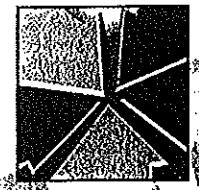
E. Turban et Al (2002). Information Technology for Management

Supply Chain Management and Enterprise Resource Planning (ERP)



HOW DELL REENGINEERED AND MANAGES ITS SUPPLY CHAIN

THE PROBLEM

Michael Dell started his business as a student, from his university dorm, by using a mail-order approach to 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 specifications of the customer. The direct mail approach enabled Dell to underprice his rivals, who were using distributors and retailers, by 10 percent. For several years the business grew slowly, but Dell constantly captured market share. In 1993, Compaq, the PC market leader at that time, decided to drastically cut prices to drive Dell out of the market. As a result of the price war, Dell Computer Inc. 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.

www.dell.com

THE SOLUTION

Dell realized that the only way to win the marketing war was to introduce fundamental changes, termed *business process reengineering* (Chapter 8), in its own business, and along the supply chain, from its suppliers all the way to its customers. 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, the computer will be on the delivery truck the next day; a complex custom-made PC will be delivered in 5 days or less. Among the innovations used to reengineer the business were:

- Dell uses an approach called *mass customization*, meaning that it produces large quantities of customized products, at a low cost. Though the approach wasn't a new one, Dell was the first to use it in marketing computers.
- Dell builds many 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.
- Component warehouses, which are maintained by Dell's suppliers, are located within 15 minutes of Dell factories. Not only can Dell get parts quickly, but it can get parts that are up to 60 days newer than those of its major competitors.
- Most orders from customers and to suppliers are done on the Web.
- Shipments, which are done by UPS and other carriers, are all arranged electronically.
- Dell collaborates electronically with its major buyers to pick customers' 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 cooperation with another vendor reduced the testing period from 60 or 90 days to 15.
- Dell's employees constantly monitor productivity and rate of return on investment (ROI), on all products.

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Most significant for Dell has been the emergence of *electronic commerce*. In 2001, Dell was selling more than $4.0 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. Dell is aiming to sell most of its computers from its Web site (*dell.com*).

Dell is frequently cited as an example of a top customer relationship management (CRM) provider. The CRM activities are integrated with customers' ordering and order fulfillment. Customers can track their orders online, to see if the computers are in production or already on the shipping track. They also can access detailed diagrams of the computers and get information about troubleshooting. By using viewer-approved configurations and pricing for its customers and by eliminating paperwork, Dell has been able to cut administrative-process expenses by 15 percent.

In addition, Dell created customized home pages for its biggest corporate customers, such as Eastman Chemical, Monsanto, and Wells Fargo. These sites, known as Premier Pages, enable customers' employees to use Dell's provided configuration and workflow software to design computers, get an order approved inside the client organization, and place orders quickly and easily. These employees can also order PCs for their own homes and receive the corporate price! The electronic ordering makes customers happy, but it also enables Dell to collect payments very quickly.

Once orders are received they are transferred electronically to the production floor. Intelligent systems prepare the required parts and components list for each computer, and check availability. If not in stock, components are ordered electronically directly from suppliers who can sometimes deliver in less than 60 minutes. Dell uses several other information technologies, including e-mail, EDI, video teleconferencing, electronic procurement, computerized faxes, an intranet, DSS, and a Web-based call center. 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 passes along data about its defect rates, engineering changes, and product enhancements to its suppliers. Since both Dell and its suppliers are in constant communication, the margin for error is reduced. Also, employees are now able to collaborate in real time on product designs and enhancements. In turn, suppliers are required to share with Dell sensitive information, such as their own quality problems. It was easy to get suppliers to follow Dell's lead because they also reap the benefits of faster cycle times, reduced inventory, and improved forecasts.

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 and its value chain.

THE RESULTS

By 2000, Dell had become the number-one PC seller. It is considered one of the world's best-managed and most profitable companies.

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

LESSONS LEARNED FROM THIS CASE

The Dell case demonstrates the following points:

1. By introducing a new business model, a firm can change the manner in which business is done and may even capture the leadership in an industry.
2. To implement this model on a large scale (mass customization), one needs to build superb supply chain management that includes suppliers and customers.
3. Another major success factor in Dell's plans was the improvements made in its logistics system along the entire supply chain. Using Web technologies, Dell integrated its own suppliers into its supply chain efficiently and effectively.
4. By introducing major customer-related changes, Dell enables customers to order what they like, do it from home, and get it quickly, at a competitive price and with high quality. Improved communications and customer service, which are part of Dell's CRM program, are the cornerstones of its success.
5. In addition to trading, Dell was using e-commerce with its business partners.
6. Dell created flexible and responsive IT manufacturing systems that are integrated with the supply chain.

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 7.

6.1 ESSENTIALS OF THE SUPPLY AND VALUE CHAINS

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 to places where they were needed. There was also recognition of a *demand chain,* which described the process of taking orders. Soon it was realized that these two concepts are interrelated, so they were integrated under the single concept of *extended supply chain,* or just *supply chain.*

DEFINITION. A **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.

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.

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. Clerchus of Sparta said, as

early as 401 B.C., 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 echoed later by famous generals such as Napoleon and Eisenhower.

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. Figure 6.1 shows a relatively simple supply chain, which links a company with its suppliers (on the left) and its distributors and 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 suppliers. In addition to flow of material there is a flow of information and money as well. The flow of money goes in the opposite direction to the flow of materials.

