CHAPTER 3
SUPPLY CHAIN DRIVERS AND METRICS

Learning Objectives

After reading this chapter, you will be able to:

1. Identify the major drivers of supply chain performance.
2. Discuss the role each driver plays in creating strategic fit between the supply chain strategy and the competitive strategy.
3. Define the key metrics that track the performance of the supply chain in terms of each driver.
4. Describe the major obstacles that must be overcome to manage a supply chain successfully.

In this chapter, we introduce the three logistical drivers—facilities, inventory, and transportation—and the three cross-functional drivers—information, sourcing, and pricing—that determine the performance of any supply chain. We discuss how these drivers are used in the design, planning, and operation of the supply chain. We define several metrics that can be used to gauge the performance of each driver. We also introduce many of the obstacles faced by supply chain managers.

3.1 DRIVERS OF SUPPLY CHAIN PERFORMANCE

The strategic fit discussed in Chapter 2 requires that a company's supply chain achieve the balance between responsiveness and efficiency that best meets the needs of the company's competitive strategy. To understand how a company can improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical and cross-functional drivers of supply chain performance: facilities, inventory, transportation, information, sourcing, and pricing. These drivers interact with each other to determine the supply chain's performance in terms of responsiveness and efficiency. As a result, the structure of these drivers determines if and how strategic fit is achieved across the supply chain.

First we define each driver and discuss its impact on the performance of the supply chain.

1. ***Facilities*** are the actual physical locations in the supply chain network where product is stored, assembled, or fabricated. The two major types of facilities are production sites and storage sites. Decisions regarding the role, location, capacity, and flexibility of facilities have a significant impact on the supply chain's performance. For instance, an auto-parts distributor striving for responsiveness could have many warehousing facilities located close to customers even though this practice reduces efficiency. Alternatively, a high-efficiency distributor would have fewer warehouses to increase efficiency despite the fact that this practice will reduce responsiveness.

2. ***Inventory*** encompasses all raw materials, work in process, and finished goods within a supply chain. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness. For example, a clothing retailer can make itself more responsive by stocking large amounts of inventory and satisfying customer demand from stock. A large inventory, however, increases the retailer's cost, thereby making it less efficient. Reducing inventory makes the retailer more efficient but hurts its responsiveness.

3. ***Transportation*** entails moving inventory from point to point in the supply chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on supply chain responsiveness and efficiency. For example, a mail-order catalog company can use a faster mode of transportation such as FedEx to ship products, thus making its supply chain more responsive, but also less efficient given the high costs associated with using FedEx. Or the company can use slower but cheaper ground transportation to ship the product, making the supply chain efficient but limiting its responsiveness.

4. ***Information*** consists of data and analysis concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain. Information is potentially the biggest driver of performance in the supply chain because it directly affects each of the other drivers. Information presents management with the opportunity to make supply chains more responsive *and* more efficient. For example, with information on customer demand patterns, a pharmaceutical company can produce and stock drugs in anticipation of customer demand, which makes the supply chain very responsive because customers will find the drugs they need when they need them. This demand information can also make the supply chain more efficient because the pharmaceutical firm is better able to forecast demand and produce only the required amount. Information can also make this supply chain more efficient by providing managers with shipping options, for instance, that allow them to choose the lowest-cost alternative while still meeting the necessary service requirements.

5. ***Sourcing*** is the choice of who will perform a particular supply chain activity such as production, storage, transportation, or the management of information. At the strategic level, these decisions determine what functions a firm performs and what functions the firm outsources. Sourcing decisions affect both the responsiveness and efficiency of a supply chain. After Motorola outsourced much of its production to contract manufacturers in China, it saw its efficiency improve but its responsiveness suffer because of the long distances. To make up for the drop in responsiveness, Motorola started flying in some of its cell phones from China even though this choice increased transportation cost. Flextronics, an electronics contract manufacturer, is hoping to offer both responsive and efficient sourcing options to its customers. It is trying to make its production facilities in the United States very responsive while keeping its facilities in low-cost countries efficient. Flextronics hopes to become an effective source for all customers using this combination of facilities.

6. ***Pricing*** determines how much a firm will charge for goods and services that it makes available in the supply chain. Pricing affects the behavior of the buyer of the good or service, thus affecting supply chain performance. For example, if a transportation company varies its charges based on the lead time provided by the customers, it is very likely that customers who value efficiency will order early and customers who value responsiveness will be willing to wait and order just before they need a product transported. Early orders are less likely if prices do not vary with lead time.

Our definition of these drivers attempts to delineate logistics and supply chain management. Supply chain management includes the use of logistical and cross-functional drivers to increase the supply chain surplus. Cross-functional drivers have become

increasingly important in raising the supply chain surplus in recent years. While logistics remains a major part, supply chain management is increasingly becoming focused on the three cross-functional drivers.

It is important to realize that these drivers do not act independently but interact with each other to determine the overall supply chain performance. Good supply chain design and operation recognizes this interaction and makes the appropriate trade-offs to deliver the desired level of responsiveness. Consider, for example, the furniture industry in the United States. Low-cost furniture sourced from Asia is available at many discount retailers. The primary goal of this supply chain is to deliver a low price and acceptable quality. Variety is typically low and retailers such as Wal-Mart stock inventory of finished goods. The low variety and stable replenishment orders allow furniture manufacturers in Asia to focus on efficiency. Given the available inventory, low-cost modes of transportation from Asia are used. In this instance, relatively low-cost inventory at the retailer allows the supply chain to become efficient by lowering transportation and production costs. In contrast, some U.S. furniture makers have chosen to focus on providing variety. Given the high variety and high prices, keeping inventory of all variants at a retailer would be very expensive. In this case the supply chain has been designed so the retailer carries very little inventory. Customers place their orders with the retailer by seeing one variant of the furniture and selecting among the various options. The supply chain is made responsive by using information technology to convey order information effectively, structuring very flexible manufacturing facilities to be able to produce in small lots, and using responsive transportation to deliver the furniture to the customer. In this instance, responsive facilities, transportation, and information are used to lower inventory costs. As the following chapter will illustrate, the key to achieving strategic fit across the supply chain is to structure the supply chain drivers appropriately to provide the desired level of responsiveness.

Before we discuss each of the six drivers in detail, we put these drivers into a framework that helps to clarify the role of each driver in improving supply chain performance.

