

# COMPUTER-BASED SUPPLY CHAIN MANAGEMENT AND INFORMATION SYSTEMS INTEGRATION

10

## CHAPTER PREVIEW

The success of many organizations, private, public, and military, depends on their ability to manage the flow of materials, information, and money into, within, and out of the organization. Such a flow is referred to as a *supply chain*. Because supply chains may be long and complex and may involve many different business partners, we frequently see problems in the operation of the supply chains. These problems may result in delays, in customers' dissatisfaction, in lost sales, and in high expenses of fixing the problems once they occur. World-class companies, such as Dell Computer, attribute much of their success to effective supply chain management (SCM), which is largely supported by IT.

In this chapter we describe the nature and types of supply chains and explain why problems occur there. Then we outline the IT-based solutions, most of which are provided by integrated software such as MRP and ERP. Next we show you how EC can cure problems along the supply chain. Finally we describe the problems of fulfilling orders in e-commerce systems and some of the solutions used.

## CHAPTER OUTLINE

- 10.1 Supply Chains and Their Management
- 10.2 Supply Chain Problems And Solutions
- 10.3 IT Supply Chain Support and Systems Integration
- 10.4 Enterprise Resource Planning (ERP)
- 10.5 E-Commerce And Supply Chain Management
- 10.6 Order Fulfillment in E-Commerce

## LEARNING OBJECTIVES

1. Understand the concept of the supply chain, its importance, and its management.
2. Describe the various types of supply chains.
3. Describe the problems in managing supply chains.
4. Describe the major categories of supply chain solutions.
5. Explain the need for software integration and describe the available software.
6. Explain how EC improves supply chain management.
7. Describe EC order-fulfillment problems and solutions.



## HOW DELL MANAGES ITS SUPPLY CHAIN

[www.dell.com](http://www.dell.com)

### The Business Problem

Michael Dell started his business as a student, from his university dorm, by using a mail-order approach for selling PCs. This changed the manner by which PCs were sold. The customer did not have to come to a store to buy a computer, and Dell was able to customize the computer to the customer's specifications. The direct-mail approach enabled Dell to underprice his rivals, who were using distributors and retailers, by about 10 percent. For several years the business grew, and Dell constantly captured market share. In 1993, Compaq, the PC market leader at that time, decided to drastically cut prices in order to drive Dell out of the market. As a result of the price war, Dell Computer Corporation had a \$65 million loss from reduced sales and inventory writedowns in the first six months of 1993 alone. The company was on the verge of bankruptcy.

### The IT Solution

Dell realized that the only way to win the marketing war was to introduce fundamental changes along the supply chain, from its suppliers all the way to its customers. Among the innovations used to restructure the business were the following.

- Most orders from customers and to suppliers were moved to the Web. Customers configure what they want, and find the cost and the deliverability in seconds, all on-line.
- Dell builds most computers only after they are ordered. This is done by using just-in-time manufacturing, which also enables quick deliveries, low inventories, little or no obsolescence, and lower marketing and administrative costs. This is an example of mass customization cited previously in the text.
- Component warehouses, which are maintained by Dell's major suppliers, are located within 15 minutes of Dell factories. Not only does Dell get components quickly, but those components are up to 60 days newer than the ones acquired by major competitors.
- Shipments, which are done by UPS and other carriers, are all arranged electronically.
- Dell collaborates electronically with its buyers to pick their brains for new product ideas.
- Dell's new PC models are tested at the same time as the networks that they are on are tested. This collaboration reduces the testing period from 60 or 90 days to 15.

In addition to competing on *price* and *quality*, Dell started competing on *speed*. Since 2000, if you order a customized PC on any working day in the United States, the computer will be on the delivery truck the next day. A complex custom-made PC will be delivered in no more than 5 days.

In 2001, Dell was selling more than \$4 million worth of computers each day on its Web site, and this amount was growing by 6 percent per month! In 1999, Dell added electronic auctions (*dellauction.com*) as a marketing channel. Eventually, Dell is aiming to sell most of its computers and servers from its Web site (*dell.com*).

In addition, Dell created customized home pages for its biggest corporate customers, such as Eastman Chemical, Monsanto, and Wells Fargo. At these sites, customers' employees use configuration tools and work-flow software to design computers, get the order approved inside the client organization, and place the order quickly and easily. The electronic ordering by both larger and smaller customers

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enables Dell to collect payments very quickly, even before it starts to assemble the computers.

Once orders are received they are transferred electronically to the production floor. Intelligent systems prepare the required parts and component list for each computer, and check availability. If not in stock, components and parts are automatically and electronically ordered directly from suppliers, who sometimes deliver in less than 60 minutes. Computerized manufacturing systems tightly link the entire demand and supply chains from suppliers to buyers. This system is the foundation on which the build-to-order strategy rests.

Dell also electronically passes along to its suppliers data about its defect rates, engineering changes, and product enhancements. Since Dell and its suppliers are in constant communication, the margin for error is reduced. Dell employees collaborate electronically with business partners in real time on product designs and enhancements. Also, suppliers are required to share sensitive information with Dell, such as their own quality problems. Suppliers follow Dell's lead because they also reap the benefits of faster cycle times, reduced inventory, and improved forecasts.

Dell is using several other information technologies, including e-mail, EDI, videoteleconferencing, electronic procurement, computerized faxes, an intranet, DSS, a Web-based call center, and more. Dell also uses the Internet to create a community around its supply chain. Dell's corporate portal has links to bulletin boards where partners from around the world can exchange information about their experiences with Dell's products, logistics, and customer service.

### The Results

By 1999, Dell had become the world's number-two PC seller, and in 2001 it became number one. It is considered one of the world's best-managed and most profitable companies.

Sources: Compiled from articles in *Business Week* (1997–2001), *Information Week* (1998–2001), *cio.com* (2001), and *us.dell.com/dell/media*.

### What We Learned from This Case

The Dell case demonstrates that the new build-to-order business model changed the manner in which business is done in the PC industry (and later, in the server industry). To implement such a model on a large scale (mass customization), Dell built superb supply chain management that includes both suppliers and customers. A major success factor in Dell's operation was the improvements made by using IT along the *entire* supply chain. Dell created flexible and responsive IT-based manufacturing systems that are integrated with the supply chain. In addition, Dell is able to collect payment before it starts to assemble computers, thus shortening the corporate cash flow. Dell successfully implemented the concepts of *supply chain management*, *enterprise resource planning*, *supply chain intelligence*, and *customer-relationship management*. The first three topics are the subject of this chapter. (CRM is described in Chapter 8.)

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## 10.1 SUPPLY CHAINS AND THEIR MANAGEMENT

### Definitions and Benefits

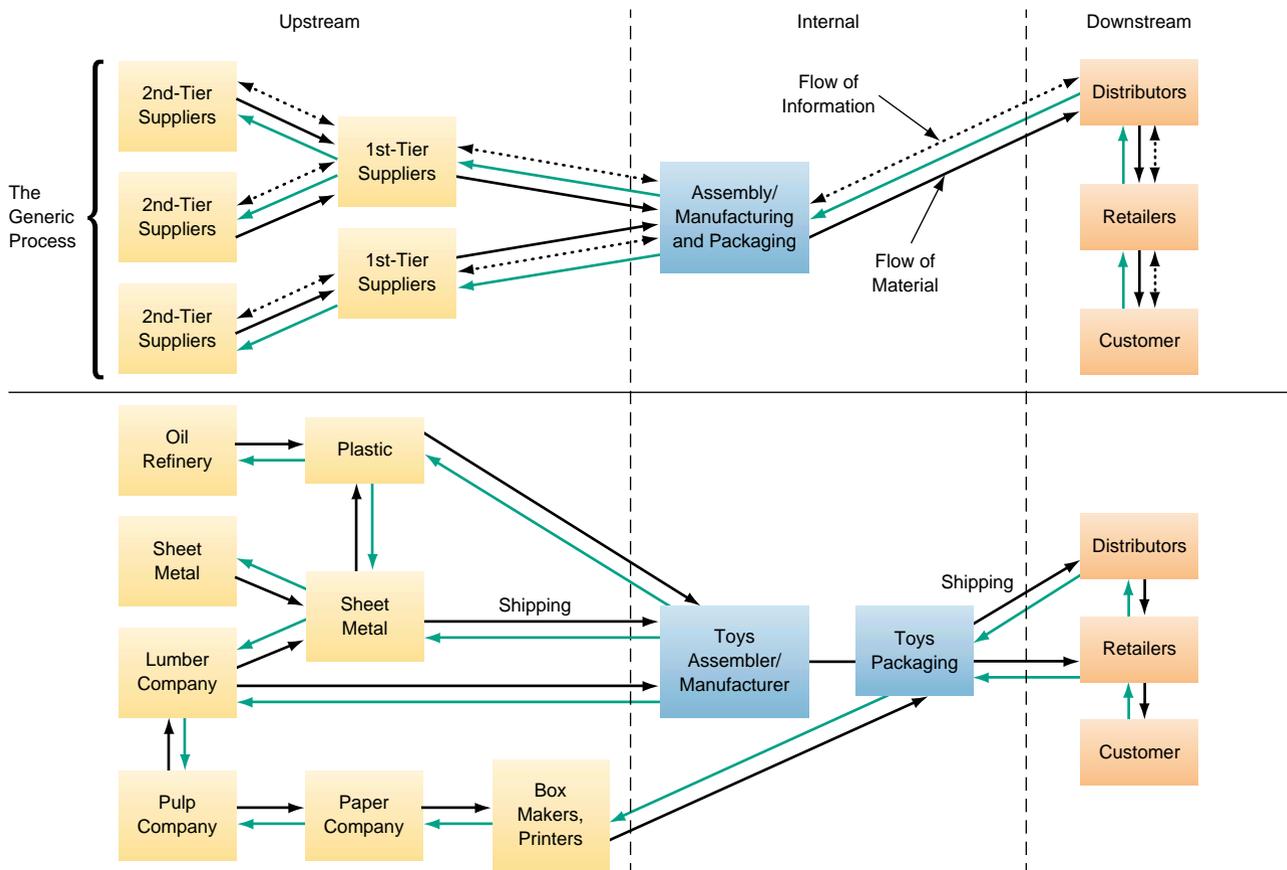
Initially, the concept of a *supply chain* referred to the flow of materials from their sources (suppliers) to the company, and then inside the company for processing. Then, finished products were moved to customers. Today the concept is much broader.