Note that the supply chain involves three parts:

1. ***Upstream supply chain.*** This part includes the organization's *first-tier* suppliers (which themselves can be manufacturers and/or assemblers) and their

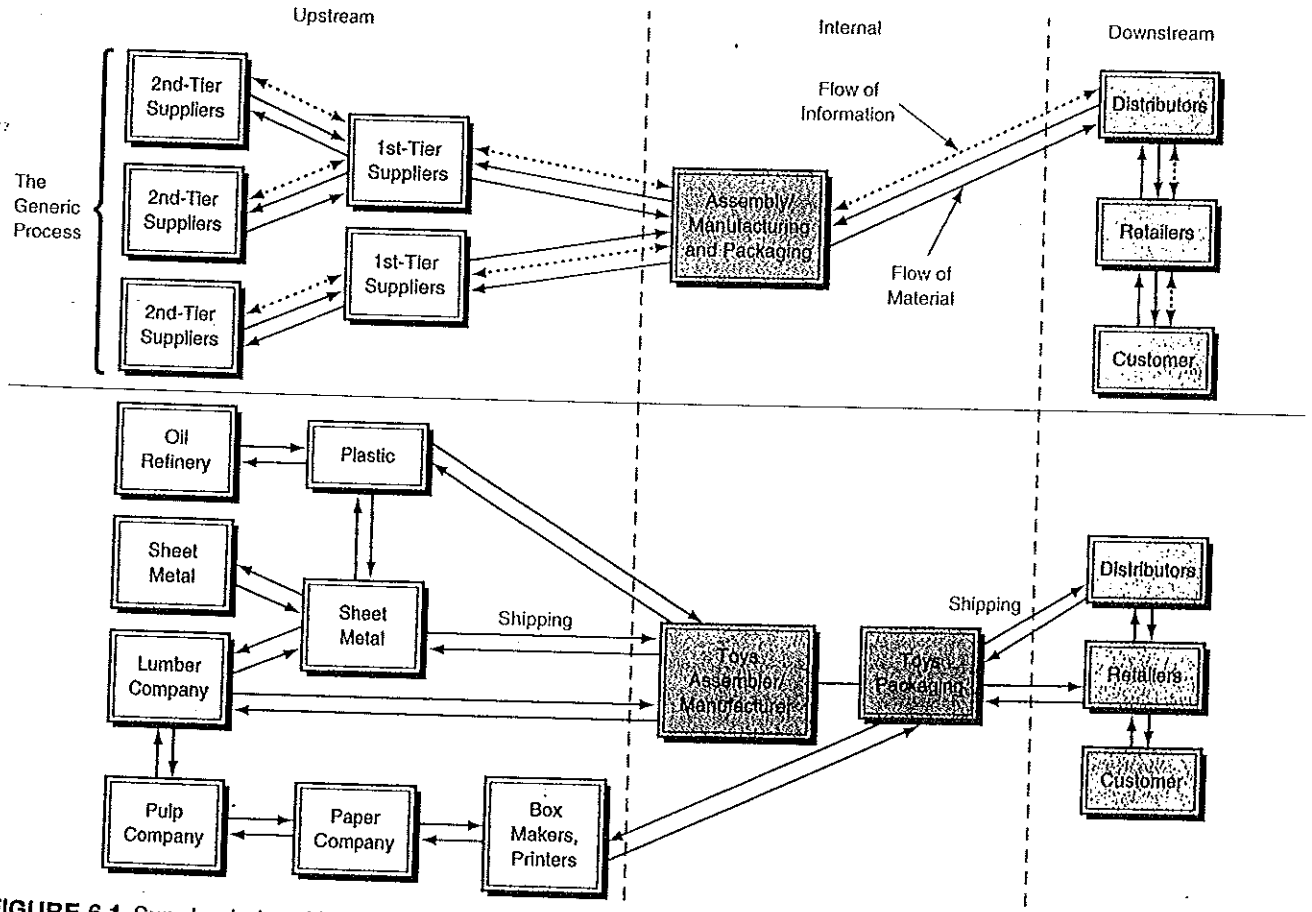


FIGURE 6.1 Supply chains. Not shown in the figure is the flow of money, which goes opposite to the flow of materials.

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).

2. ***Internal supply chain.*** This part includes all the processes used by an organization in transforming the inputs shipped by the suppliers to outputs, from the time materials enter the organization to the time that the product goes to distribution, outside the organization.
3. ***Downstream supply chain.*** This part includes all the processes involved in delivering the product 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.

As you can see, a supply chain involves a *product life cycle* 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.

Supply chains come in all shapes and sizes and may be fairly complex, as shown in Figure 6.2. As can be seen in the figure, the supply chain for a car manufacturer includes hundreds of suppliers, dozens of manufacturing plants