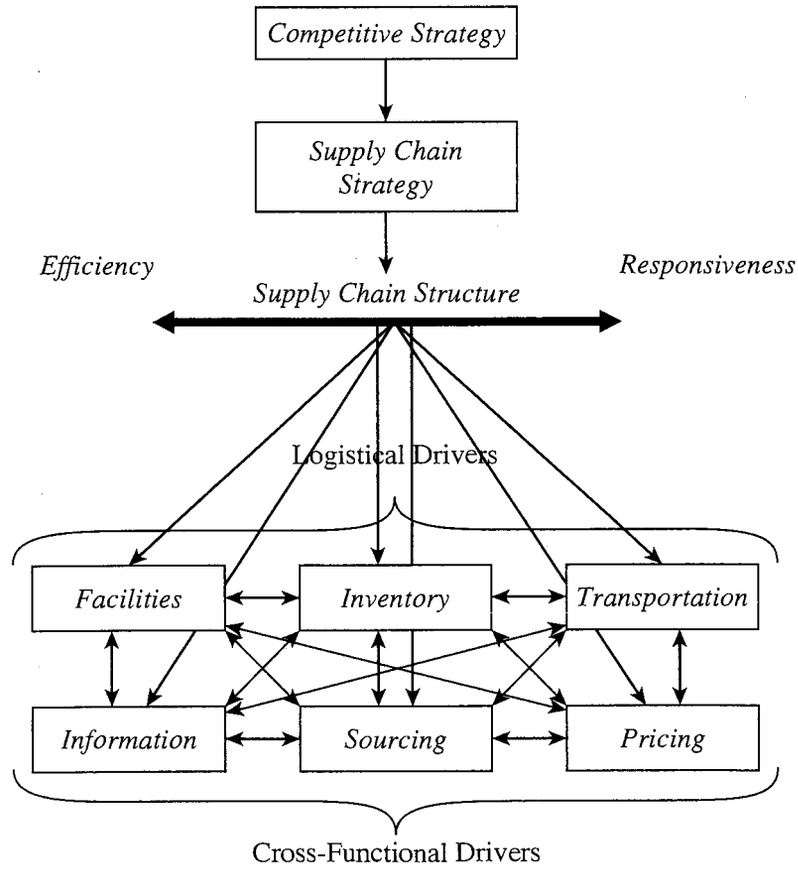
3.2 FRAMEWORK FOR STRUCTURING DRIVERS

Recall from Chapter 2 that the goal of a supply chain strategy is to strike the balance between responsiveness and efficiency that fits with the competitive strategy. To reach this goal, a company must structure the right combination of the three logistical and three cross-functional drivers discussed earlier. For each of the individual drivers, supply chain managers must make a trade-off between efficiency and responsiveness based on interaction with the other drivers. The combined impact of these drivers then determines the responsiveness and the profits of the entire supply chain.

We provide a visual framework for supply chain decision making in Figure 3-1. Most companies begin with a competitive strategy and then decide what their supply chain strategy ought to be. The supply chain strategy determines how the supply chain should perform with respect to efficiency and responsiveness. The supply chain must then use the three logistical and three cross-functional drivers to reach the performance level the supply chain strategy dictates and maximize the supply chain profits. Although this framework is generally viewed from the top down, in many instances, a study of the six drivers may indicate the need to change the supply chain and potentially even the competitive strategy.

Consider this framework using Wal-Mart as an example. Wal-Mart's competitive strategy is to be a reliable, low-cost retailer for a wide variety of mass-consumption

FIGURE 3-1 Supply Chain Decision-Making Framework



goods. This strategy dictates that the ideal supply chain will emphasize efficiency but also maintain an adequate level of responsiveness. Wal-Mart uses the three logistical and three cross-functional drivers effectively to achieve this type of supply chain performance. With the inventory driver, Wal-Mart maintains an efficient supply chain by keeping low levels of inventory. For instance, Wal-Mart pioneered cross-docking, a system in which inventory is not stocked in a warehouse but rather is shipped to stores from the manufacturer. These shipments make only brief stops at distribution centers (DCs), where they are transferred to trucks that make deliveries to stores. This significantly lowers inventory because products are stocked only at stores, not at both stores and warehouses. With respect to inventory, Wal-Mart favors efficiency over responsiveness. On the transportation front, Wal-Mart runs its own fleet, to keep responsiveness high. This increases transportation cost, but the benefits in terms of reduced inventory and improved product availability justify this cost in Wal-Mart's case. In the case of facilities, Wal-Mart uses centrally located DCs within its network of stores to decrease the number of facilities and increase efficiency at each DC. Wal-Mart builds retail stores only where the demand is sufficient to justify having several of them supported by a DC, thereby increasing efficiency of its transportation assets. To utilize information in the supply chain, Wal-Mart has invested significantly more than its competitors in information technology. As a result, Wal-Mart is a leader in its use of the information driver to improve responsiveness and decrease inventory investment. Wal-Mart feeds demand information across the supply chain to suppliers who manufacture only what is being demanded. The supply chain's ability to share demand information has

required large investments, but the result is an improved supply chain in terms of both responsiveness and efficiency. With regard to the sourcing driver, Wal-Mart identifies efficient sources for each product it sells. Wal-Mart feeds them large orders, allowing them to be efficient by exploiting economies of scale. Finally, for the pricing driver, Wal-Mart practices "every day low pricing" (EDLP) for its products. This ensures that customer demand stays steady and does not fluctuate with price variations. The entire supply chain then focuses on meeting this demand in an efficient manner. Wal-Mart uses all the supply chain drivers to achieve the right balance between responsiveness and efficiency so that its competitive strategy and supply chain strategy are in harmony.

We devote the next six sections to a detailed discussion of each of the three logistical and three cross-functional drivers and their roles in the supply chain.

3.3 FACILITIES

In this section, we discuss the role that facilities play in the supply chain as well as critical facility-related decisions that supply chain managers need to make.

ROLE IN THE SUPPLY CHAIN

If we think of inventory as *what* is being passed along the supply chain and transportation as *how* it is passed along, then facilities are the *where* of the supply chain. They are the locations to or from which the inventory is transported. Within a facility, inventory is either transformed into another state (manufacturing) or it is stored (warehousing).

ROLE IN THE COMPETITIVE STRATEGY

Facilities are a key driver of supply chain performance in terms of responsiveness and efficiency. For example, companies can gain economies of scale when a product is manufactured or stored in only one location; this centralization increases efficiency. The cost reduction, however, comes at the expense of responsiveness, as many of a company's customers may be located far from the production facility. The opposite is also true. Locating facilities close to customers increases the number of facilities needed and consequently reduces efficiency. If the customer demands and is willing to pay for the responsiveness that having numerous facilities adds, however, then this facilities decision helps meet the company's competitive strategy goals.

Example 3-1: **Toyota and Honda**
Both Toyota and Honda use facilities decisions to be more responsive to their customers. These companies have an end goal of opening manufacturing facilities in every major market that they enter. While there are other benefits to opening local facilities, such as protection from currency fluctuation and trade barriers, the increase in responsiveness plays a large role in Toyota and Honda's decision to place facilities in their local markets.

COMPONENTS OF FACILITIES DECISIONS

Decisions regarding facilities are a crucial part of supply chain design. We now identify components of facilities decisions that companies must analyze.

Role

For production facilities, firms must decide whether they will be flexible, dedicated, or a combination of the two. Flexible capacity can be used for many types of products but

is often less efficient, whereas dedicated capacity can be used for only a limited number of products but is more efficient. Firms must also decide whether to design a facility with a product focus or a functional focus. A product-focused facility performs many different functions (e.g., fabrication and assembly) in producing a single type of product. A functional-focused facility performs few functions (e.g., only fabrication or only assembly) on many types of products. A product focus tends to result in more expertise about a particular type of product at the expense of the functional expertise that comes from a functional methodology.

For warehouses and DCs, firms must decide whether they will be primarily cross-docking facilities or storage facilities. At cross-docking facilities, inbound trucks from suppliers are unloaded; the product is broken into smaller lots, and is quickly loaded onto store-bound trucks. Each store-bound truck carries a variety of products, some from each inbound truck. For storage facilities, firms must decide on the products to be stored at each facility.

Location

Deciding where a company will locate its facilities constitutes a large part of the design of a supply chain. A basic trade-off here is whether to centralize in order to gain economies of scale or to decentralize to become more responsive by being closer to the customer. Companies must also consider a host of issues related to the various characteristics of the local area in which the facility is situated. These include macroeconomic factors, quality of workers, cost of workers, cost of facility, availability of infrastructure, proximity to customers, the location of that firm's other facilities, tax effects, and other strategic factors.