**Definitions.** A **supply chain** refers to the flow of materials, information, payments, and services, from raw material suppliers, through factories and warehouses, to 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. The function of **supply chain management (SCM)** is to plan, organize, coordinate, and control all the supply chain's activities.

**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. The benefits of supply chain management have long been recognized both in business and in the military. As early as 401 B.C., Clerchus of Sparta said, that the survival of the Greek army depended not only upon its discipline, training, and morale, but also upon its supply chain. The same idea was later echoed by famous generals such as Napoleon and Eisenhower.

### The Components of Supply Chains

The term *supply chain* comes from a picture of how partnering organizations in a specific supply chain are linked together. Figure 10.1 shows a relatively simple supply chain, which links a company with its suppliers (on the left) and its distributors and



**Figure 10.1** A linear supply chain.

customers (on the right). The upper part of the figure shows a generic supply chain; the lower part shows the chain of a toy manufacturer. Notice that suppliers may have their own (second-tier) suppliers. In addition to flow of material there is a flow of information (shown only in the upper part of the figure) and money as well. The flow of money usually goes in the direction opposite to the flow of materials.

Note that the supply chain is *linear* and it involves three basic parts:

1. **Upstream supply chain.** This part includes the organization's *first-tier* suppliers (which themselves can be manufacturers and/or assemblers) and their suppliers. Such a relationship can be extended, to the left, in several tiers, all the way to the origin of the material (e.g., mining ores, growing crops). Here the major activities are purchasing and shipping.
2. **Internal supply chain.** This part includes all the processes used by an organization in *transforming* the inputs shipped by the suppliers into outputs, from the time materials enter the organization to the time that the finished product goes to distribution, outside the organization. Activities here include materials handling, inventory management, manufacturing, and quality control.
3. **Downstream supply chain.** This part includes all the processes involved in distributing and delivering the products to final customers. Looked at very broadly, the supply chain actually ends when the product reaches its after-use disposal—presumably back to “Mother Earth” somewhere. Activities here include packaging, warehousing, and shipping. These activities may be done by using several tiers of distributors (e.g., wholesalers and retailers).

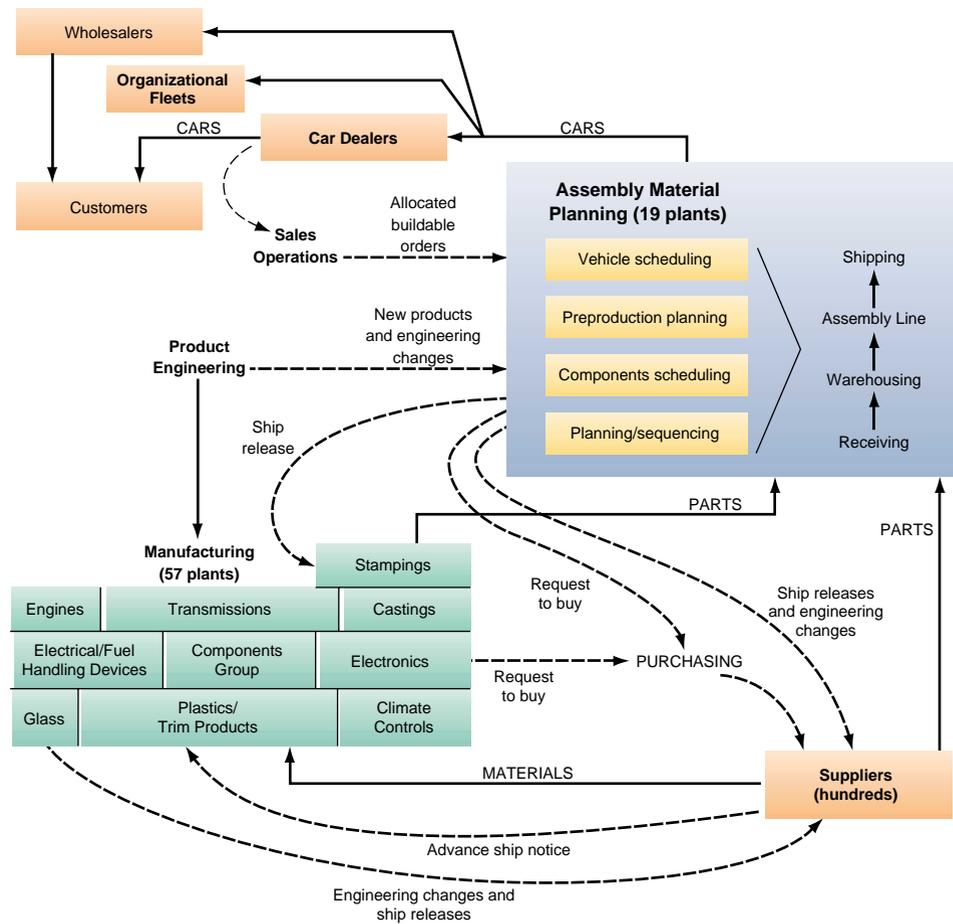
Supply chains come in all shapes and sizes and may be fairly complex, as shown in Figure 10.2. As can be seen in the figure, the supply chain for a car manufacturer includes hundreds of suppliers, dozens of manufacturing plants (for parts) and assembly plants (assembling cars), warehouses, dealers, direct business customers (buying fleets), wholesalers (some of which are virtual), customers, and support functions such as product engineering, purchasing agents, banks, and transportation companies.

Notice that in this case the chain is not strictly linear as it was in Figure 10.1. Here we see some loops in the process. In addition, sometimes the flow of information and even goods can be bidirectional, as it would be, for example, for the *return* of products (known as **reverse logistics**). For an automaker, that would be cars returned to the dealers in cases of defects or recalls by the manufacturer. Also notice that the supply chain is much more than just physical. It includes both information and financial flows. As a matter of fact, the supply chain of a service such as obtaining a mortgage or a digitizable product may not include *any* physical materials. (See Problem-Solving Activity 4 for an example.)

## Types of Supply Chains

The supply chain shown in Figure 10.1 is typical for a manufacturing company. If the company is a traditional one, it will produce items that will be stored in warehouses and other locations, making the supply chain more complex. If the company uses a make-to-order business model, there will be no need for storing finished products, but there will be need to store raw materials and components. Therefore, it is clear that supply chains depend on the nature of the company. The following four types are very common.

**Integrated make-to-stock.** The **integrated make-to-stock** supply chain model focuses on tracking customer demand in real time, so that the production process can restock the finished-goods inventory efficiently. This integration is often achieved through use



**Figure 10.2** An automotive supply chain. (Source: Modified from R. B. Handfield and E. L. Nichols, Jr., *Introduction to Supply Chain Management*, Upper Saddle River, NJ: Prentice-Hall, 1999.)

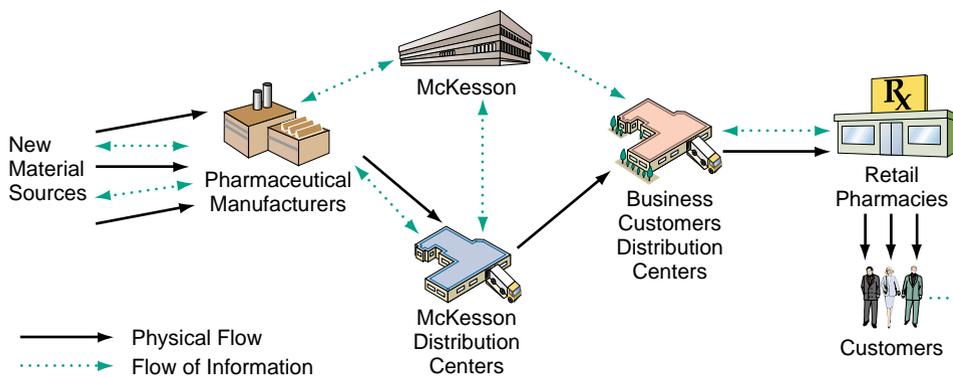
of an information system that is fully integrated (an enterprise system, described in Section 10.4). Through application of such a system, the organization can receive real-time demand information that can be used to develop and modify production plans and schedules. This information is also integrated further down the supply chain to the **procurement** function, so that the modified production plans and schedules can be supported by input materials.