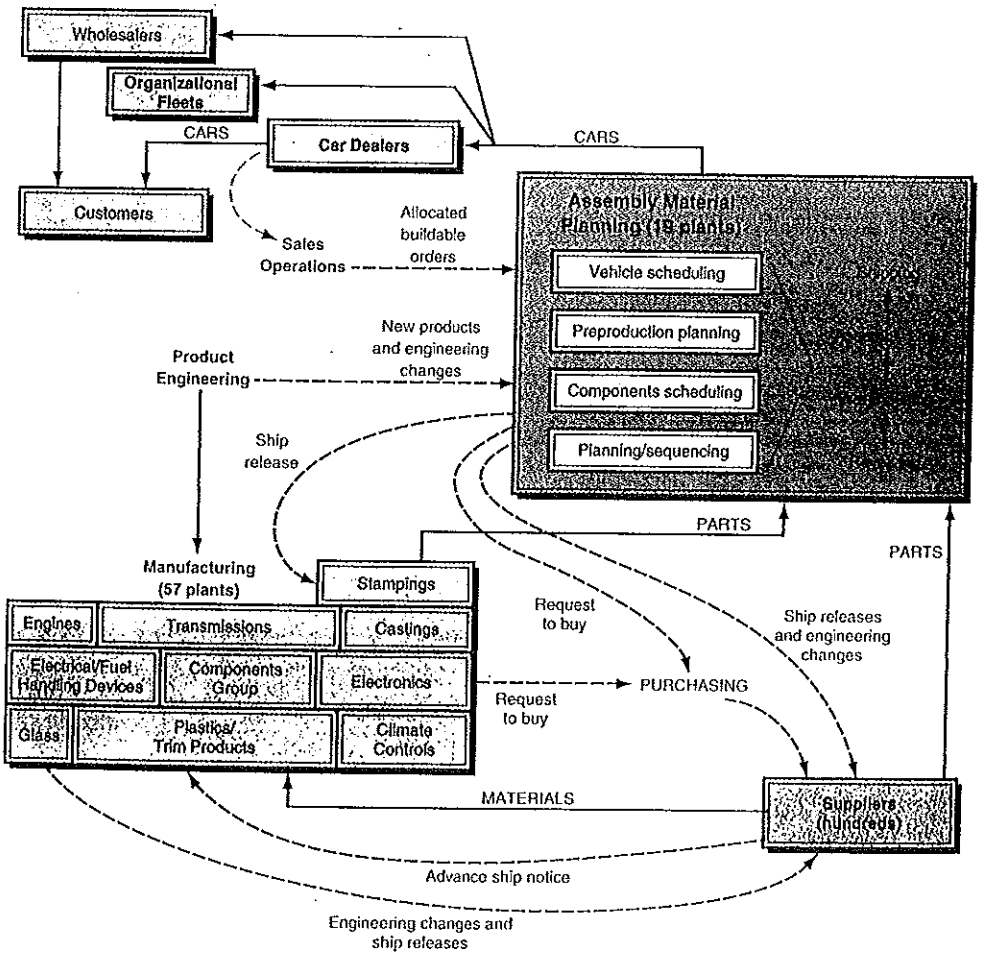


FIGURE 6.2 An automotive supply chain. (*Source:* Modified from *Introduction to Supply Chain Management* by Handfield/Nichols, © 1999. Reprinted by permission of Pearson Education, Inc., Upper Saddle River, N.J.)

(parts) and assembly plants (cars), dealers, direct business customers (fleets), wholesalers (some of which are virtual), customers, and support functions such as product engineering and purchasing.

Notice that in this case the chain is not strictly linear as it was in Figure 6.1. 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 the *return* of products (known as **reverse logistics**). For the 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 or a digitizable product may not include *any* physical materials.

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 model shown in Figure 6.1, were shown as a chain in Figure 3.6. Some of the support activities of the value chains can be identified in Figure 6.2. Note also that the *value system* concept corresponds to the concept of an *extended supply chain*, which includes suppliers, warehousing, distribution, and other business partners.

Porter's value chain (1985) emphasized that values are added as one moves along the chain. One of the major goals of supply chain management is to maximize this value, and this is where IT in general and electronic commerce in particular enter the picture, as will be shown in Sections 6.3 and 6.4. But let us first see why it is difficult to maximize or optimize the value chain.

6.2 SUPPLY CHAIN PROBLEMS AND SOLUTIONS

Background

Adding value along the supply chain is essential for competitiveness or even survival. Unfortunately, such addition 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 Gulf War, the allied armies had superb supply chains that were managed by the latest computerized technologies (including DSS and EIS applications). These chains were a major contributor to the swift victory in this war.

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 applications.

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 the year, online toy retailers, including eToys (now kbkids.com), Amazon.com, and ToysRUs, conducted a massive advertising campaign for Internet ordering. This 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. ToysRUs, for example, offered each of its unhappy customers a $100 store coupon as a compensation. Despite its generous gift, over 40 percent of the unhappy ToysRUs customers said they will not shop online at ToysRUs again.

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 ensure availability of gasoline for its trucks. Such vertical integration is effective in some cases but ineffective in others. In the remaining portion of this section we will look closely at some of the major problems in managing the supply chain and some of the 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 1999 toy season. The demand forecast may be influenced by several factors such as competition, prices, weather conditions, technological development, customers' general confidence, and more. 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 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 Lee et al., 1997). This effect was initially observed by Procter & Gamble with its disposable diapers product (Pampers). While actual sales in stores were fairly stable and predictable, orders from distributors had wild swings, creating production and inventory problems for P&G. An investigation revealed that distributors' orders were fluctuating because of poor demand forecast, price fluctuation, order batching, and rationing within the supply chain. All this resulted in unnecessary 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 (Lee et al., 1997).

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 (Handfield and Nichols, 1999).

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 across the supply chain, leading in some cases to as many as 100 days of inventory—which is waiting, "just in case."

A 1998 industry study projected that $30 billion in savings could materialize in the grocery industry supply chains alone, by sharing information. Thus, companies may avoid the "sting of the bullwhip." Such sharing is facilitated by EDI, extranets, and groupware technologies, and it is part of interorganizational EC or c-commerce. 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 makes for Wal-Mart. The information is collected by P&G on a daily basis from every Wal-Mart store. Then, P&G is able to manage the inventory replenishment for Wal-Mart. By monitoring the inventory level of each P&G item in every store, P&G knows when the inventories fall below the threshold that triggers a shipment. All this is done automatically. 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.) Later on we will show how Warner-Lambert and other manufacturers are sharing information with wholesalers and retailers in order to solve the bullwhip effect problem.