Capacity

Companies must also determine a facility's capacity to perform its intended function or functions. A large amount of excess capacity allows the facility to be very flexible and to respond to wide swings in the demands placed on it. Excess capacity, however, costs money and therefore can decrease efficiency. A facility with little excess capacity will likely be more efficient per unit of product it produces than one with a lot of unused capacity. The high-utilization facility, however, will have difficulty responding to demand fluctuations. Therefore, a company must make a trade-off to determine the right amount of capacity to have at each of its facilities.

Facility-Related Metrics

A manager should track the following facility-related metrics that influence supply chain performance.

- ***Capacity*** measures the maximum amount a facility can process.
- ***Utilization*** measures the fraction of capacity that is currently being used in the facility. Utilization affects both the unit cost of processing and the associated delays. Unit costs tend to decline and delays increase with increasing utilization.
- ***Theoretical flow/cycle time of production*** measures the time required to process a unit if there are absolutely no delays at any stage.
- ***Actual average flow/cycle time*** measures the average actual time taken for all units processed over a specified duration such as a week or month. The actual flow/cycle time includes the theoretical time and any delays.
- ***Flow time efficiency*** is the ratio of the theoretical flow time to the actual average flow time.
- ***Product variety*** measures the number of products/product families processed in a facility. Processing costs and flow times are likely to increase with product variety.

- ***Volume contribution of top 20 percent SKUs and customers*** measures the fraction of total volume processed by a facility that comes from the top 20 percent SKUs or customers. An 80/20 outcome in which the top 20 percent contribute 80 percent of volume indicates likely benefits from focusing the facility where separate processes are used to process the top 20 percent and the remaining 80 percent.
- ***Processing/setup/down/idle time*** measure the fraction of time that the facility was processing units, being set up to process units, unavailable because it was down, or idle because it had no units to process.
- ***Average production batch size*** measures the average amount produced in each production batch. Large batch sizes will decrease production cost but increase inventories in the supply chain.
- ***Production service level*** measures the fraction of production orders completed on time and in full.

OVERALL TRADE-OFF: RESPONSIVENESS VERSUS EFFICIENCY

The fundamental trade-off that managers face when making facilities decisions is between the cost of the number, location, and type of facilities (efficiency) and the level of responsiveness that these facilities provide the company's customers. Increasing the number of facilities increases facility and inventory costs but decreases transportation costs and reduces response time. Increasing the flexibility of a facility increases facility costs but decreases inventory costs and response time.

3.4 INVENTORY

In this section we discuss the role that inventory plays in the supply chain and how managers use inventory to drive supply chain performance.

ROLE IN THE SUPPLY CHAIN

Inventory exists in the supply chain because of a mismatch between supply and demand. This mismatch is intentional at a steel manufacturer, where it is economical to manufacture in large lots that are then stored for future sales. The mismatch is also intentional at a retail store where inventory is held in anticipation of future demand. An important role that inventory plays in the supply chain is to increase the amount of demand that can be satisfied by having the product ready and available when the customer wants it. Another significant role that inventory plays is to reduce cost by exploiting economies of scale that may exist during production and distribution.

Inventory is held throughout the supply chain in the form of raw materials, work in process, and finished goods. Inventory is a major source of cost in a supply chain and has a huge impact on responsiveness. If we think of the responsiveness spectrum discussed in Chapter 2, the location and quantity of inventory can move the supply chain from one end of the spectrum to the other. For example, an apparel supply chain with high inventory levels at the retail stage has a high level of responsiveness because a consumer can walk into a store and walk out with the shirt he or she was looking for. In contrast, an apparel supply chain with little inventory could be very efficient but would make customers wait several weeks or even months for their clothes.

Inventory also has a significant impact on the material flow time in a supply chain. *Material flow time* is the time that elapses between the point at which material enters

the supply chain to the point at which it exits. For a supply chain, *throughput* is the rate at which sales occur. If inventory is represented by I, flow time by T, and throughput by D, the three can be related using Little's law as follows:

$$I = DT \quad \textbf{(3.1)}$$

For example, if the flow time of an auto assembly process is 10 hours and the throughput is 60 units an hour, Little's law tells us that the inventory is $60 \times 10 = 600$ units. If we were able to reduce inventory to 300 units while holding throughput constant, we would reduce our flow time to five hours (300/60). We note that in this relationship, inventory and throughput must have consistent units.

The logical conclusion here is that inventory and flow time are synonymous in a supply chain because throughput is often determined by customer demand. Managers should use actions that lower the amount of inventory needed without increasing cost or reducing responsiveness, because reduced flow time can be a significant advantage in a supply chain.

ROLE IN THE COMPETITIVE STRATEGY

Inventory plays a significant role in a supply chain's ability to support a firm's competitive strategy. If a firm's competitive strategy requires a very high level of responsiveness, a company can achieve this responsiveness by locating large amounts of inventory close to the customer. Conversely, a company can also use inventory to become more efficient by reducing inventory through centralized stocking. The latter strategy would support a competitive strategy of being a low-cost producer. The trade-off implicit in the inventory driver is between the responsiveness that results from more inventory and the efficiency that results from less inventory.

Example 3-2: **Nordstrom**
Nordstrom's competitive strategy targets upper-end customers with high responsiveness requirements. These customers are willing to pay a premium to have the products they want when they want them. To support this competitive strategy, Nordstrom uses inventory; the company stocks a large variety and quantity of products to ensure a high level of availability. In fact, Nordstrom stocks a significantly larger amount of inventory than other department stores. Nordstrom incurs higher costs because of its large inventory, but it gains extra margin from its customers, who are willing to pay for the level of service that Nordstrom's inventory makes possible.

COMPONENTS OF INVENTORY DECISIONS

We now identify major inventory-related decisions that supply chain managers must make to effectively create more responsive and more efficient supply chains.

Cycle Inventory

Cycle inventory is the average amount of inventory used to satisfy demand between receipts of supplier shipments. The size of the cycle inventory is a result of the production, transportation, or purchase of material in large lots. Companies produce or purchase in large lots to exploit economies of scale in the production, transportation, or purchasing process. With the increase in lot size, however, also comes an increase in carrying costs. As an example of a cycle stock decision, consider an online book retailer. This retailer's sales average around 10 truckloads of books a month. The cycle inventory decisions the retailer must make are how much to order for replenishment and how often to place these orders. The e-retailer could order 10 truckloads once each month or it could order one truckload every three days. The basic

trade-off supply chain managers face is the cost of holding larger lots of inventory (when cycle inventory is high) versus the cost of ordering product frequently (when cycle inventory is low).

Safety Inventory

Safety inventory is inventory held in case demand exceeds expectation; it is held to counter uncertainty. If the world were perfectly predictable, only cycle inventory would be needed. Because demand is uncertain and may exceed expectations, however, companies hold safety inventory to satisfy an unexpectedly high demand. Managers face a key decision when determining how much safety inventory to hold. For example, a toy retailer such as Toys "R" Us must calculate its safety inventory for the holiday buying season. If it has too much safety inventory, toys go unsold and may have to be discounted after the holidays. If the company has too little safety inventory, however, then Toys "R" Us loses sales, along with the margin those sales would have brought. Therefore, choosing safety inventory involves making a trade-off between the costs of having too much inventory and the costs of losing sales due to not having enough inventory.

Seasonal Inventory

Seasonal inventory is built up to counter predictable variability in demand. Companies using seasonal inventory build up inventory in periods of low demand and store it for periods of high demand when they will not have the capacity to produce all that is demanded. Managers face key decisions in determining whether to build seasonal inventory, and if they do build it, in deciding how much to build. If a company can rapidly change the rate of its production system at very low cost, then it may not need seasonal inventory, because the production system can adjust to a period of high demand without incurring large costs. However, if changing the rate of production is expensive (e.g., when workers must be hired or fired), then a company would be wise to establish a smooth production rate and build up its inventory during periods of low demand. Therefore, the basic trade-off supply chain managers face in determining how much seasonal inventory to build is the cost of carrying the additional seasonal inventory versus the cost of having a more flexible production rate.