### EXAMPLE

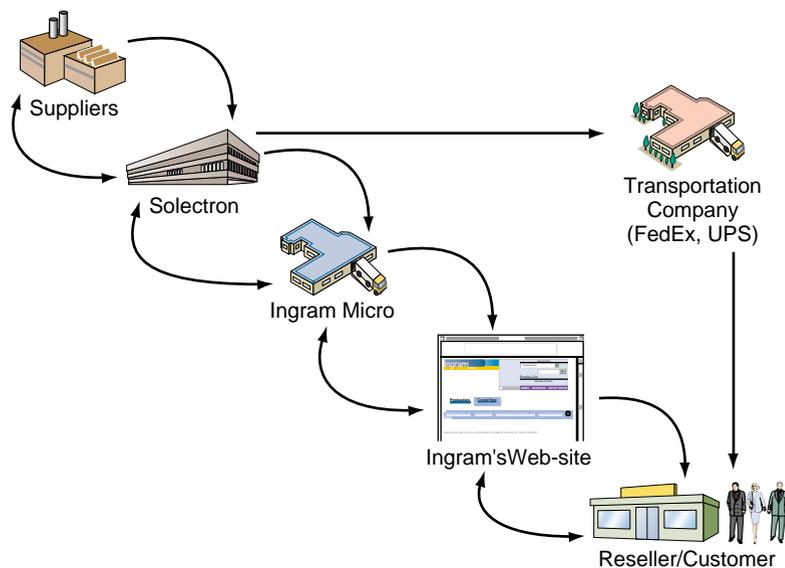
**Starbucks matches supply and demand using IT.** Starbucks Coffee (*starbucks.com*) uses several distribution channels, not only selling coffee drinks to consumers, but also selling beans and ground coffee to businesses such as airlines, supermarkets, department stores, and ice-cream makers. Sales are also done through direct mail, including the Internet. Starbucks is successfully integrating all sources of demand and matching it with the supply by using Oracle's automated information system for manufacturing (called GEMMS). The system does distribution planning, manufacturing scheduling, and inventory control (using MRP). The coordination of supply with multiple distribution channels requires timely and accurate information flow about demand, inventories, storage capacity, transportation scheduling, and more. The information systems are critical in doing all the above with maximum effectiveness and reasonable cost. Finally, Starbucks must work closely with hundreds of business partners. ●

**Continuous replenishment.** The idea of the **continuous replenishment** supply chain model is to constantly replenish the inventory by working closely with suppliers and/or intermediaries. However, if the replenishment process involves many shipments, the cost may be too high, causing the supply chain to collapse. Therefore very tight integration is needed between the order-fulfillment process and the production process. Real-time information about demand changes is required in order for the production process to maintain the desired replenishment schedules and levels. This model is most applicable to environments with stable demand patterns, as is usually the case with distribution of prescription medicine. The model requires intermediaries when large systems are involved. Such a distribution channel is shown in Figure 10.3a, for McKesson Co. (whose case is described in Section 10.5 in detail).

**Build-to-order.** Dell Computer (opening case) is best known for its application of the **build-to-order** model. The concept behind the build-to-order supply chain model is to begin assembly of the customer's order almost immediately upon receipt of the order. This requires careful management of the component inventories and delivery of needed supplies along the supply chain. A solution to this potential inventory problem is to utilize many common components across several production lines and in several locations.



(a) Integrated pharmaceutical supply chain. (Flow of payments not shown.)



(b) Build-to-order supply chain with no inventory.

**Figure 10.3** Types of supply chains. (Source for part b: R. Kalakota and M. Robinson, *E-Business 2.0*, Reading, MA., Addison Wesley, 2000, p. 301, Fig. 9.10.)

One of the primary benefits of this type of supply chain model is the perception that each customer is receiving a personalized product. In addition, the customer is receiving it rapidly. This type of supply chain model supports the concept of *mass customization*.

**Channel assembly.** A slight modification to the build-to-order model is the **channel assembly** supply chain model. In this model, the parts of the product are gathered and assembled as the product moves through the distribution channel. This is accomplished through strategic alliances with *third-party logistics (3PL)* firms. These services sometimes involve either physical assembly of a product at a 3PL facility or collection of finished components for delivery to the customer. For example, a computer company would have items such as the monitor shipped directly from its vendor to a 3PL facility, such as at Federal Express and UPS. The customer's computer order

## IT's About Business

lego.com

MKT

POM

### 10.1: Lego struggles with global issues

Lego Company of Denmark is a major producer of toys, including electronic ones. In 1999, the company decided to market its Lego Mindstorms on the Internet. Mindstorms' 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 the following concerns:

- Choice of countries. It did not make sense to go to all countries, since sales are very low in some countries and some countries offer no logistical support services.
- A supportive distribution and service system would be needed.
- Merging the offline and online operations or creating a new centralized unit seemed to be a complex undertaking.
- Existing warehouses were optimized to handle distribution to commercial buyers, not to the individual customers who would be the buyers over the Internet.
- It would be necessary to handle returns around the globe.
- 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?
- The company would need a system to handle the direct mail and track individual shipments.

- Invoicing must 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 advertising and sales to children. Also laws on consumer protection vary among countries. How would the company ensure compliance with these regulations and laws?
- 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. It took almost 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.

#### Questions

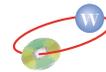
1. Visit Lego's Web site (*lego.com*). What are the company's latest EC activities?
2. Investigate what Lego's competitors are doing.
3. Do you think the Web is the best way for Lego to go global? Why or why not?
4. Contact Lego and find out how they will ship to you. Draw the supply chain.

would therefore only come together once all items were placed on a vehicle for delivery. A channel assembly may have low or zero inventories, and it is popular in the computer technology industry. An example is shown in Figure 10.3b with a large distributor, Ingram Micro, at the center of the supply chain.

## Global Supply Chains

Supply chains that involve suppliers and/or customers in other countries are referred to as **global supply chains**. The major reasons why companies go global in their supply chains are: lower prices of materials, services, and labor; availability of products or technology that are unavailable domestically; high quality of products available in global markets; the firm's global sales strategy; intensification of global competition, which drives companies to cut costs; the need to develop a foreign presence; and fulfillment of counter trade. The introduction of e-commerce has made it much easier and cheaper to find suppliers in other countries (e.g., by using electronic bidding) and to reach many customers.

Global supply chains are usually longer than domestic ones, and they may be complex. Therefore, additional uncertainties and problems are likely. Information technologies are extremely useful in supporting global supply chains. For example, TradeNet in Singapore connects sellers, buyers, and government agencies via electronic data interchange (EDI). (TradeNet's case is described in detail on the Web site of this book.) A similar network, TradeLink, operates in Hong Kong, using both EDI and EDI/Internet to connect thousands of trading partners. 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 such difficulties can be seen in IT's About Business 10.1.



### *Before you go on . . .*

1. Define a supply chain and its management and benefits.
2. Describe the components of a supply chain.
3. Define reverse logistics.
4. Describe the major types of supply chains.
5. Describe a global supply chain and its difficulties.

## 10.2 SUPPLY CHAIN PROBLEMS AND SOLUTIONS

A large number of problems may develop along supply chains. Here we demonstrate the most recurrent ones.

### Background

Supply chain problems have been recognized both in the military and in business operations for generations. Some even caused armies to lose wars or 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. 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. On the other hand, some world-class companies such as Wal-Mart, Federal Express, and Dell have superb supply chains with many innovative features.

### EXAMPLE

**Problems with “Santa’s 1999” supply chain.** A recent 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 Amazon.com, and Toys ‘R’ Us, conducted a massive advertising campaign for Internet ordering. This included \$20–\$30 discount vouchers for shopping online. The retailers underestimated the overwhelming customer response and were unable to get the necessary toys from the manufacturing plants and warehouses and deliver them to the customers’ doors by Christmas Eve. As compensation, Toys ‘R’ Us offered each of its unhappy customers a \$100 store coupon. Despite its generous offer, over 40 percent of the unhappy Toys ‘R’ Us customers said they would not shop online at Toys ‘R’ Us again. ●

In the remaining portion of this section we will look closely at some of the major problems in managing the supply chain and at some proposed solutions, many of which are supported by IT.

## Problems Along the Supply Chain

The 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 Santa’s 1999 toy example. The demand forecast may be influenced by several factors such as competition, prices, weather conditions, technological development, and customers’ general level of confidence. Other supply chain uncertainties are delivery times, which depend on many factors ranging from machine failures in the production process to road conditions and traffic jams that interfere with shipments. Quality problems with materials and parts may create production delays.

Coordination problems occur when a company’s departments are not well connected, when messages to business partners are misunderstood or lost, and when parties are not informed, are misinformed, or are informed too late on what is needed or is occurring.

A major symptom of ineffective supply chain management 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 is known as the bullwhip effect.

**The bullwhip effect.** The **bullwhip effect** refers to erratic shifts in orders along the supply chain. This effect was initially observed by Procter & Gamble (P&G) in connection with its disposable diapers product (Pampers). Although actual sales in stores were fairly stable and predictable, orders from wholesalers and distributors to P&G (the manufacturer) had wild swings, creating production and inventory problems for P&G. An investigation revealed that distributors’ orders were fluctuating because of poor demand forecast and lack of coordination and trust among the supply chain partners. If each distinct entity along the supply chain makes ordering and inventory decisions with an eye to its own interests (fear of product outages) above those of the chain, stockpiling may occur simultaneously at as many as seven or eight places across

the supply chain. Such stockpiling can lead in some cases to as many as 100 days of inventory (instead of the usual 10 to 15 days)—inventory that is waiting, “just in case.” Keeping such large inventory can be very expensive for supply chain partners, costing as much as 24 percent of the value of the items stocked, each year.

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. A 1998 grocery industry study projected that simply by sharing information, \$30 billion in savings could materialize in the grocery industry supply chains alone. To avoid the “sting of the bullwhip,” companies must *share information*. Such sharing is facilitated by EDI, extranets, and groupware technologies, and it is now part of collaborative commerce as it is done by P&G with its major customers, as the following example shows.