Solutions to Supply Chain Problems

Over the years organizations have developed many solutions to the 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. 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 penalty cost, including lost sales opportunities and bad reputation, can be very high. Thus, companies make major attempts to control inventory, as shown in the *IT at Work* example on page 248.

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 the 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. 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 the causes of the uncertainty, determine how uncertainties in some activities will affect other activities up and down the supply

IT at Work

HOW LITTLEWOODS STORES IMPROVED ITS SCM

...in Marketing and Production and Operations Management

www.littlewoods.co.uk

Littlewoods Stores is one of Britain's largest retailers of high-quality clothing. It has 136 stores around the U.K. and Northern Ireland (*littlewoods.co.uk*). The retail clothing business is very competitive, so in the late 1990s the company embarked on an IT-supported initiative to improve its supply chain efficiency. A serious SCM problem for the company was *overstocking*.

In order to get better SCM, the company introduced a Web-based performance reporting system. The new system analyzes, on a daily basis, marketing and finance data, and space planning, merchandising, and purchasing 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 other data.

The system uses a data warehouse–based decision support system and other end-user-oriented software to make better decisions. Here are some of the results:

- The ability to strategically price merchandise differently in different stores saved $1.2 million in 1997 alone.
- Reducing the need for stock liquidations saved $1.4 million in a single year.
- Marketing distribution expenses were cut by $7 million a year.
- The company was able to reduce staff from 84 to 49 people, a saving of about $1 million annually.
- Back-up inventory expenses were cut by about $4 million a year. For example, due to quick replenishment, stock went down by 80 percent.

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

For Further Exploration: Explain how integrated software solved the excess inventory problem. Also, review the role of data warehouse decision support in this case.

Sources: Compiled from *microstrategy.com* (January 2000, Customers' Success Stories), and from *littlewoods.co.uk* (March 2001).

chain, and then formulate specific ways to reduce or eliminate the uncertainties. Combined with this is the need for an effective and efficient communication environment among all business partners. 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. This enables firms to achieve optimal inventory levels.

Here are some other solutions to solve SCM 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.

Most of the above solutions are enhanced by IT support. For specific IT solutions see Table 6.1.

Two tools in particular, supply chain teams and performance measurement, are especially potent in helping to solve supply chain problems.

SUPPLY CHAIN TEAMS. The change of the linear supply chain to a hub (Chapters 1 and 5) points to the need sometimes to create **supply chain teams**. 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

TABLE 6.1 IT Solutions to Supply Chain Problems

Supply Chain Problem	IT Solution
Linear sequence of processing is too slow.	Parallel processing, using workflow software.
Waiting times between chain segments are excessive.	Identify reason (DSS 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. Bar codes, 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 (see Epner, 1999).
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 *gensym.com*).

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, he or she 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.

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

6.3 COMPUTERIZED SYSTEMS: MRP, MRPII, ERP, AND SCM

The concept of the supply chain is interrelated with the computerization of its activities, which has evolved over 50 years.

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, scheduling, and billing. 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 will be 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 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. This realization resulted in an enhanced MRP methodology

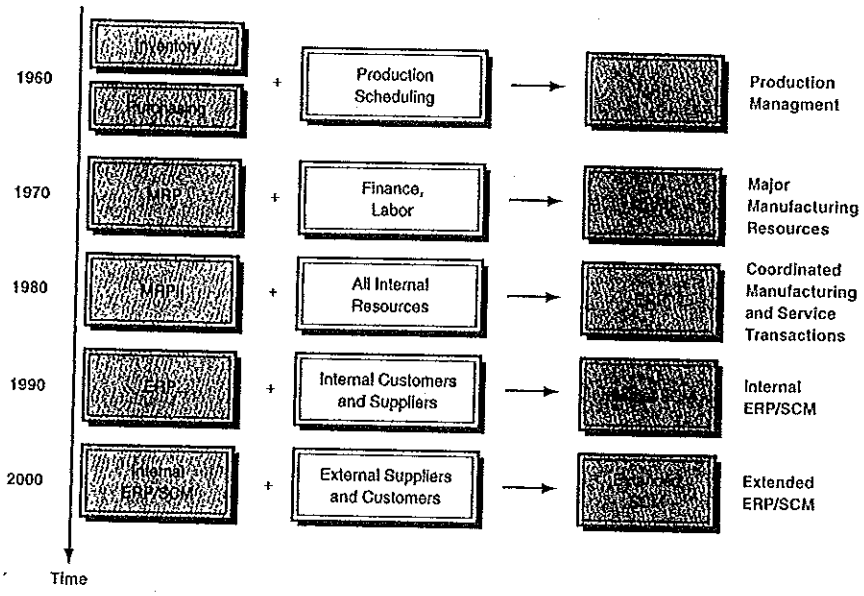


FIGURE 6.3 The evolution of integrated systems.

(and software) called **manufacturing resource planning (MRP II)**, which adds labor requirements and financial planning to MRP.

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 activities of all functional areas in the entire enterprise. ERP was initially expanded to include internal suppliers and customers and later to incorporate external suppliers and customers in what is known as *extended ERP/SCM software*. This evolution is shown in Figure 6.3. 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.) We'll look at ERP again in a bit more detail later in this section.

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.