Level of Product Availability

Level of product availability is the fraction of demand that is served on time from product held in inventory. A high level of product availability provides a high level of responsiveness but increases cost because a lot of inventory is held but rarely used. In contrast, a low level of product availability lowers inventory holding cost but results in a higher fraction of customers who are not served on time. The basic trade-off when determining the level of product availability is between the cost of inventory to increase product availability and the loss from not serving customers on time.

Inventory-Related Metrics

A manager should track the following inventory-related metrics that influence supply chain performance.

- ***Average inventory*** measures the average amount of inventory carried. Average inventory should be measured in units, days of demand, and financial value.
- ***Products with more than a specified number of days of inventory*** identifies the products for which the firm is carrying a high level of inventory. This metric can be used to identify products that are in oversupply or identify reasons that justify the high inventory, such as price discounts, or being a very slow mover.
- ***Average replenishment batch size*** measures the average amount in each replenishment order. The batch size should be measured by SKU in terms of both units

and days of demand. It can be estimated by averaging over time the difference between the maximum and the minimum inventory (measured in each replenishment cycle) on hand.

- ***Average safety inventory*** measures the average amount of inventory on hand when a replenishment order arrives. Average safety inventory should be measured by SKU in both units and days of demand. It can be estimated by averaging over time the minimum inventory on hand in each replenishment cycle.
- ***Seasonal inventory*** measures the amount of both cycle and safety inventory that is purchased solely due to seasonal changes in demand.
- ***Fill rate*** measures the fraction of orders/demand that were met on time from inventory. Fill rate should not be averaged over time but over a specified number of units of demand (say, every thousand, million, etc.).
- ***Fraction of time out of stock*** measures the fraction of time that a particular SKU had zero inventory. This fraction can be used to estimate the demand during the stock out period.

Overall Trade-Off: Responsiveness Versus Efficiency

The fundamental trade-off that managers face when making inventory decisions is between responsiveness and efficiency. Increasing inventory generally makes the supply chain more responsive to the customer. A higher level of inventory also facilitates a reduction in production and transportation costs because of improved economies of scale in both functions. This choice, however, increases inventory holding cost.

3.5 TRANSPORTATION

In this section we discuss the role that transportation plays in the supply chain, as well as key transportation-related decisions that supply chain managers must make.

ROLE IN THE SUPPLY CHAIN

Transportation moves product between different stages in a supply chain. Like the other supply chain drivers, transportation has a large impact on both responsiveness and efficiency. Faster transportation allows a supply chain to be more responsive but reduces its efficiency. The type of transportation a company uses also affects the inventory and facility locations in the supply chain. Dell, for example, flies some components from Asia because doing so allows the company to lower the level of inventory it holds. Clearly, such a practice also increases responsiveness but decreases transportation efficiency because it is more costly than transporting parts by ship.

ROLE IN THE COMPETITIVE STRATEGY

The role of transportation in a company's competitive strategy figures prominently in the company's consideration of the target customer's needs. If a firm's competitive strategy targets a customer who demands a very high level of responsiveness, and that customer is willing to pay for this responsiveness, then a firm can use transportation as one driver for making the supply chain more responsive. The opposite holds true as well. If a company's competitive strategy targets customers whose main decision criterion is price, then the company can use transportation to lower the cost of the product at the expense of responsiveness. Because a company may use both inventory and transportation to increase responsiveness or efficiency, the optimal decision for the company often means finding the right balance between the two.

Example 3-3: **Laura Ashley**
Laura Ashley sells clothing and other household items through a mail-order catalog and uses transportation as part of its competitive strategy. Laura Ashley's customers are willing to pay a premium price for a high level of responsiveness. To meet this level of responsiveness, the company has located its main warehouse near the FedEx hub in Memphis, Tennessee, to better utilize the responsive transportation that FedEx offers. When an order is placed, the goods are easily and quickly sent from the Laura Ashley warehouse to the FedEx hub, where they are sent overnight to the customer. This transportation policy enables Laura Ashley's customers to order their goods later than they can at other companies and still receive them next day.

COMPONENTS OF TRANSPORTATION DECISIONS

We now identify key components of transportation that companies must analyze when designing and operating a supply chain.

Design of Transportation Network

The transportation network is the collection of transportation modes, locations, and routes along which product can be shipped. A company must decide whether transportation from a supply source will be direct to the demand point or will go through intermediate consolidation points. Design decisions also include whether multiple supply or demand points will be included in a single run or not. Finally, companies must also decide on the set of transportation modes that will be used.

Choice of Transportation Mode

The mode of transportation is the manner in which a product is moved from one location in the supply chain network to another. Companies can choose between air, truck, rail, sea, and pipeline as modes of transport for products. Today, information goods can also be sent via the Internet. Each mode has different characteristics with respect to the speed, size of shipments (individual parcels to pallets to full trucks to entire ships), cost of shipping, and flexibility that lead companies to choose one particular mode over the others.

Transportation-Related Metrics

A manager should track the following transportation-related metrics that influence supply chain performance.

- ***Average inbound transportation cost*** typically measures the cost of bringing product into a facility as a percentage of sales or cost of goods sold (COGS). Ideally, this cost should be measured per unit brought in, but this can be difficult. The inbound transportation cost is generally included in COGS. It is useful to separate this cost by supplier.
- ***Average incoming shipment size*** measures the average number of units or dollars in each incoming shipment at a facility.
- ***Average inbound transportation cost per shipment*** measures the average transportation cost of each incoming delivery. Along with the incoming shipment size, this metric identifies opportunities for greater economies of scale in inbound transportation.
- ***Average outbound transportation cost*** measures the cost of sending product out of a facility to the customer. Ideally, this cost should be measured per unit shipped, but it is often measured as a percentage of sales. It is useful to separate this metric by customer.
- ***Average outbound shipment size*** measures the average number of units or dollars on each outbound shipment at a facility.

- ***Average outbound transportation cost per shipment*** measures the average transportation cost of each outgoing delivery. Along with the outgoing shipment size, this metric identifies opportunities for greater economies of scale in outbound transportation.
- ***Fraction transported by mode*** measures the fraction of transportation (in units or dollars) using each mode of transportation. This metric can be used to estimate if certain modes are overused or underutilized.

Overall Trade-Off: Responsiveness Versus Efficiency

The fundamental trade-off for transportation is between the cost of transporting a given product (efficiency) and the speed with which that product is transported (responsiveness). Using fast modes of transport raises responsiveness and transportation cost but lowers the inventory holding cost.

3.6 INFORMATION

In this section we discuss the role that information plays in the supply chain, as well as key information-related decisions that supply chain managers must make.

ROLE IN THE SUPPLY CHAIN

Information deeply affects every part of the supply chain. Its impact is easy to underestimate, as information affects a supply chain in many different ways. Consider the following:

1. Information serves as the connection between various stages of a supply chain, allowing them to coordinate and maximize total supply chain profitability.
2. Information is also crucial to the daily operations of each stage in a supply chain. For instance, a production scheduling system uses information on demand to create a schedule that allows a factory to produce the right products in an efficient manner. A warehouse management system uses information to create visibility of the warehouse's inventory. The company can then use this information to determine whether new orders can be filled.