### EXAMPLE

**Information sharing between two giants.** One of the most notable examples of information sharing is between Procter and Gamble (P&G) and Wal-Mart. Wal-Mart provides P&G access to sales information about every P&G product that Wal-Mart sells. The information is collected electronically by P&G on a daily basis, from every Wal-Mart store. By monitoring the inventory level of each P&G item in every store, P&G knows when the inventories fall below the threshold that requires a shipment. This way, P&G is able to manage the inventory replenishment for Wal-Mart. All this is done electronically. The benefit for P&G is accurate demand information. P&G has similar agreements with other major retailers. Thus, P&G can plan production more accurately, avoiding some of the problem of the bullwhip effect. In fact, P&G implemented a Web-based “Ultimate-Supply System,” which replaced 4,000 different EDI links to suppliers and retailers in a more cost-effective way. ●

**Other problems along the supply chain.** Many other supply chain problems exist. One major problem is known as **phantom stockouts**. Such a problem occurs when customers are told that a product they want is not available, though in fact the product *is* available (e.g., when the product *is* misplaced, or the count of in-stock is inaccurate). According to *Harvard Business Review* (May 2001), phantom stockouts cut one company’s profitability by 25 percent.

## Solutions to Supply Chain Problems

Over the years organizations have developed many solutions to supply chain problems. One of the earliest solutions was *vertical integration*. For example, Henry Ford purchased rubber plantations in South America in order to control tire production for his cars. Today, many companies whose success depends on tight coordination of all the parts use vertical integration. For example, Starbucks Coffee owns coffee-processing plants, warehouses, and distribution systems, all tied together by software programs.

Undoubtedly, the most common solution used by companies is *building inventories* as insurance against supply chain uncertainties. This way products and parts flow smoothly through the production processes. 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 inventory holding cost and the cost of sales opportunities lost and bad reputation, can be very high. Thus, companies make major attempts to control inventory, usually with the aid of inventory control software or supply chain software that includes inventory modules.



### Manager's Checklist 10.1

#### IT Solutions to Supply Chain Problems

- Use outsourcing rather than do-it-yourself during demand peaks.
- Similarly, “buy” rather than “make” production inputs whenever appropriate.
- Configure optimal shipping plans.
- Create strategic partnerships with suppliers.
- Use the *just-in-time approach* to purchasing, in which suppliers deliver small quantities whenever supplies, materials, and parts are needed. (See the Dell opening case.)
- Reduce the lead time for buying and selling.
- Use fewer suppliers.
- Improve supplier-buyer relationships.
- Manufacture only after orders are in, as Dell does with its custom-made computers.
- Achieve accurate demand by working closely with suppliers to forecast demand.

Effective supply chain and inventory management requires coordination of all activities and links of the supply chain. Successful coordination enables materials and goods to move smoothly and on time from suppliers to manufacturers to customers, which enables firms to keep inventories low and costs down. 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. This enables firms to achieve optimal inventory levels. Other solutions for solving SCM problems are provided in Manager's Checklist 10.1.

In conclusion, in today's competitive business environment, the efficiency and effectiveness of supply chains in most organizations are critical for the organization's survival and are greatly dependent upon the supporting information systems. In the next section, we will show you how IT is used to support supply chains.

#### *Before you go on . . .*

1. Describe typical problems along the supply chain.
2. Define the bullwhip effect.
3. Describe some solutions to supply chain problems.

## 10.3 IT SUPPLY CHAIN SUPPORT AND SYSTEMS INTEGRATION

Effective solutions to supply chain problems have been provided by IT for decades. Indeed, the concept of the supply chain is interrelated with the computerization of its activities, which has evolved over 50 years. Some examples of how IT solves recurrent supply chain problems are provided in Table 10.1. (Some of the supporting technologies mentioned in this table are described in Chapters 11 and 12.)

**Table 10.1 Some Supply Chain Problems and Their IT Solutions**

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

## The Evolution of Computerized Aids

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, production scheduling, and billing. The major objectives were to reduce costs, 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. But it was difficult to combine them.

In a short time it became clear that interdependencies exist among some of the supply chain activities. One early realization was that production schedule 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 8). It became clear that computer support could greatly enhance the use of this model, which may require daily updating. This resulted in commercial MRP software packages coming on the market.

MRP packages were useful in many cases, and they are still in use today, helping to drive inventory levels down and streamlining portions of the supply chain. However, some of the MRP applications failed. One of the major reasons for such failure was that schedule-inventory-purchasing operations are closely related to both financial and labor resources, but were not included in the MRP packages. The realization of this failure resulted in an enhanced MRP methodology and software called **manufacturing resource planning (MRP II)**, which adds labor and financial planning to the simpler MRP model.

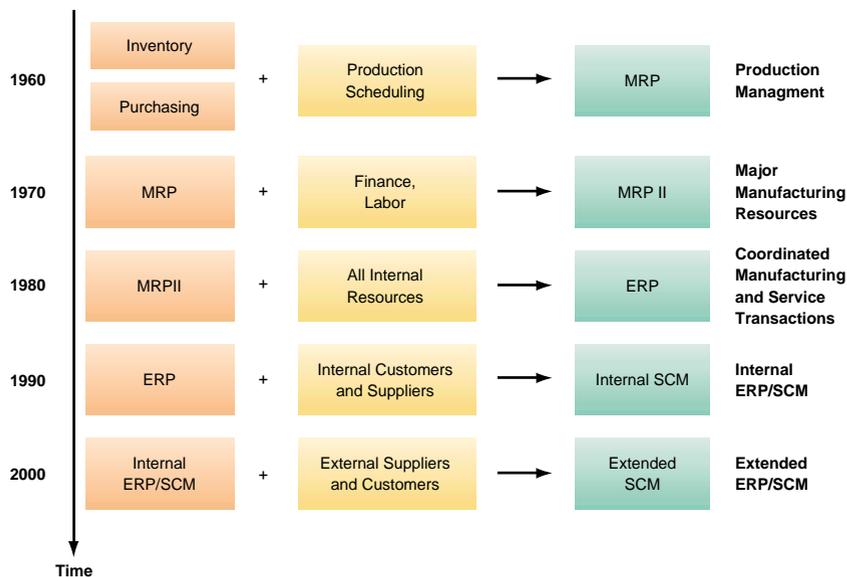
This evolution continued, leading to the **enterprise resource planning (ERP)** concept, which expanded MRP II to other activities in the entire enterprise. ERP was confined initially to include internal suppliers and customers, but later it incorporated external suppliers and customers in what is known as *extended ERP software*. (We look at ERP again in more detail in Section 10.4.)

The above evolution of computerized integrated systems is shown in Figure 10.4. The next step in this evolution, which is just beginning to make its way into business use, is the inclusion of markets and communities. (See *mySAP.com* for details.)

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). The question is—why?

### Why 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 they need to be



**Figure 10.4** The evolution of integrated systems.

processed together. In many cases employees simply do not get the information they need, or they get it too late.

The following are the major tangible and intangible benefits of systems integration (in 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 and 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 in both types of benefits many items are directly related to improved supply chain management.

## Supply Chain and Value Chain Integration

The 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. This requires flexibility of the integrated systems.

**Types of integration: from supply to value and system chains.** The most obvious integration is of the segments of the supply chain and/or of the information that flows among the segments. But there is another type of integration, related to what are called value chains. The term **value chain** (Chapter 13) describes the primary activities of an organization (inboard logistics, operations, etc.), along with its support activities (infrastructure, human resources, technology, etc.), and the net value that is added to the organization's product or service by each primary activity, sequentially.

Traditionally, we thought of the value chain in terms of one organization's primary activities such as purchasing, transportation, warehousing, and logistics. However, when the value chain is extended to include suppliers, customers, and so forth, it becomes a **value system**, or **integrated value chain** (Chapter 13). 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 manage (electronically as well as physically) the flow of goods, services, and information along their entire joint chain in a manner that increases customer-perceived value (*value proposition*). This process optimizes the efficiency of the chain, creating competitive advantage for all stakeholders in their own value chains.

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 is transformed into an integrated value chain when it:

- Extends the chain all the way from subsuppliers (tier 2, 3, etc.) to customers
- Integrates back-office operations with those of the front office
- Becomes highly customer-centric, focusing on demand generation and customer service as well as demand fulfillment and logistics
- Is proactively designed by chain members to compete as an extended enterprise, creating and enhancing customer-perceived value by means of cross-enterprise collaboration
- Seeks to optimize the value added by information and utility-enhancing services

## 10.2: How Warner-Lambert applies an integrated supply chain

One of Warner-Lambert's major products is Listerine antiseptic mouthwash (now a division of Pfizer). The materials for making Listerine come from eucalyptus trees in Australia and are shipped to the Warner-Lambert (W-L) manufacturing plant in New Jersey, USA. The Listerine is distributed by wholesalers and by thousands of retail stores, some of which are giants such as Wal-Mart. The problem that W-L faces is to *forecast the overall demand* in order to determine how much Listerine to produce. A wrong forecast will result either in high inventories, or in shortages. Inventories are expensive to keep, and shortages may result in loss of revenue and reputation.

Warner-Lambert forecasts demand with the help of Manugistic Inc.'s Demand Planning Information System. (Manugistic is a vendor of IT software for SCM.) Then the system analyzes manufacturing, distribution, and sales data against expected demand and business climate information. Its goal is to help W-L decide how much Listerine (and other products) to make and distribute and how much of each raw ingredient is needed, and when. The sales and marketing group of W-L enters the expected demand for Listerine into another SCM software) which schedules the production of Listerine in the amounts needed and generates electronic purchase orders for W-L's suppliers.