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 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 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 in both types of benefits many items are directly related to improved supply chain management. (For further discussion of the improvements that integration provided to SCM, see "Competition's New Battleground: The Integrated Value Chain," at *ctp.com*.)

Integrating the Supply Chain and the Value Chain

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 electronic 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.

TYPES OF INTEGRATION: FROM SUPPLY TO VALUE CHAIN. The most obvious integration is that of the segments of the supply chain, and/or 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. While 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.

Another way of defining the 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:

- 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 6.4)
- 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

Presently only a few large companies are successfully involved in a comprehensive collaboration to reengineer the supply chain or some of its segments.

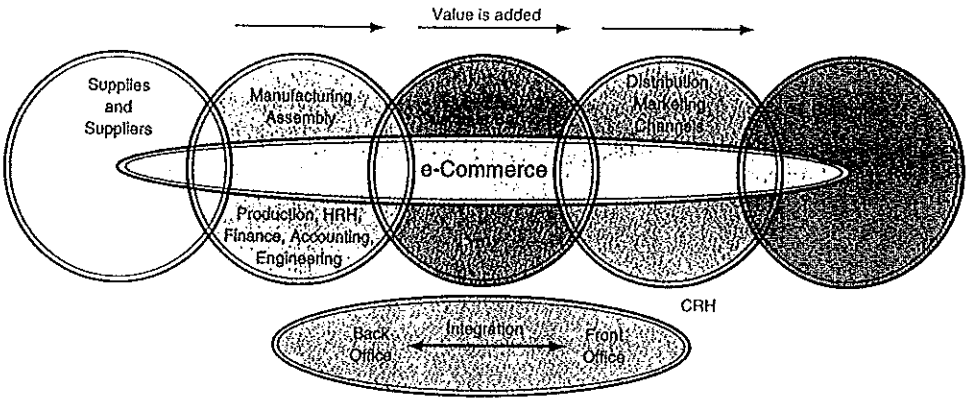
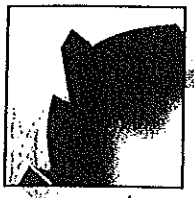


FIGURE 6.4 Back office and front office integration in a value chain.



IT at Work

HOW WARNER-LAMBERT APPLIES AN INTEGRATED SUPPLY CHAIN

...in Production and Operations Management

www.warner-lambert.com

One of Warner-Lambert's major products is Listerine antiseptic mouthwash. The materials for making Listerine come from eucalyptus trees in Australia and are shipped to the Warner-Lambert (WL) manufacturing plant in New Jersey, U.S.A. The major problem there is to determine how much Listerine to produce. Listerine is first purchased by wholesalers and by thousands of retail stores, some of which are giants such as Wal-Mart. The problem that the manufacturing plant faces is to *forecast the overall demand*. A wrong forecast will result either in high inventories at WL, or in shortages. Inventories are expensive to keep, and shortages may result in loss of business.

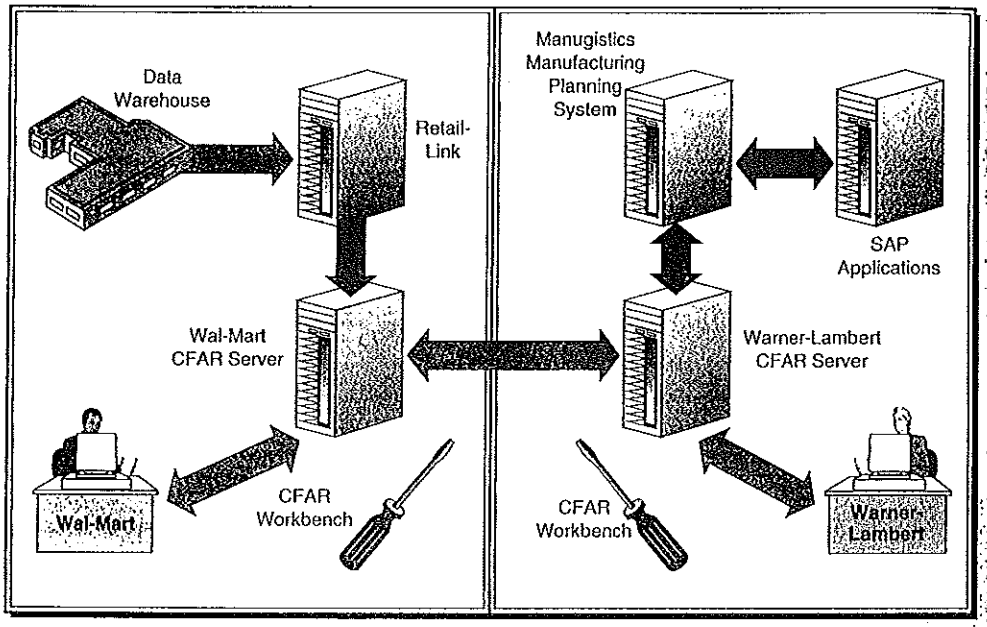
Warner-Lambert forecasts demand with the help of Manugistic Inc.'s Demand Planning Information System. (Manugistic is a vendor of IT software for SCM.) Used with other software in Manugistics' Supply Chain Planning suite, the system analyzes manufacturing, distribution, and sales data against expected demand and business climate information. Its goal is to help WL decide how much Listerine (and other products) to make and how much of each raw ingredient is needed, and when. For example, the model can anticipate the impact of seasonal promotion or of a production line being down. The sales and marketing group of WL also meets monthly with WL employees in finance, procurement, and other departments. The group enters the expected demand for Listerine into a Marcam Corp. Prism Capacity Planning system (another SCM software), which schedules the production of Listerine in the amounts needed and generates electronic purchase orders for WL's suppliers.