ROLE IN THE COMPETITIVE STRATEGY

Information is an important driver that companies have used to become both more efficient and more responsive. The tremendous growth of the importance of information technology is a testimony to the impact that information can have on improving a company. Like all the other drivers, however, even with information, companies reach a point when they must make the trade-off between efficiency and responsiveness.

Another key decision involves what information is most valuable in reducing cost and improving responsiveness within a supply chain. This decision will vary depending on the supply chain structure and the market segments served. Some companies, for example, target customers who require customized products that carry a premium price tag. These companies might find that investments in information allow them to respond more quickly to their customers. The following examples illustrate this type of investment.

Example 3-4: Andersen Windows

Andersen Windows, a major manufacturer of residential wood windows located in Bayport, Minnesota, has invested in an information system that enables the company to bring customized products to the market rapidly. This system, called "Window of Knowledge," allows distributors and customers to design windows to custom-fit their needs. Users can

select from a library of over 50,000 components that can be combined in any number of ways. The system immediately gives the customer price quotes and automatically sends the order to the factory if the customer decides to buy. This information investment not only gives the customer a much wider variety of products, it allows Andersen to be much more responsive to the customer, as it gets the customer's order to the factory as soon as the order is placed.

Example 3-5: **Dell**
Dell takes orders directly from consumers over the phone and via the Internet. Building this direct channel required an investment because of the added functions Dell must perform. A large part of that cost can be attributed to information. With the direct channel model, however, Dell is able to view the actual consumer demand much sooner than most PC manufacturers. Therefore, the company can respond more quickly to changes in consumer needs. Dell can then modify its product offerings to meet these new needs. Dell is not the low-cost provider. The company is, however, the cheapest for its level of responsiveness, and a large part of its responsiveness is due to the information flow between Dell and its customers, and Dell and its suppliers, that is made possible by its investment in information.

COMPONENTS OF INFORMATION DECISIONS

We now consider key components of information that a company must analyze to increase efficiency and improve responsiveness within its supply chain.

Push Versus Pull

When designing processes of the supply chain, managers must determine whether these processes are part of the push or pull phase in the chain. We discuss this distinction in Chapter 1, but we mention it again because different types of systems require different types of information. Push systems generally require information in the form of elaborate *material requirements planning* (MRP) systems to take the master production schedule and roll it back, creating schedules for suppliers with part types, quantities, and delivery dates. Pull systems require information on actual demand to be transmitted extremely quickly throughout the entire chain so that production and distribution of products may reflect the real demand accurately.

Coordination and Information Sharing

Supply chain coordination occurs when all stages of a supply chain work toward the objective of maximizing total supply chain profitability based on shared information. Lack of coordination can result in a significant loss of supply chain profit. Coordination among different stages in a supply chain requires each stage to share appropriate information with other stages. For example, if a supplier is to produce the right parts in a timely manner for a manufacturer in a pull system, the manufacturer must share demand and production information with the supplier. Information sharing is thus crucial to the success of a supply chain.

Forecasting and Aggregate Planning

Forecasting is the art and science of making projections about what future demand and conditions will be. Obtaining forecasting information frequently means using sophisticated techniques to estimate future sales or market conditions. Managers must decide how they will make forecasts and to what extent they will rely on forecasts to make decisions. Companies often use forecasts both on a tactical level to schedule production and on a strategic level to determine whether to build new plants or even whether to enter a new market.

Once a company creates a forecast, the company needs a plan to act on this forecast. *Aggregate planning* transforms forecasts into plans of activity to satisfy the projected demand. A key decision managers face is how to collaborate on aggregate planning

throughout the entire supply chain. The aggregate plan becomes a critical piece of information to be shared across the supply chain because it affects both the demand on a firm's suppliers and the supply to its customers.

Enabling Technologies

Many technologies exist to share and analyze information in the supply chain. Managers must decide which technologies to use and how to integrate these technologies into their companies and their partners' companies. The consequences of these decisions are becoming more and more important as the capabilities of these technologies grow. Some of these technologies include the following.

1. Electronic data interchange (EDI) allows companies to place instantaneous, paperless purchase orders with suppliers. EDI is not only efficient, it also decreases the time needed to get products to customers because transactions are faster and more accurate than when they are paper based. Although EDI is a bit outdated and has limited capabilities, it still offers efficiency and responsiveness gains for some firms.
2. The Internet has critical advantages over EDI with respect to information sharing. The Internet conveys much more information and therefore offers much more visibility than EDI. Better visibility improves decisions across the supply chain. Internet communication among stages in the supply chain is also easier because a standard infrastructure (the World Wide Web) already exists. Thanks to the Internet, e-commerce has become a major force in the supply chain.
3. Enterprise resource planning (ERP) systems provide the transactional tracking and global visibility of information from within a company and across its supply chain. This real-time information helps a supply chain to improve the quality of its operational decisions. ERP systems keep track of the information, whereas the Internet provides one method with which to view this information. A more detailed discussion of ERP systems is in Chapter 17.
4. Supply chain management (SCM) software uses the information in ERP systems to provide analytical decision support in addition to the visibility of information. ERP systems show a company what is going on, while SCM systems help a company decide what it should do. A more detailed discussion of SCM systems is in Chapter 17.
5. Radio frequency identification (RFID) consists of an active or passive radio frequency (RF) tag applied to the item being tracked and an RF reader/emitter. A passive tag draws energy from the reader, whereas an active tag has its own battery and draws power from there. Wal-Mart has mandated the use of RFID technology by its top 100 suppliers at the case level. RFID has many potential uses. It can be used in manufacturing to check availability of the entire bill of materials. The technology can make the receiving of a truck much faster and cheaper. Full implementation of RFID could eliminate the need for manual counting and barcode scanning at the receiving dock. It can also be used to get an exact count of incoming items and items in storage. RFID technology, however, has yet to reach 100 percent accuracy, and its cost per unit is still high enough to make global acceptance difficult, even at the case level.

Information-Related Metrics

A manager should track the following information-related metrics that influence supply chain performance.

- ***Forecast horizon*** identifies how far in advance of the actual event a forecast is made. The forecast horizon must equal the lead time of the decision that is driven by the forecast.

- ***Frequency of update*** identifies how frequently each forecast is updated. The forecast should be updated somewhat more frequently than a decision will be revisited, so that large changes can be flagged and corrective action taken.
- ***Forecast error*** measures the difference between the forecast and actual demand. The forecast error is a measure of uncertainty and drives all responses to uncertainty such as safety inventory or excess capacity.
- ***Seasonal factors*** measure the extent to which the average demand in a season is above or below the average in the year.
- ***Variance from plan*** identifies the difference between the planned production/inventories and the actual values. These variances can be used to raise flags that identify shortages and surpluses.
- ***Ratio of demand variability to order variability*** measures the standard deviation of incoming demand and supply orders placed. A ratio less than one potentially indicates the existence of the bullwhip effect.

Overall Trade-Off: Responsiveness Versus Efficiency

Good information can help a firm improve both its responsiveness and efficiency. The information driver is used to improve the performance of other drivers, and the use of information is based on the strategic position the other drivers support. Accurate information can help a firm improve efficiency by decreasing inventory and transportation costs. Accurate information can improve responsiveness by helping a supply chain better match supply and demand.

3.7 SOURCING

In this section we discuss the role that sourcing plays in the supply chain and key sourcing related decisions that managers need to make.