W-L's supply chain excellence stems from the Collaborative Planning, Forecasting, and Replenishment (CPFR) program. This is a retailing-industry project for which piloting was done at W-L. In the pilot project W-L

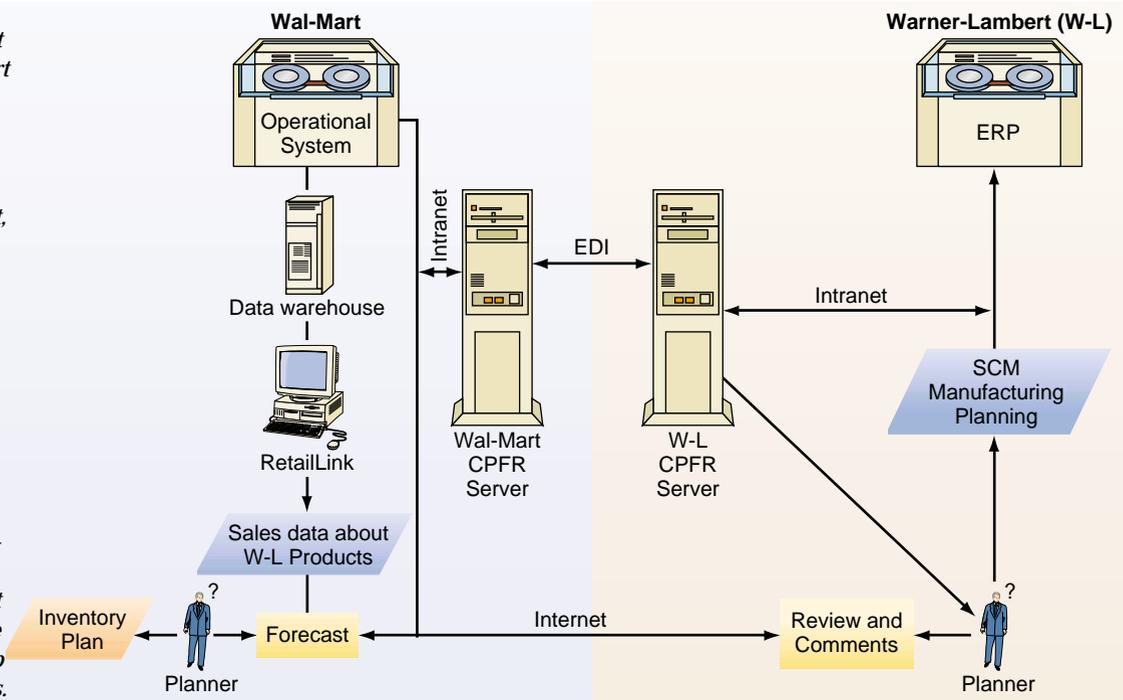
shared strategic plans, performance data, and market insight with Wal-Mart over private networks (see the figure). The company realized that it could benefit from Wal-Mart's market knowledge, just as Wal-Mart could benefit from W-L's product knowledge. In CPFR, trading partners collaborate on demand forecast. The project includes major SCM and ERP vendors such as SAP and Manugistics. During the CPFR pilot, W-L increased its products' shelf-fill rate—the extent to which a store's shelves are fully stocked—from 87 percent to 98 percent, earning the company about \$8 million a year in additional sales for much less investment. W-L is now using the Internet to expand the CPFR program to all its suppliers and retail partners.

Warner-Lambert is involved in another collaborative retail-industry project, the Supply-Chain Operations Reference (SCOR), an initiative of the Supply-Chain Council in the United States. SCOR divides supply chain operations into parts, giving manufacturers, suppliers, distributors, and retailers a framework with which to evaluate the effectiveness of their processes along the same supply chains.

### Questions

1. Can you identify other industries, besides retailing, for which a similar collaboration would be beneficial?
2. Why was Listerine a target for the pilot SCM collaboration?

*A CPFR project. In a pilot project, Wal-Mart has used the CPFR to link up with one of its key suppliers, Warner-Lambert, manufacturer of consumer products like Listerine. Through CPFR workbenches (spreadsheet-like documents with ample space for collaborative comments), Wal-Mart buyers and Warner-Lambert planners are able to jointly develop product forecasts.*



Presently only a few large companies are successfully involved in a comprehensive collaboration to reengineer the value system. One such effort is described in IT's About Business 10.2, a case about Warner-Lambert, manufacturer of consumer products like Listerine.

Through CPFR workbenches (spreadsheet-like documents with ample space for collaborative comments), Warner-Lambert (W-L) planners and buyers from Wal-Mart, a giant buyer of W-L products, are able to jointly develop forecasts of overall product demand. Such forecasts help guide W-L's production planning for its manufacturing plants. This kind of collaboration is referred to as **collaborative commerce networks**, a type of *collaborative commerce* (see Chapter 9).

Another example of supply chain 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. Finally, one should distinguish between integration inside a company (integrating the information systems of departments, connecting to database, connecting the ordering system to the back-end production activities), and interorganizational system integration (connecting systems of different organizations).

### Before you go on . . .

1. Trace the evolution from MRP to ERP.
2. Describe the need for software integration.
3. Define value chain and value system.

## 10.4 ENTERPRISE RESOURCE PLANNING (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. The integrated solution known as **enterprise resource planning (ERP)** is a process of managing all resources and their use in the entire enterprise in a coordinated manner. ERP's major objective is to *integrate all departments and functions across a company* onto a single information system that can serve all of the enterprise's needs. 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, quality, and profitability, and it increases customer satisfaction. The implementation of ERP is done by commercial software available from companies such as SAP, Oracle, and PeopleSoft. An ERP implementation is illustrated in IT's About Business 10.3.

ERP software crosses functional department lines. It includes dozens of integrated modules such as sales, procurement, inventory control, manufacturing scheduling, accounts payable, accounts receivable, payroll, monthly financial statements, and systems management. An ERP suite provides a single interface for managing all the routine activities performed in manufacturing—from entering sales orders to coordinating shipping and after-sales customer service. As of the late 1990s, ERP systems have begun to be extended along the supply chain to suppliers and customers, incorporating functionality for customer interaction and for managing relationships with suppliers and vendors.



### 10.3: 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 com-

pany to access more timely and accurate data, and reduce costs (see figure at our Web site).

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 and act locally. Colgate's U.S. division installed SAP R/3 for this purpose (see description of SAP R/3 on the book's Web site).

#### Questions

1. Draw the supply chain of Colgate's toothpaste. (To do so, you need to find how the product is made and distributed.)
2. What role does the ERP software play?
3. What benefits can customers, like yourself, derive from the ERP?

But ERP was never meant to fully support supply chains. ERP solutions are centered around *business transactions*. As such, they do not provide the computerized decision support needed to respond rapidly to real-time changes in supply, demand, labor, or capacity. This deficiency has been overcome by the second generation of ERP.

### Second-Generation ERP

ERP has traditionally excelled in the 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. The reports generated by 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—planning that continues to refine and enhance the plan as changes and events occur, up to the very last minute before executing the plan. First-generation ERP systems did not support decision making either. To get such support for segments of the supply chain, companies used standalone (unintegrated) *supply chain management (SCM) software*.

**SCM software.** Planning systems oriented toward *decision making* were provided by SCM software. To illustrate, consider how ERP and SCM approach an order-processing problem. There is a fundamental difference: The question in SCM becomes “Should I take your order?” instead of the ERP approach of “How can I best take or fulfill your order?” The following example demonstrates how SCM software works.

## EXAMPLE

**IBM links its global supply chain with SCM software.** IBM reengineered its global supply chain in order to achieve quick responsiveness to customers and to do so with minimal inventory. To support this effort, it developed a supply chain analysis tool called the Asset Management Tool (AMT). AMT integrates analytical performance optimization, simulation, activity-based costing, graphical process modeling, and enterprise database connectivity into a system that allows quantitative analysis of extended supply chains. IBM has used AMT to study such issues as inventory budgets, customer-service targets, and new-product introductions. The system was implemented at a number of IBM business units and their supply chain partners. AMT benefits include savings of over \$750 million in material costs and reductions in administrative expenses each year. ●

However, SCM solutions need to be coordinated, and they sometimes require information provided by ERP software. Therefore, it makes sense to integrate ERP and SCM.

**Integrating ERP and SCM.** How is ERP/SCM integration done? One approach is to work with different software products from different vendors. For example, a company might use SAP R/3 as an ERP and add to it Manugistics' manufacturing-oriented SCM software (as shown in the Warner-Lambert case). Such an approach, which is known as the *"best of breed" approach*, requires fitting different softwares, from different vendors, which may be a complex task unless special interfaces exist.

**Table 10.2 Comparing SCM and SCI**

<i>Supply Chain Management (SCM)</i>	<i>Supply Chain Intelligence (SCI)</i>
Largely about managing the procurement and production links of the supply chain. life cycle.	Provides a broad view of an entire supply chain to reveal full product and component
Transactional.	Analytical.
Tactical decision making.	Strategic decision making.
Helps reduce costs through improved operational efficiency.	Reveals opportunities for cost reduction, but also stimulates revenue growth.
Usually just the SCM application's data (as a vertical stovepipe).	Integrates supplier, manufacturing, and product data (horizontal).
Records one state of data, representing "now".	Keeps a historic record.
Assists in material and production planning. data.	Does what-if forecasting based on historic
Quantifies cost of some materials.	Enables an understanding of total cost.
Shows today's yield but cannot explain influences on it; thus provides no help for improvements.	Drills into yield figures to reveal what caused the performance level, so it can be improved.
Simple reporting.	Collaborative environment with personalized monitoring of metrics.