WL'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 WL (see *Datamation*, November 1996, and *Interactive Week*, February 23, 1999). In the pilot project, WL shared strategic plans, performance data, and market insight with Wal-Mart over private networks. The company realized that it could benefit from Wal-Mart's market knowledge, just as Wal-Mart could benefit from WL's product knowledge. In CPFR, trading partners collaborate on demand forecast using *collaborative e-commerce* (Chapter 5). The project includes major SCM and ERP vendors such as SAP and Manugistics (see figure, next page). During the CPFR pilot, WL 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 (the equivalent of a new product launch) for much less investment. WL 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 within which to evaluate the effectiveness of their processes along the same supply chains.

For Further Exploration: For what industries, besides retailing, will e-commerce beneficial? Why was Listerine a target for the pilot SCM collaboration?

Sources: Compiled from *CIO*, August 15, 1998; *Store*, June 1998; and *Logistics Management and Distribution Report*, October 1998, November 1999.



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

For a special report on this collaboration project, see ASCET (2000), where the name of such collaboration is **collaborative commerce networks**, or **collaborative commerce** (see Chapter 5).

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. (For further discussion, see Selland, October 1999 and January 1999; and Andersen Consulting's white paper, 2000.)

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 planning and managing all resources and their use in the entire enterprise. It promises benefits ranging from increased efficiency to improved quality, productivity, and profitability. (See Appleton, 1997, for details.) The name 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. 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). ERP systems are in use in thousands of large and medium companies worldwide. Some ERP systems are producing dramatic results.

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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 software. The leading software for ERP 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.

The ERP software crosses functional departments. 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 later 1990s, ERP systems have begun to be 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.

Companies have been successful in integrating several hundred applications using ERP software, saving millions of dollars and significantly increasing customer satisfaction. For example, ExxonMobil consolidated 300 different information systems by implementing SAP R/3 in its U.S. petrochemical operations alone. ERP forces discipline and organization around business processes, making the alignment of IT and business goals more likely. Such change is related to business process reengineering (BPR) (Chapter 8). Also, by implementing ERP a company can discover all the "dusty corners" of its business.

However, SAP and other ERP software can be extremely complex to implement; companies often need to change existing business processes to fit SAP's format; and some companies require only some of R/3's 70 software modules, yet must purchase the entire package. For these reasons, SAP may not be attractive to everyone. For example, Caldwell and Stein (1998) reports that Inland Steel Industries, Inc., opted to write its own ERP system (containing 7 million lines of code), which supports 27 integrated applications, rather than use commercial ERP. Also, some companies, such as Starbucks, decided to use a *best of breed* approach, building their ERP with ready-made components from several vendors.

In whatever form it is implemented, ERP has played a critical role in getting small- and medium-sized 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).

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 models 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.

*SAP R/3 is described in the FoxMeyer case at *wiley.com/college/turban*, Chapter 3.

Post-ERP (Second-Generation ERP)

First-generation ERP aimed at automating key office processes. 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. Let's explain:

The first generation of ERP basically supported routine business transactions. In other words, 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. Palaniswamy and Frank (2000) cite examples of five case studies indicating that ERP significantly enhances the performance of manufacturing organizations as a result of automating 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, 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.

This created the need for planning systems oriented toward *decision making*, and this is what the *SCM software* vendors provided. 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?"

Thus SCM systems have emerged as a *complement* to ERP systems, to provide *intelligent decision support* capabilities. 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.

www.ibm.com

An example of a successful SCM effort is that of IBM. IBM reengineered its global supply chain in order to achieve quick responsiveness to customers with minimal inventory. To support this effort, it 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 extended supply chains. IBM has used AMT to study 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 over $750 million in material costs and price-protection expenses being saved each year. (For details see Yao et al., 2000.) Creating a plan from an SCM

system 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.

How is such integration 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 software, as shown earlier in the Warner-Lambert case. Such an approach requires fitting different softwares, which may be a complex task, unless special interfaces exist.

The second approach is for the ERP vendors to add decision support and **business intelligence** capabilities. Business intelligence refers to analysis performed by DSS, EIS, data mining, and intelligent systems (see Chapters 10–12). These added capabilities solve the integration problem. But as is the case with integration of database management systems and spreadsheets in Excel or Lotus 1-2-3, 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. The added functionalities, which create the *second-generation ERP*, include not only decision support but also customer relationship management (CRM) (Chapter 7), electronic commerce (Section 6.4), and data warehousing and mining (Chapter 11). Some systems include a *knowledge management* component (Chapter 9) as well. Another approach that is related to integration is componentization.

SUPPLY CHAIN INTELLIGENCE. The inclusion of business intelligence in supply chain software solutions is called by some **supply chain intelligence (SCI)**. SCI applications enable 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 10 to 12.

To better understand SCI, it is worthwhile to compare it with SCM. Such a comparison is provided in Table 6.2 on page 258.

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 2001 products.
- Integrate the ERP with business intelligence software from a specialized vendor such as Brio, Cognus, or Comshare.
- Create a best-of-breed system by using components from several vendors that will provide the required capabilities. (For component-based applications, see Chapter 14.)

COMPONENTIZATION. *Componentization* refers to breaking large ERP systems into individual components that work together. By breaking up large applications into components, ERP vendors such as SAP, Oracle, PeopleSoft, and J. D. Edwards are able to more quickly fix or add functionalities. The accounts payable component, for example, could be enhanced without having to touch the other financial components or any other components such as planning or logistics. And once the ERP vendor has established a component architecture, it becomes easier and safer for IT to customize the systems.