ROLE IN THE SUPPLY CHAIN

Sourcing is the set of business processes required to purchase goods and services. Managers must first decide which tasks will be outsourced and those that will be performed within the firm. For each outsourced task, the manager must decide whether to source from a single supplier or a portfolio of suppliers. If a portfolio of multiple suppliers is to be carried, then the role of each supplier in the portfolio must be clarified. The next step is to identify the set of criteria that will be used to select suppliers and measure their performance. Managers then select suppliers and negotiate contracts with them. Contracts define the role of each supply source and should be structured to improve supply chain performance and minimize information distortion from one stage to the next. Once suppliers and contracts are in place, procurement processes that facilitate the placement and delivery of orders play a major role.

ROLE IN THE COMPETITIVE STRATEGY

Sourcing decisions are crucial because they affect the level of efficiency and responsiveness the supply chain can achieve. In some instance, firms outsource to responsive third parties if it is too expensive for them to develop this responsiveness on their own. An example is the outsourcing of next-day delivery by all firms to a few package carriers because it is too expensive for a firm to develop next-day delivery capability on its own. In other instances firms have kept the responsive process in-house, to maintain control. An example of this is Benetton, which keeps the dyeing of knit garments

in-house so it can respond quickly to orders as they arrive. Firms also outsource for efficiency if the third party can achieve significant economies of scale or has a lower underlying cost structure for other reasons. Outsourcing decisions should be driven by the desire for growth in total supply chain profitability.

Example 3-6: **Cisco**
Cisco has outsourced almost all of its manufacturing. It does, however, have a sourcing strategy that varies by product type. For low-end products such as routers for home networks, Cisco aims for efficiency. These routers are produced and packed in China and shipped in bulk for sale in the United States. Cisco aims for the lowest-cost manufacturing location and economies of scale in transportation because the targeted market segment values low cost. For high-end products, in contrast, Cisco outsources to contract manufacturers in the United States. These manufacturers are not cheap but they are responsive and can serve the rapidly evolving needs of the high-end market.

COMPONENTS OF SOURCING DECISIONS

We now consider key sourcing decisions that are made within a firm.

In-House or Outsource

The most significant sourcing decision for a firm is whether to perform a task in-house or outsource it to a third party. This decision should be driven in part by its impact on the total supply chain profit. It is best to outsource if the growth in total supply chain profit is significant with little additional risk. Within a task such as transportation, managers must decide whether to outsource all of it, outsource only the responsive component, or outsource only the efficient component. Once again, the decision should be based in part on the growth in total supply chain profitability.

Supplier Selection

Managers must decide on the number of suppliers they will have for a particular activity. They must then identify the criteria along which suppliers will be evaluated and how they will be selected. For the selection process, managers must decide whether they will use direct negotiations or resort to an auction. If an auction is used, it must be structured to ensure the desired outcome.

Procurement

Procurement is the process in which the supplier sends product in response to customer orders. Managers must decide on the structure of procurement of direct as well as indirect materials, and strategic as well as general materials. In each case, it is important to identify the critical mechanism for increasing supply chain profits. For example, a firm should set up procurement for direct materials to ensure good coordination between the supplier and buyer. In contrast, the procurement of MRO products should be structured to ensure that transaction costs are low.

Sourcing-Related Metrics

A manager should track the following sourcing related metrics that influence supply chain performance.

- ***Days payable outstanding*** measures the number of days between when a supplier performed a supply chain task and when it was paid.
- ***Average purchase price*** measures the average price at which a good or service was purchased during the year. The average price should be weighted by the quantity purchased at each price.
- ***Range of purchase price*** measures the fluctuation in purchase price during a specified period. The goal is to identify if the quantity purchased correlated with the price.

- ***Average purchase quantity*** measures the average amount purchased per order. The goal is to identify whether a sufficient level of aggregation is occurring across locations when placing an order.
- ***Fraction on-time deliveries*** measures the fraction of deliveries from the supplier that were on time.
- ***Supply quality*** measures the quality of product supplied.
- ***Supply lead time*** measures the average time between when an order is placed and the product arrives.

Overall Trade-Off: Increase the Supply Chain Profits

Sourcing decisions should be made to increase the size of the total profit to be shared across the supply chain. The total profits are affected by the impact of sourcing on sales, service, production costs, inventory costs, transportation costs, and information costs. Outsourcing to a third party is meaningful if the third party raises the supply chain profits more than the firm can by its own. In contrast, a firm should keep a supply chain function in-house if the third party cannot increase the supply chain profits or if the risk associated with outsourcing is significant.

3.8 PRICING

In this section we discuss the role that pricing plays in the supply chain.

ROLE IN THE SUPPLY CHAIN

Pricing is the process by which a firm decides how much to charge customers for its goods and services. Pricing affects the customer segments that choose to buy the product, as well as the customer's expectations. This directly affects the supply chain in terms of the level of responsiveness required as well as the demand profile that the supply chain attempts to serve. Pricing is also a lever that can be used to match supply and demand. Short-term discounts can be used to eliminate supply surpluses or decrease seasonal demand spikes by moving some of the demand forward. In short, pricing is one of the most significant factors that affect the level and type of demand that the supply chain will face.

ROLE IN THE COMPETITIVE STRATEGY

Pricing is a significant attribute through which a firm executes its competitive strategy. For example, Costco, a membership-based wholesaler in the United States, has a policy that prices are kept steady but low. Customers expect low prices but are comfortable with a lower level of product availability. The steady prices also ensure that demand stays relatively stable. Costco serves a well-defined segment, and it can thus design an appropriate supply chain. The Costco supply chain aims to be very efficient, at the expense of some responsiveness. In contrast, some manufacturing and transportation firms use pricing that varies with the response time desired by the customer. Through their pricing, these firms are targeting a broader set of customers, some of whom need responsiveness while others need efficiency. In this case it becomes important for these firms to structure a supply chain that can meet the two divergent needs.

Example 3-7: **Amazon**

Amazon offers its customers a large menu of prices for products that are purchased from the company. For example, in November 2005, a person purchasing two books worth $30 could use standard shipping (ships in 3–5 business days) at a cost of $4.98, two-day shipping (ships in 2 business days) at a cost of $11.47, one-day shipping (ships in 1 business day) at a cost of $20.47 or use free shipping (ships in 7–14 business days). The pricing menu

allows Amazon to attract customers with varying levels of desired responsiveness. Whereas customers paying for one-day shipping impose a high degree of uncertainty on Amazon, customers opting for free shipping can be used to level out the workload at the warehouse over time. Amazon can thus use its pricing to provide responsiveness to those who value it while using those who want a low price to help it improve its efficiency. Amazon also uses pricing effectively to shift some of the Christmas peak to November, when it usually offers a discount on shipping. The discount moves some of the December demand forward, allowing it to reduce its December peak and improve its efficiency without giving up on responsiveness for those customers who do not want to order earlier.

COMPONENTS OF PRICING DECISIONS

We now describe key components of pricing decisions that affect supply chain performance.

Pricing and Economies of Scale

Most supply chain activities display economies of scale. Changeovers make small production runs more expensive per unit than large production runs. Loading and unloading costs make it cheaper to deliver a truckload to one location than four. In each case, the provider of the supply chain activity must decide how to price it appropriately to reflect these economies of scale. A commonly used approach is to offer quantity discounts. Care must be taken to ensure that quantity discounts offered are consistent with the economies of scale in the underlying process. Otherwise there is a danger of customer orders being driven primarily by the quantity discounts even though the underlying process does not have significant economies of scale.

Everyday Low Pricing Versus High–Low Pricing

A firm such as Costco practices everyday low pricing at its warehouse stores, keeping prices steady over time. Costco will go to the extent of not offering any discount on damaged books to ensure its everyday low pricing strategy. In contrast, most supermarkets practice high–low pricing and offer steep discounts on a subset of their product every week. The Costco pricing strategy results in relatively stable demand. The high–low pricing strategy results in a peak during the discount week, often followed by a steep drop in demand during the following weeks. The two pricing strategies lead to very different demand profiles that the supply chain must serve.