Source: P. Russom, "Increasing Manufacturing Performance Through Supply Chain Intelligence," *DM Review*, (September 2000).

The second approach is for the ERP vendors to add SCM functionalities, such as decision support and *business intelligence* capabilities. **Business intelligence** refers to analysis performed by DSS, EIS, data mining, and intelligent systems (see Chapters 11 and 12). These added capabilities solve the integration problem. But as is the case with integration of database management systems and spreadsheets in Excel, the result can be a product with some not-so-strong functionalities. However, most ERP vendors are adding such functionalities for another reason: It is cheaper for the customers. Packages with these added functionalities represent the **second-generation ERP**, which includes not only decision support but also customer relationship management (CRM) (Chapter 8), e-commerce (Section 10.5), and data warehousing and mining (Chapter 11). Some second-generation systems include a *knowledge management* (Chapter 11) component as well.

**Supply chain intelligence.** The inclusion of business intelligence in supply chain software solutions is referred to by some as **supply chain intelligence (CSI)**. CSI applications enable strategic decision making by analyzing data along the entire supply chain. To better understand CSI, it is worthwhile to compare it with SCM, as shown in Table 10.2.

### *Before you go on . . .*

1. Define ERP and its functionalities.
2. Describe SCM software.
3. Describe the second-generation ERP (integrated ERP/SCM).
4. What is supply chain intelligence?

## 10.5 E-COMMERCE AND SUPPLY CHAIN MANAGEMENT

E-commerce is emerging as a superb approach for providing solutions to problems along the supply chain. As seen in the Dell example at the beginning of the chapter, many supply chain activities, from taking customers' orders to parts procurement, can be conducted as EC initiatives.

### EC Activities Along the Supply Chain

A major role of EC is to facilitate buying, selling, and collaborating along the supply chain. Here we describe the types of EC activities along the supply chain.

**Upstream activities.** Several innovative EC models can improve the upstream supply chain activities. These models are described generally as *e-procurement*. Three are presented in Chapter 9: reverse auctions, aggregation of vendors' catalogs at the buyer's site, and procurement via consortia and group purchasing.

**Internal SCM activities.** Internal SCM activities include different *intra-business EC* activities. These activities range from entering orders of materials, to streamlining production, to recording sales, to tracking shipments. They are usually conducted over a corporate intranet. Details and examples are provided in Chapters 8 and 9.

**Downstream activities.** Typical EC downstream activities are related to online selling as described in Chapters 8 and 9. Two popular models of downstream activities follow.

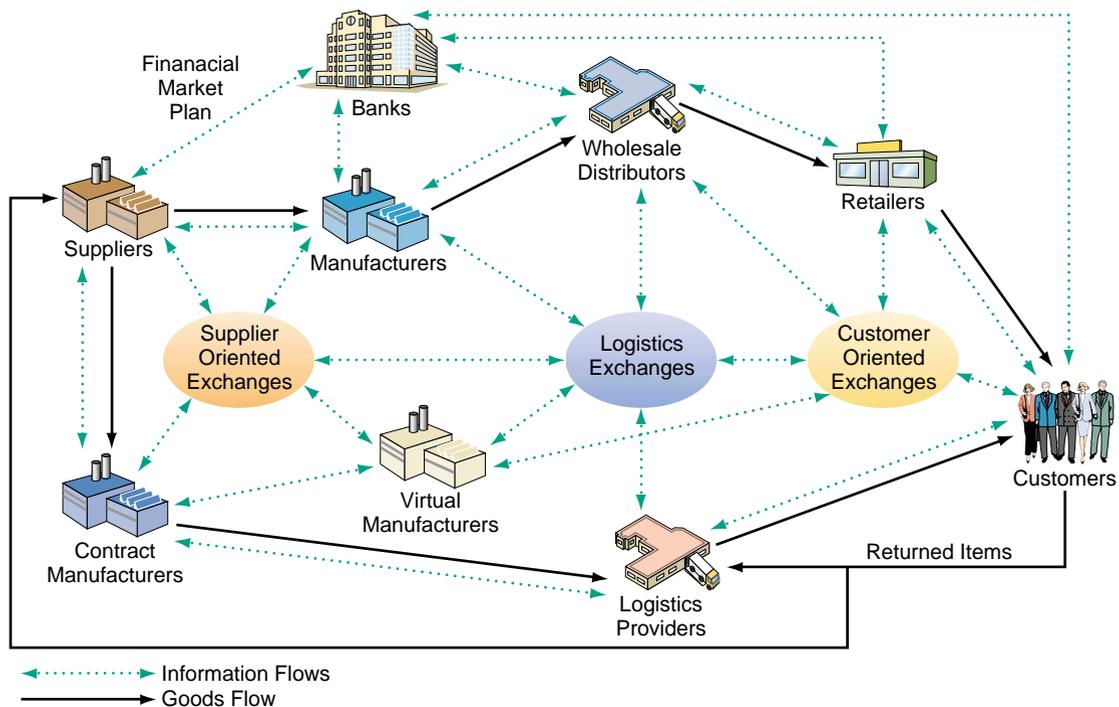
**Selling on your own Web site.** Large companies such as Intel, Cisco, and IBM use this model. At the company's own Web site, buyers review electronic catalogs from which they buy. Large buyers are provided with their own Web pages and customized catalogs.

**Auctions.** Large companies such as Dell conduct auctions of products or obsolete equipment on their Web sites. Electronic auctions can shorten cycle time and the supply chain and save on logistics and administrative expenses. One online auctioneer, for example, is Autodaq (*autodaq.com*). The buyers are car dealers who then resell the used cars (the transaction is B2B2C). 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 \$500 per car can be realized.

**Exchanges.** Considerable support to B2B supply chains can be provided by electronic exchanges (Chapter 9). Such exchanges are shown in Figure 10.5. Notice that in this example there are three separate exchanges. In other cases there may be only one exchange for the entire industry.

## Restructuring the Supply Chain

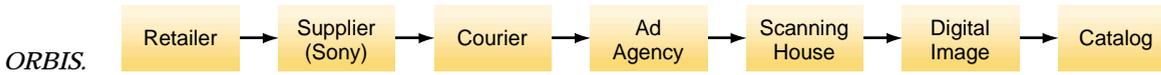
E-commerce can introduce structural changes in the supply chain. For example, the creation of electronic markets drastically changes order processing and fulfillment. In many cases, linear supply chains are changed to hubs, as shown in the case of ORBIS Corp. in IT's About Business 10.4.



**Figure 10.5** Web-based supply chain involving exchanges.



## 10.4 Orbis changes a linear physical supply chain to an electronic hub



Orbis Corp. is a small Australian company that provides Internet and EC services. One of its services is called ProductBank ([productbank.com.au](http://productbank.com.au)). This service revolutionized the flow of information and products in the B2B advertising field. In order to understand how the service works, let's look at how a retail catalog or brochure is put together. A catalog shows pictures of many products. These pictures are obtained from manufacturers such as Sony or Nokia. The traditional process is linear, as shown in the figure.

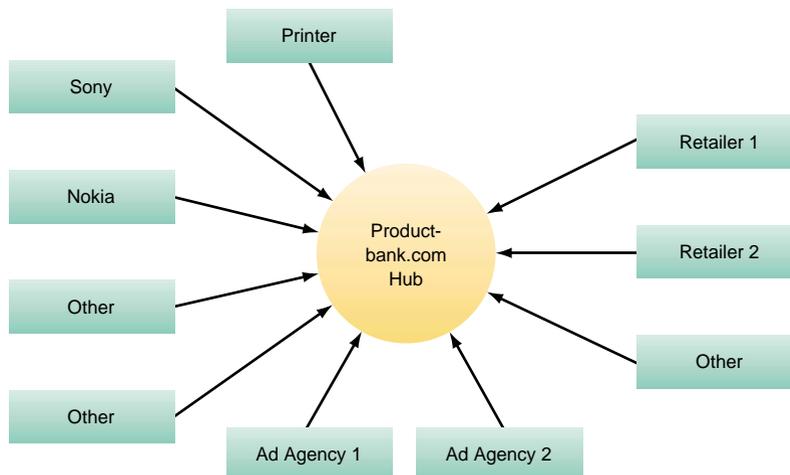
The traditional process works like this: When retailers need a photo of a product they contact the manufacturers, who send the photos via a courier to an ad agency. The ad agency decides, in cooperation with the retailer, which photos to use and how to present them. The ad agency then rushes the photos to be scanned and converted into digital images, which are transferred to the printer. The cycle time for each photo is 4 to 6 weeks, and the total transaction cost of preparing one picture for the catalog is about \$150 AU.

ProductBank simplifies this lengthy process. It has centralized the entire process by changing the linear flow of products and information to a digitized hub as shown in the figure.

With the new system, manufacturers send digitized photos to Orbis, and Orbis enters and organizes the photos in a database. When retailers need pictures, they can view online the images in the database and decide which they want to include in their catalog. The retailers communicate electronically with their ad agency about what images they want to include in their catalogs. The ad agency makes suggestions and works on the design of the catalog. Once the design is complete, the catalog can be downloaded by the printer. The transaction cost per picture (usually paid by the manufacturer) is 30 to 40 percent lower, and the cycle time is 50 to 70 percent shorter than in the traditional catalog production method.

### Questions

1. Identify the benefits to the supply chain participants.
2. Where does the cost reduction come from?
3. Where does the cycle time reduction come from?
4. Explain the benefits of electronic collaboration between the catalog owners and the ad agency.



## Integration of EC with ERP

Since many middle-sized and large companies already have an ERP system, and since e-commerce needs to *interface* with ERP, it makes sense to integrate the two. 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 user-friendly graphical interfaces.