TABLE 6.2 Comparing SCM and SCI

Supply Chain Management	Supply Chain Intelligence
Largely about managing the procurement and production links of the supply chain.	Provides a broad view of an entire supply chain to reveal full product and component life cycle.
Transactional.	Analytic.
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.	Does what-if forecasting based on historic data.
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 personalizable monitoring of metrics.

Source: P. Russom, "Increasing Manufacturing Performance Through Supply Chain Intelligence," *DM Review*, September 2000. Reprinted by permission from Sage Tree, Inc.

Componentization not only makes it easier for ERP vendors to enhance their solutions but also makes it easier for customers to upgrade the software. A customer could selectively upgrade some components without having to upgrade the entire ERP solution, which usually entails a substantial effort and expense. Componentization also helps the vendors extend the core ERP system with supply chain, sales force automation solutions, and customer relationship management (CRM).

ERP Failures

Despite all the improvements, ERP projects, especially large ones, may fail. The *IT at Work* on the opposite page discusses some examples of ERP failures.

In order to avoid failures and ensure success, it is necessary, according to *thespot4sap.com*, 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 gaps
- The level of change the customer has to go through to make the system fit
- The level of commitment within the customer organization to see the project through to completion
- The fit between the customer's organization and culture and the project organization and culture
- The risks presented by politics within the customer organization
- The consultant's capabilities, responsibilities, and role (if applicable)

Application Service Providers and ERP Outsourcing

A popular option today for businesses that want ERP functions is to lease applications rather than to build systems. In leasing applications, the ERP vendor takes care of the functionalities and the integration problems. This approach is known

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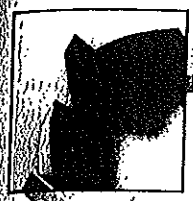


IT at Work

EVEN THE BEST-PLANNED ERP SOMETIMES FAILS

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

- Hershey's chocolate bars and its other products were not selling well in late 1999. Hershey Foods Corporation 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.
- In November 1999, Whirlpool Corp. 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 *cnet.com*, SAP gave Whirlpool the 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.
- FoxMeyer, a major distributor of drugs to hospitals and pharmacies, which filed for bankruptcy in 1996, sued both SAP and Andersen Consulting for $500 million each, claiming that the ERP system they constructed led to its demise. See the complete case on the book's Web site at *www.wiley.com/college/turban*.
- W. L. Gore and Associates 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. In both the W. L. Gore and FoxMeyer 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.

For Further Exploration: Why do even the best-planned ERPs fail? If planning doesn't help, what can you do? Can you identify similarities in the four incidents cited here?

Sources: T. H. Davenport, *Mission Critical: Realizing the Promise of Enterprise Systems*, Cambridge, MA: Harvard Business School Press, 2000; *cnet.com*; *cio.com*; *Business Courier* (miscellaneous dates).

as the "ASP alternative." An **application service provider (ASP)** is a software vendor that offers to lease ERP-based applications to other businesses. The basic concept is similar to that of the old-fashioned computer *time share*. The outsourcers set up the systems and run them for you. ASP is considered a product risk-management strategy, and it best fits small- to mid-size companies. (See Chapters 13 and 14 for details.) The delivery of the software can be done effectively via the Internet.

The ASP concept is especially useful in ERP projects, which are expensive to install and take a long time to implement, and for which staffing is a major problem. However, ASP offerings are also evident in ERP-added functions such as electronic commerce, CRM, datamarts, desktop productivity, human resource information systems (HRIS), and other supply-chain-related applications.

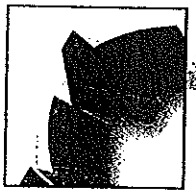
The use of ASP has its downside. First, ERP vendors typically want a five-year commitment. Some companies may not want to lock themselves in for that long, reasoning that within five years ERP may be simplified and easy to get and implement. Second, you lose flexibility with the use of ASP. Rented systems are fairly standard and may not fit your needs. (For further discussion of ASPs, see *Datamation*, July 1999.)

Global Supply Chains

The major reasons why companies go global are: lower prices of material, products, and labor; availability of products that are unavailable domestically; the firm's

global attitude; advanced technology available in other countries; high quality of products available; intensification of global competition, which drives companies to cut costs; the need to develop a foreign presence; and fulfillment of counter trade. Supply chains that involve suppliers and/or customers in other countries are referred to as *global supply chains.* 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 Turban et al., 2002).

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 the Lego case below.



IT at Work

LEGO STRUGGLES WITH GLOBAL ISSUES

www.lego.com

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. 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 electronic commerce was made, the company had the following concerns:

- Choice of countries. It does 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 individual customers.
- 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?
- How should the company 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 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. 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.

For Further Exploration: Visit Lego's Web site and see the latest EC activities. Also, investigate what the competitors are doing. Is the Web the way to go global?

Sources: Compiled from *lego.com*, and from L. Damsguard and J. Horluck, "Designing www.LEGO.com/ shop: Business Issues and Concerns," case 500-0061, European Case Clearing House, 2000.

Information technologies are found to be 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 about 70,000 trading partners.

IT also facilitates global SCM. 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). Finally, IT facilitates outsourcing of products and services, especially IT programming, to countries with a plentiful supply of labor, at low cost.