Fixed Price Versus Menu Pricing

A firm must decide whether it will charge a fixed price for its supply chain activities or have a menu with prices that vary with some other attribute, such as the response time or location of delivery. If marginal supply chain costs or the value to the customer vary significantly along some attribute, it is often effective to have a pricing menu. We have already discussed Amazon as an example of a firm offering a menu that is somewhat consistent with the cost of providing the particular supply chain service. An example where the pricing menu is somewhat inconsistent is seen at many MRO suppliers. They often allow customers to have their order shipped to them or to be picked up in person. A customer pays an additional shipping fee for home delivery but pays nothing for a personal pickup. The pick, pack, and deliver cost at the warehouse, however, is higher in the case of a personal pickup compared to home delivery. The pricing policy thus can lead to customer behavior that has a negative impact on profits.

Pricing-Related Metrics

A manager should track the following pricing-related metrics. With menu pricing, each metric should be tracked separately for each segment in the menu.

- ***Profit margin*** measures profit as a percentage of revenue. A firm needs to examine a wide variety of profit margin metrics to optimize its pricing, including dimensions

such as type of margin (gross, net, etc.), scope (SKU, product line, division, firm), customer type, and others.

- ***Days sales outstanding*** measures the average time between when a sale is made and when the cash is collected.
- ***Incremental fixed cost per order*** measures the incremental costs that are independent of the size of the order. These include changeover costs at a manufacturing plant or order processing or transportation costs that are incurred independent of shipment size at a mail-order firm.
- ***Incremental variable cost per unit*** measures the incremental costs that vary with the size of the order. These include picking costs at a mail-order firm or variable production costs at a manufacturing plant.
- ***Average sale price*** measures the average price at which a supply chain activity was performed in a given period. The average should be obtained by weighting the price with the quantity sold at that price.
- ***Average order size*** measures the average quantity per order. The average sale price, order size, incremental fixed cost per order, and incremental variable cost per unit help estimate the contribution from performing the supply chain activity.
- ***Range of sale price*** measures the maximum and the minimum of sale price per unit over a specified time horizon.
- ***Range of periodic sales*** measures the maximum and minimum of the quantity sold per period (day/week/month) during a specified time horizon. The goal is to understand any correlation between sales and price and any potential opportunity to shift sales by changing price over time.

Overall Trade-Off: Increase Firm Profits

All pricing decisions should be made with the objective of increasing firm profits. This requires an understanding of the cost structure of performing a supply chain activity and the value this activity brings to the supply chain. Strategies such as everyday low pricing may foster stable demand that allows for efficiency in the supply chain. Other pricing strategies may lower supply chain costs, defend market share, or even steal market share. Differential pricing may be used to attract customers with varying needs, as long as this strategy helps either increase revenues or shrink costs, preferably both.

In the next section, we discuss the main obstacles companies face when striving to achieve strategic fit.

3.9 OBSTACLES TO ACHIEVING STRATEGIC FIT

The key to achieving strategic fit is a company's ability to find a balance between responsiveness and efficiency that best matches the needs of its target customer. In deciding where this balance should be located on the responsiveness spectrum, companies face many obstacles. In this section we discuss some of the obstacles and also provide a feel for how the supply chain environment has changed over the years. On one hand, these obstacles have made it much more difficult for companies to create the ideal balance. On the other hand, they have afforded companies increased opportunities for improving supply chain management. Managers need a solid understanding of the impact of these obstacles because they are critical to a company's ability to reap the maximum profitability from its supply chain.

INCREASING VARIETY OF PRODUCTS

Product proliferation is rampant today. With customers demanding ever more customized products, manufacturers have responded with mass customization and even segment-of-one (companies view each customer as an independent market segment) views of the market. Products that were formerly quite generic are now custom-made for a specific consumer. For example, the number of running shoe styles sold in the United States went from five in the early 1970s to almost 300 by the late 1990s. The increase in product variety complicates the supply chain by making forecasting much more difficult. Increased variety tends to raise uncertainty, and increased uncertainty hurts both efficiency and responsiveness within the supply chain.

DECREASING PRODUCT LIFE CYCLES

In addition to the increasing variety of product types, the life cycle of products has been shrinking. Today there are products whose life cycles can be measured in months, compared to the old standard of years. These are not just niche products, either. PCs now have a life cycle of several months, and even some automobile manufacturers have lowered their product life cycles from five plus years to about three years. This decrease in product life cycles makes the job of achieving strategic fit more difficult, as the supply chain must constantly adapt to manufacture and deliver new products, in addition to coping with these products' demand uncertainty. Shorter life cycles increase uncertainty while reducing the window of opportunity within which the supply chain can achieve fit. Increased uncertainty combined with a smaller window of opportunity has put additional pressure on supply chains to coordinate and create a good match between supply and demand.

INCREASINGLY DEMANDING CUSTOMERS

Customers are constantly demanding improvements in delivery lead times, cost, and product performance. If they do not receive these improvements, they move on to new suppliers. Many companies had periodic, standard price increases—not due to a rise in demand or any other factor, but simply because raising prices was the way business was done. Now, one repeatedly sees companies that cannot force through *any* price increases without losing market share. Today's customers are demanding faster fulfillment, better quality, and better-performing products for the same price they paid years ago. This tremendous growth in customer *demands* (not necessarily *demand*) means that the supply chain must provide more just to maintain its business.

FRAGMENTATION OF SUPPLY CHAIN OWNERSHIP

Over the past several decades, most firms have become less vertically integrated. As companies have shed noncore functions, they have been able to take advantage of supplier and customer competencies that they themselves did not have. This new ownership structure, however, has also made managing the supply chain more difficult. With the chain broken into many owners, each with its own policies and interests, the chain is more difficult to coordinate. Potentially, this problem could cause each stage of a supply chain to work only toward its own objectives rather than the whole chain's, resulting in the reduction of overall supply chain profitability.

GLOBALIZATION

Supply chains today are more likely than ever to be global. Establishing a global supply chain creates many benefits, such as the ability to source from a global base of suppliers

who may offer better or cheaper goods than were available in a company's home nation. Globalization, however, also adds stress to the chain, because facilities within the chain are farther apart, making coordination much more difficult.

Globalization has also increased competition, as once-protected national players must compete with companies from around the world. In the past, with fewer companies satisfying customers' needs, customers were willing to tolerate longer response times. However, in most industries there are now many more firms aggressively pursuing their competitors' business. This competitive situation makes supply chain performance a key to maintaining and growing sales while also putting more strain on supply chains and thus forcing them to choose their trade-offs even more precisely.

DIFFICULTY EXECUTING NEW STRATEGIES

Creating a successful supply chain strategy is not easy. Once a good strategy is formulated, however, the execution of the strategy can be even more difficult. For instance, Toyota's production system, which is a supply chain strategy, has been widely known and understood. Yet this strategy has been a sustained competitive advantage for Toyota for more than two decades. Does Toyota have a brilliant strategy that no one else can figure out? Their strategy *is* brilliant, but many others have figured it out. The difficulty other firms have had is in executing that strategy. Many highly talented employees at all levels of the organization are necessary to make a supply chain strategy successful. Although we deal mostly with the formulation of strategy in this book, one should keep in mind that skillful execution of a strategy can be as important as the strategy itself.