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 tend to focus on back-office (administrative) applications, whereas EC focuses on front-office applications such as sales and order taking, customer service, and other customer relationship management (CRM) activities. Ideally, one should attempt to achieve tight integration along the entire supply chain as done by McKesson, described in IT's About Business 10.5.



### IT's About Business

[mckesson.com](http://mckesson.com)

#### 10.5: How McKesson integrates the pharmaceutical supply chain

McKesson Drug Company is the largest U.S. distributor of pharmaceuticals, healthcare products, medical supplies, and related products ([mckesson.com](http://mckesson.com)). It is positioned between manufacturers and retailers and other business customers, such as hospitals. Its supply chain is shown in Figure 10.3a.

With annual sales of over \$22 billion and close to 40,000 business customers, who generate over 2,000,000 purchasing orders every month, for thousands of products, the supply chain and its management are rather complex.

Effectiveness and efficiency, which are needed for survival, can be achieved only with a tight integration with both the major customers and the suppliers. To enable such integration with its major customers (such as CVS drug chain and Rite Aid), McKesson assumed the responsibility of monitoring and replenishing the inventory of its major products at the store level. In other cases, virtually all purchasing orders are submitted to McKesson electronically. Once submitted, orders are organized by region and stored on a mainframe. Regional distribution centers pull the orders daily and make the necessary deliveries. In addition, all payments are made online.

McKesson provides its business customers with Web-based up-to-date sales data, by product and by store, enabling the customers to make better marketing, promotions, inventory, and pricing decisions. The tight software integration with the customers on the *downstream side* of the supply chain enables better demand forecast, which results in lower inventories and elimina-

tion of the bullwhip effect discussed earlier. On the *upstream side*, McKesson uses e-procurement with its major suppliers. It also collaborates with them electronically on demand forecasts by product. Finally, McKesson uses an elaborate intrabusiness e-commerce system between its headquarters, the distribution centers, and the transportation units (company owned and outsourced). All documentation flows electronically in the system. Also, warehouse management and order pick-ups are computerized to minimize pickers' efforts.

The benefits to McKesson of its integration of the supply chain include rapid, reliable, and cost-effective customer order processing. Sales personnel are no longer primarily order takers; they can do proactive marketing. Purchasing from suppliers has been reorganized to tightly match actual sales, and productivity of the warehouse staff has been significantly increased. Finally, customers are more loyal to McKesson because of the benefits they enjoy.

#### Questions

1. Enter [mckesson.com](http://mckesson.com) and identify any new supply-chain related initiatives.
2. Identify the B2B2C activities used by McKesson.
3. In theory, manufacturers can sell direct to retailers, eliminating McKesson. Explain McKesson's strategy to protect itself. Is the company likely to be successful? Why or why not?



### Manager's Checklist 10.2

How E-Commerce Activities Can Improve SCM

- Digitized products (such as software) are much cheaper and faster to create and move than are physical products.
- Replacing paper documents with electronic documents improves speed and accuracy, and the cost of document transmission is much cheaper.
- Replacing faxes, telephone calls, and telegrams with an electronic messaging system streamlines communications and cuts communications costs.
- Restructuring the supply chain from linear to a hub (as shown in the Orbis case, in IT's About Business 10.4) enables faster, cheaper, and better communication, collaboration, and discovery of information.
- Enhancing collaboration and information sharing among the partners in the supply chain can improve cooperation, coordination, and demand forecasts.
- EC can shorten supply chains and minimize inventories. As a result of the build-to-order model provided by EC, the auto industry, for example, is expected to save billions of dollars annually in inventory reduction alone.
- Innovations such as FAQs and the self-tracking of shipments can reduce the need for information flow between companies and customers.
- E-marketplaces bring efficiencies into buying and selling, as shown in Chapter 9.

Other e-commerce activities can make significant contributions to SCM improvement, as suggested in Manager's Checklist 10.2.

#### *Before you go on . . .*

1. Describe how EC improves activities along the major segments of the supply chain.
2. Explain how EC changes the linear supply chain to a hub.
3. Describe the need of integrating EC with ERP.

## 10.6 ORDER FULFILLMENT IN E-COMMERCE

In the previous section we described how e-commerce tools can solve problems 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*. Let's explain.

### Order Fulfillment and Logistics: An Overview

**Order fulfillment** refers not only to providing the customers with what they ordered and doing it on time, but also to providing all related customer service. To do so in e-tailing one must send small packages to a large number of customers. In contrast, in traditional retailing you ship large quantities to a small number of retail stores. Therefore, e-tailers face several problems in order fulfillment, especially during the holiday season. The problems occur in storage, picking up items, packaging, and shipping, all of which must be done effectively at a minimum cost. These problems result in inability to

deliver on time, delivery of wrong items, paying too much for deliveries, and costly compensation of unhappy customers. Taking orders over the Internet could well be the easy part of B2C electronic commerce. Fulfillment to customers' door is the tricky part.

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. One factor that is typical of EC is that it is 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 *production to inventory*, which is then *pushed* to customers. In the pull case it is more difficult to forecast demand, due to the unique nature of customized orders.

## Innovative Solutions to the Order Fulfillment Problem

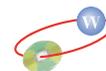
During the last few years companies have developed innovative solutions to both B2C and B2B order fulfillment. Here are some examples.

**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. Delivering groceries is an example where speed is important. Quick deliveries of pizzas have been practiced for a long time using telephone ordering. Many restaurants use the same approach, which is known as “dine online.” Online ordering can be much more efficient.

### EXAMPLE

**Dialing for dinners.** Some dine online companies offer aggregating services, which process orders for several restaurants (e.g., Campusfood.com and Dialadinner.com.hk) and also make the deliveries. Here is how it works in Hong Kong: Customers click on the online menu at *dialadinner.com.hk*, select the dishes they want, then submit their order electronically. Sometimes customers can even mix and match orders from two restaurants. For first-time customers, a Dialadinner staff member phones to check delivery details and to confirm that the order is genuine. The orders are forwarded electronically from Dialadinner to the participating restaurants. Delivery staff receives a copy of the order by e-mail (SMS) on their mobile phones, telling them which restaurant to go to. There, they are handed the food and delivery details. Delivery is made in small cars or on motorcycles (see photo). Customers receive their meals and pay cash on delivery. Average time from order to delivery is 30 to 40 minutes. For other examples of quick delivery, see *Asameday.com* and *Xmessenger.com*. ●

**Automated warehouses.** Traditional warehouses are built to deliver *large quantities* to a *small number* of stores or manufacturing plants. In B2C EC, companies need to send *small quantities* to a *large number* of individual customers. The picking and packing process therefore is different, and usually more labor intensive. Therefore, large-volume EC fulfillment requires special, possibly automated, warehouses, which may include robots and other devices that expedite the pickup of products. Several large e-tailers, such as Amazon.com, operate their own warehouses. However, most order fulfillment is probably shipped via outsourcers. For a description of how a typical automated warehouse would work, see the book's Web site.



## Dealing with Returns

Returning unwanted merchandise and providing for exchanges are necessary for maintaining customers' trust and loyalty. The Boston Consulting Group found that “absence of good return mechanism” was the second biggest reason that U.S. shoppers cited for refusing to buy on the Web. For their part, merchants face the major problem of how to deal with returns. Several options exist:

1. 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. Neither is the seller, who must unpack the item, check the paperwork, and resell the item, usually at a loss. This solution is good only if the number of returns is small.
2. Separate the logistics of returns from the logistics of delivery. Returns are shipped to an independent unit and handled separately inside the company. This solution may be more efficient from the seller's point of view, but the buyer is still unhappy.
3. Allow the customer to physically drop the returned items at collection stations (such as at 7-Eleven stores or Mail Boxes Etc.), from which the returns can be picked up. For example, BP Australia Ltd. (operator of gasoline service stations) teamed up with Wishlist.com.au, to accept returns. Caltex Oil of Australia also provides such service at their convenience stores.
4. Completely outsource the logistics of returns. Several outsourcers, including United Postal Service (UPS), provide such services. The services they offer deal not only with returns, but also with the entire logistics process of deliveries.

### *Before you go on . . .*

1. Describe the order fulfillment process.
2. Explain the same-day delivery process.
3. Describe the role of automated warehouses in the logistics of e-commerce.
4. List the difficulties of handling returns and describe the solutions.

## WHAT'S IN IT FOR ME?

ACC

### FOR THE ACCOUNTING MAJOR

The accounting information systems (part of the back-end systems) are a central component in any ERP package. As a matter of fact, all large CPA firms actively consult clients on ERP implementation, using thousands of specially trained accounting majors. Also, many supply chain issues ranging from inventory management and valuation to risk analysis are in the realm of accountants. Finally, many SCM software packages are available to support your job.

FIN

### FOR THE FINANCE MAJOR

Starting with MRP II and continuing with ERP, finance activities and modeling are integral portions of all such commercial software packages. Flows of funds (payments) are at the core of most supply chains, and they must be done efficiently and effectively. Financial arrangements are especially important along global supply chains where currency convention and financial regulations must be considered.

MKT

### FOR THE MARKETING MAJOR

The downstream part of supply chains is where marketing, distribution channels, and customer service are conducted. An understanding of how this portion of the supply chain is related to the other portions is critical. Supply chain problems hurt customer

satisfaction and marketing efforts, so you need to understand the nature of such problems and their solutions.

#### FOR THE PRODUCTION/OPERATIONS MANAGEMENT MAJOR

Supply chain management is usually the responsibility of the POM departments since it involves material handling, inventory control, logistics, and other activities done by that department. The POM department started the trend of software integration with MRP. Many of the SCM innovations are in the realm of the POM department. As a matter of fact, almost all POM majors will deal with supply chain issues and its software support once they are employed.