6.4 ELECTRONIC COMMERCE AND SCM

E-commerce is emerging as a superb approach for providing solutions to problems along the supply chain. As seen in Dell's example at the beginning of the chapter, many supply chain activities, from taking customers' orders to parts procurement, can be conducted as part of an EC initiative. In general EC can make the following contributions to supply chain management:

1. Digitize products such as software. This expedites the flow of materials in the chain. It is also much cheaper to create and move electronic digits than physical products.
2. Replace with electronic documents all paper documents that move physically. This change improves speed and accuracy, and the cost of document transmission is much cheaper.
3. Replace faxes, telephone calls, and telegrams with an electronic messaging system. A single transaction could involve many messages, totaling thousands of messages per week or even per day at a minimal cost.
4. 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.
5. Enhance several of the activities discussed in the previous sections, such as collaboration and information sharing among the partners in the supply chain. This can improve cooperation, coordination, and demand forecasts.
6. Shorten supply chain and minimize 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 build-to-order strategy.
7. Facilitate customer service. Of special interest is the reduction of information flow between companies and customers due to innovations such as FAQs and the self-tracking of shipments.
8. Introduce efficiencies into buying and selling through the creation of e-marketplaces, as we saw in Chapter 5.

Let's look now at some specific activities and cases.

Buying and Selling Along the Supply Chain

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

UPSTREAM ACTIVITIES. There are many innovative models of EC that improve the upstream 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, and procurement via consortia and group purchasing. (For others, see Mitchell, 2000; Adamson, 2000; and Varley, 2000.)

INTERNAL SCM ACTIVITIES. Internal SCM activities include different *intrabusiness EC* activities. These activities, from entering orders of materials, to recording sales, to tracking shipments, are usually conducted over a corporate intranet. Details and examples are provided in Chapters 5 and 7.

DOWNSTREAM ACTIVITIES. Typical EC models of downstream activities are provided in Chapters 5 and 7. Some examples 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 get their own pages and customized catalogs (see the Dell opening case).

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 save on logistics expenses. For example, electronic auctions sell over 2.5 million cars each year, supplied by car rental companies, government agencies, banks, and some large organizations. One online B2B auctioneer, for example, is Autodags. The buyers are car dealers who then resell the used cars. 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 are realized.

UPSTREAM AND DOWNSTREAM COMBINED. It is sometimes advisable to combine upstream and downstream EC activities. These can be done in *exchanges*, where many buyers and sellers meet, as discussed in Chapter 5. Most of these exchanges are centered on specialized products or services, so they are referred to as **vertical portals**. 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 marketplaces use auctions and reverse auctions, offering *dynamic pricing*, as described in Chapter 5.

INTEGRATION OF EC WITH ERP. Since most 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 connect the two. These efforts 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 in 2000 as a major initiative. 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 *A Closer Look* 6.1).

A CLOSER LOOK
6.1 mySAP.com

As a complement to existing SAP products (i.e., R/3, New Dimensions products, and Knowledge Management), mySAP.com offers four building blocks:

- Workplace—a personalized interface
- Marketplace—a one-stop destination where business professionals can collaborate
- Business Scenarios—products for the Internet and intranets
- Application hosting—hosting of Web applications for SEMs

Together, these building blocks create a strategy that extends the reach of the Internet to empower employees and improve competitive advantage by participating in the EC marketplace. As part of Web-enabled applications, they can break down functional and geographic barriers while encouraging a high level of individual and collaborative performance.

The capabilities of the four component areas are as follows:

1. ***Workplace.*** The Workplace is a role-based *enterprise portal* solution. Via an easy-to-use and personalized Web browser–based front end, users are presented with all of the information, applications, and services they need to get their jobs done.

   Targeted information is presented to users immediately when they log on, a feature that can help to alleviate information overflow. The Workplace comes with approximately 150 role templates that customers are free to use or modify, or they can define their own.
2. ***Marketplace.*** The Marketplace is a one-stop destination for business and industry professionals. It enables SAP collaborative business scenarios, allowing many buyers and sellers to come together and do business. It is an integration site for enterprises and business professionals to collaborate, conduct commerce, access personalized content, and interact in professional communities. (See *www.sap.com/solutions/marketplace/index.*) The Marketplace provides:
   - The complete infrastructure, security, commerce-enabling applications, value-added services, and interoperability required to enable one-stop business anytime, anywhere, with anyone.
   - A cross-industry horizontal marketplace as the basis for collaborative commerce for business professionals in general.
   - A number of vertical and regional marketplaces for specialized commerce among user groups with similar interests, such as the oil and gas industry.
3. ***Business scenarios.*** The Business Scenario component offers the specific knowledge, functions, and services that one or more users may need to succeed in their business tasks with other businesses, partners, channels, and communities. mySAP.com provides a variety of e-business-enabled solutions, including purchasing, collaborative planning, employee self-service, direct customer servicing, and interbusiness knowledge management, to support the scenarios. The major areas of the Business Scenario are:
   - Effective B2B buying and selling with multiple buyers and sellers.
   - Customer relationship management (CRM). Core CRM functions include Internet sales and service, field sales and service, collaborative bidding, and Web-enabled customer service applications. mySAP.com supports catalog maintenance and ordering, and both integrate seamlessly with back-end systems. The CRM component of mySAP.com integrates customer news, background information, and vendor data.
   - Collaborative planning forecasting. mySAP.com provides supply chain management (SCM) solutions, including scenarios in collaborative forecasting and planning.
4. ***Application hosting.*** The mySAP.com strategy is to target small- and mid-size companies with Web-based application hosting services, which offer a more cost-effective and faster approach for companies to leverage SAP business scenarios and engage in Internet collaborative markets.

Source: Based on information from *mySAP.com.*