pretty confident you understand the processes at the front of the house and the back of the house. You had just read about ERP systems when Jeremy mentioned to you the problems he has getting information from the point-of-sale (POS) systems to his inventory, financial, and kitchen management systems. You are excited about the possibility of applying some ERP principles to TWC, and so you suggest to Jeremy an investigation of integrated restaurant applications.

1. Review the capabilities of restaurant management software such as RestaurantPlus (restaurantplus.com), Micros (micros.com), NextPOS (nextpos.com), Aloha (alohapos.com) or others you can find on the Web.

2. Describe some similarities and differences between the systems you reviewed in Question 1 and the ERP systems you read about in Chapter 8.

3. Many restaurants establish a relationship with a single restaurant purveyor (Sysco, for example) to provide nearly everyting the restaurant needs for daily operations. What are the issues in this type of relationship in light of SCM?

REFERENCES


REFERENCES


littlewoods.co.uk (accessed March 2003).