POM

#### FOR THE HUMAN RESOURCES MANAGEMENT MAJOR

Interactions among employees along the supply chain, especially between business partners from different countries, are important for supply chain effectiveness. It is a necessity, therefore, for the HRM expert to understand the flows of information and the collaboration issues in SCM. (For example, more than 10,000 employees lost their jobs in eight industries when fewer people needed food on airlines after the September 11, 2001 terrorist attack—see Team Activities and Role Playing 3.)

HRM

#### FOR THE MIS MAJOR

MIS

#### FOR THE NONBUSINESS MAJOR

Everyone should understand the nature of supply chains and their problems. Supply chains are everywhere, from the supermarket to your application for a loan. You, as a customer, may be the victim of a poor supply chain. It will help if you have answers to these questions: What are the problems of supply chains? What are the solutions? And what role does IT play?

## SUMMARY

- 1 Understand the concept of the supply chain, its importance, and its management.**  
Supply chains connect suppliers to a manufacturing company, departments inside a company, and a company to its customers. To properly manage the supply chain, it is necessary to assure superb customer service, low cost, and short cycle time. The supply chain must be completely managed, from the raw material to the end customers.
- 2 Describe the various types of supply chains.**  
The major types are: manufacture to inventory, build-to-order, and continuous replenishment. Either type can be global or local.
- 3 Describe the problems in managing supply chains.**  
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. One of the major problems is known as the bullwhip problem, where lack of coordination results in large, unnecessary inventories.
- 4 Describe the major categories of supply chain solutions.**  
Solutions to SCM problems are provided via SCM functional software, ERP integrated software, and e-commerce applications. Innovative solutions also require cooperation and coordination with business partners, which is facilitated by IT innovations such as extranets that allow suppliers to view a company's inventories in real time.

**5 Explain the need for software integration and describe the available software.**

Functional software is designed for departments, and it is difficult to integrate it for enterprisewide applications. Therefore, during the last 50 years, software integration has increased both in coverage and scope, from MRP to MRP II, to ERP, to enhanced ERP. Today, ERP software, which is designed to improve standard business transactions, is enhanced with decision-support capabilities as well as Web interfaces.

**6 Explain how EC improves supply chain management.**

Electronic commerce is able to provide new solutions to problems along the supply chain by automating processes and integrating the company's major business activities with both upstream and downstream entities via an electronic infrastructure.

**7 Describe EC order-fulfillment problems and solutions.**

Order fulfillment in EC is difficult due to the need to ship small packages to many customers' doors. Outsourcing the logistics and delivery jobs is common, especially when same-day delivery is needed. Special large and automated warehouses also help in improving EC order fulfillment.


**INTERACTIVE LEARNING SESSION**
**DISCUSSION QUESTIONS**

1. What is the role of inventories in SCM, and why it is difficult to manage them?
2. Discuss what it would be like if the registration process and class scheduling process at your college or university were reengineered 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 to reengineer.) Describe the supply chain in this situation.
3. Discuss how cooperation between a company that you are familiar with and its suppliers can reduce inventory costs.
4. Find examples of how organizations improve their supply chains in two of the following: manufacturing, hospitals, retailing, education, construction, or transportation.
5. Discuss the problem of reverse logistics in EC. What kind of companies may suffer the most?
6. Discuss the meaning of intelligence in "supply chain intelligence."
7. Explain the bullwhip effect. In which type of business it is likely to occur most? How can the effect be controlled?

**PROBLEM-SOLVING ACTIVITIES**

1. Draw the supply chain of Dell and a supply chain of a competitor that sells in retail stores. Comment on the differences.
2. Review the Warner-Lambert Listerine case and draw W-L's supply chain. How was W-L's supply chain improved with IT?
3. 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 of a diagram is recommended.
4. Go to a bank and find out the process and steps of obtaining a mortgage for a house. Draw the supply chain. Now assume that some of the needed information, such as the value of the house and the financial status of the applicant, is found in a publicly available database (such a database exists in Hong Kong, for example). Draw the supply chain in this case. By how much can the cycle time be reduced?

## INTERNET ACTIVITIES

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* and *cio.com*, and identify recent issues in supply chain management. Also find information about SCOR and CPFR (try *cpfr.org*).
3. Enter *isourceonline.com*, *supplychaintoday.com*, and *tilion.com*. Find information on the bullwhip effect and on the strategies and tools used to lessen the effect.
4. Enter *coca-colastore.com*. Examine the delivery and return options available there.
5. Enter *oracle.com* and identify the solutions offered there for supply chain problems.
6. The U.S. post office is entering EC logistics. Examine its services and tracking systems at *uspsprioritymail.com*. What are the potential advantages for EC shippers?
7. Enter *brio.com* and identify Brio's solution to SCM integration as it relates to decision making for EC. View the demo.
8. Enter *mysap.com*. Identify its major components. Also review the Advanced Planning and Optimization tool. How can each benefit the management of a supply chain?
9. Enter *kewill.com*. Examine the various products offered there, including Commander WMS. Relate this to SCM.
10. Enter *frictionless.com* and find how Frictionless Sourcing eliminates supply chain inefficiencies. Follow the demo. Submit a report.
11. Enter *i2.com* and review its SCM products that go beyond ERP. Examine the OCN Network and Rhythm. Write a report.

## TEAM ACTIVITIES AND ROLE PLAYING

1. Each team will be assigned to a major ERP 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.
  - e. Availability of ASP services.

Each group will prepare a presentation for the class, trying to convince the class why its software is best for a local company known to the students (e.g., a supermarket chain).
2. Assign each team to one type of supply chain, such as build-to-order or continuous replenishment. The team should find two examples of the assigned type, draw the supply chains, and explain the IT and EC solutions used.
3. Assign teams to investigate the impact of the September 11, 2001 terrorist attacks on the following supply chains:
  - a. Food served on airlines
  - b. Manufacturers of security devices in airports
  - c. Security checkpoints in airports
  - d. Airline flights

## REAL-WORLD CASE

### Quantum Corporation Streamlines Its Supply Chain

**The Business Problem** 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 Quantum's component supply process in order to lower 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, and provide the company's purchasing agents with more time for nontransactional tasks.

Quantum's second challenge was to improve the quality of the component 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 IT Solution** The solution that Quantum chose to automate its component supply process was an inter-enterprise system that automatically e-mails reorders to suppliers. Initiated in 1999, the system uses an innovative event detection and notification solution from Categorical 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 generated and sent to suppliers as needed, allowing suppliers to make regular deliveries that match Quantum's production schedule.

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 Xalerts 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 (see the attached screen).

**The Results** The system has produced the desired results. For example, the estimated value of the improved

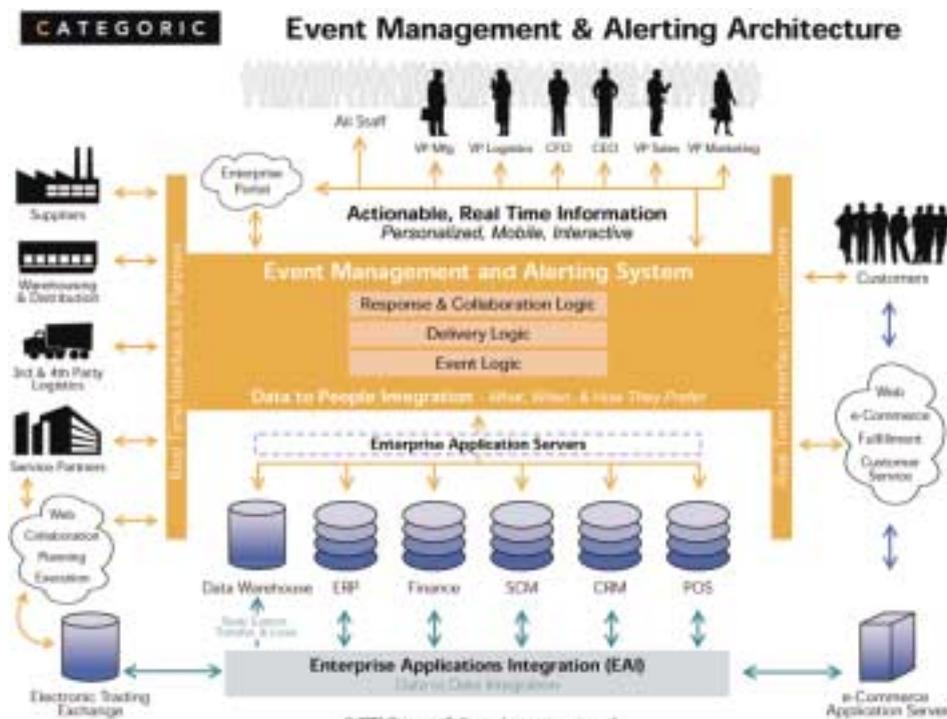
ordering process using the new system is millions of dollars in inventory reductions each year. The buyers have reduced transaction tasks and costs, and both Quantum and its buyers get a lot more information with a lot less work. Before the implementation of Xalerts, Quantum's analysts would search massive 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* (October 1, 1999), and from information at *categoric.com* (November 2001).

### Questions

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 supply-chain products, especially on Xalerts. Describe the capability of the product (review the screen).
3. Explain how purchasing was improved.
4. Describe how Quantum's customers are now being better served.





## *VIRTUAL COMPANY ASSIGNMENT*

A large, empty rectangular box with rounded corners and a blue border, intended for the student to complete the assignment.