All of the obstacles discussed earlier are making it more difficult for companies to achieve strategic fit in the supply chain. These obstacles also represent a tremendous opportunity in terms of untapped improvement within the supply chain. The increasing impact of these obstacles has led to supply chain management becoming a major factor in the success or failure of firms.

KEY POINT Many obstacles, such as rising product variety and shorter life cycles, have made it increasingly difficult for supply chains to achieve strategic fit. Overcoming these obstacles offers a tremendous opportunity for firms to use supply chain management to gain competitive advantage.

3.10 SUMMARY OF LEARNING OBJECTIVES

1. Identify the major drivers of supply chain performance.

   The major drivers of supply chain performance are facilities, inventory, transportation, information, sourcing, and pricing.

2. Discuss the role of each driver in creating strategic fit between the supply chain strategy and the competitive strategy.

   A company achieving strategic fit has found the right balance between responsiveness and efficiency. Each driver affects this balance. Having more facilities generally makes a chain more responsive, while having fewer, central facilities creates higher efficiency. Holding higher levels of inventory increases the responsiveness of a supply chain, while keeping inventory low increases the chain's efficiency. Using faster modes of transportation increases a chain's responsiveness, while using slower modes generally increases efficiency. Investing in information can vastly improve the supply chain performance on both dimensions. This investment, however, must be made based on the strategic position supported by

the other drivers. Appropriate sourcing decisions raise supply chain profits by assigning supply chain functions to the right party, who brings higher economies of scale or a higher level of aggregation of uncertainty. Pricing can be used to attract the right target customer segment. Differential pricing can be used to attract customers who value responsiveness as well as customers who want efficiency. The supply chain can then be structured to provide responsiveness to some customers while improving overall efficiency.

3. Define the key metrics that track the performance of the supply chain in terms of each driver.

   Facility-related metrics are capacity, utilization, theoretical flow/cycle time of production, actual flow/cycle time, flow time efficiency, product variety, volume contribution of top 20 percent SKUs/customers, processing/setup/down/idle time, and average production batch size. Inventory-related metrics are average inventory, products with more than a specified number of days of inventory, average replenishment batch size, average safety inventory, seasonal inventory, fill rate, and fraction of time out of stock. Transportation-related metrics are average inbound transportation cost, average incoming shipment size, average inbound transportation cost per shipment, average outbound transportation cost, average outbound shipment size, average outbound transportation cost per shipment, and fraction transported by mode. Information-related metrics are forecast horizon, forecast error, seasonal factors, variance from plan, and ratio of demand variability to order variability. Sourcing-related metrics are days payable outstanding, average purchase price, range of purchase price, average purchase quantity, fraction on-time deliveries, supply quality, and supply lead time. Pricing-related metrics are profit margin, days sales outstanding, incremental fixed cost per order, incremental variable cost per unit, average sale price, average order size, range of sale price, and range of periodic sales.

4. Describe the major obstacles that must be overcome to manage a supply chain successfully.

   Increasing product variety, decreasing product life cycles, demanding customers, and global competition all make creating supply chain strategies more difficult, as these factors can hamper supply chain performance. The increase in globalization of the supply chain and fragmentation of supply chain ownership has also made it more difficult to execute supply chain strategies.

Discussion Questions

1. How could a grocery retailer use inventory to increase the responsiveness of the company's supply chain?
2. How could an auto manufacturer use transportation to increase the efficiency of its supply chain?
3. How could a bicycle manufacturer increase responsiveness through its facilities?
4. How could an industrial supplies distributor use information to increase its responsiveness?
5. Motorola has gone from manufacturing all its cell phones in-house to almost completely outsourcing the manufacturing. What are the pros and cons of the two approaches?
6. How can a home-delivery company like Peapod use pricing of its delivery services to improve its profitability?
7. How has globalization made strategic fit even more important to a company's success?
8. What are some industries in which products have proliferated and life cycles have shortened? How have the supply chains in these industries adapted?
9. How can the full set of logistical and cross-functional drivers be used to create strategic fit for a PC manufacturer targeting both time-sensitive and price-conscious customers?

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CASE STUDY

SEVEN-ELEVEN JAPAN CO.

Established in 1973, Seven-Eleven Japan set up its first store in Koto-ku, Tokyo, in May 1974. The company was first listed on the Tokyo Stock Exchange in October 1979. In 2004 it was owned by the Ito-Yokado group, which also managed a chain of supermarkets in Japan and owned a majority share in Southland, the company managing Seven-Eleven in the United States. Seven-Eleven Japan realized a phenomenal growth between the years of 1985 and 2003. During that period, the number of stores increased from 2,299 to 10,303; annual sales increased from 386 billion to 2,343 billion yen; and net income increased from 9 billion to 91.5 billion yen. Additionally, the company's return on equity (ROE) averaged around 14 percent between 2000 and 2004. In 2004, Seven-Eleven Japan represented Japan's largest retailer in terms of operating income and number of stores. Customer visits to Seven-Eleven outlets totaled 3.6 billion that year, averaging almost 30 visits to a Seven-Eleven annually for every person in Japan.

COMPANY HISTORY AND PROFILE

Both Ito-Yokado and Seven-Eleven Japan were founded by Masatoshi Ito. He started his retail empire after World War II, when he joined his mother and elder brother and began to work in a small clothing store in Tokyo. By 1960 he was in sole control, and the single store had grown into a $3 million company. After a trip to the United States in 1961, Ito became convinced that superstores were the wave of the future. At that time, Japan was still dominated by Mom-and-Pop stores. Ito's chain of superstores in the Tokyo area was instantly popular and soon constituted the core of Ito-Yokado's retail operations.

In 1972, Ito first approached the Southland Corporation about the possibility of opening Seven-Eleven convenience stores in Japan. After rejecting his initial request, Southland agreed in 1973 to a licensing agreement. In exchange for 0.6 percent of total sales, Southland gave Ito exclusive rights throughout Japan. In May 1974, the first Seven-Eleven convenience store opened in Tokyo.

This new concept was an immediate hit in Japan, and Seven-Eleven Japan experienced tremendous growth. By 1979 there were already 591 Seven-Eleven stores in Japan; by 1984 there were 2,001. Rapid growth continued (see Table 3-1), resulting in 10,356 stores by 2004.

On October 24, 1990, the Southland Corporation entered into bankruptcy protection. Southland asked for Ito-Yokado's help, and on March 5, 1991, IYG Holding was formed by Seven-Eleven Japan (48 percent) and Ito-Yokado (52 percent). IYG acquired 70 percent of Southland's common stock for a total price of $430 million.

In 2004, convenience store operations from Seven-Eleven Japan and 7-Eleven Inc. in the United States contributed 48.2 percent of total revenues and 90.2 percent of total consolidated operating income for the Ito Yokado group. Seven-Eleven Japan contributed 87.6 percent of

TABLE 3-1 Stores and Annual Sales for Seven-Eleven Japan

Year	*Number of Stores*	*Annual Sales (billion yen)*	*Year*	*Number of Stores*	*Annual Sales (billion yen)*
1974	15	0.7	1989	3,954	780.3
1975	69	4.8	1990	4,270	931.9
1976	199	17.4	1991	4,629	1,081.8
1977	375	39.8	1992	5,058	1,194.9
1978	591	72.5	1993	5,475	1,281.9
1979	801	109.8	1994	5,905	1,392.3
1980	1,040	153.6	1995	6,373	1,477.1
1981	1,306	202.1	1996	6,875	1,609.0
1982	1,643	256.5	1997	7,314	1,740.9
1983	2,001	319.0	1998	7,732	1,848.1
1984	2,299	386.7	1999	8,153	1,963.9
1985	2,651	453.6	2000	8,602	2,046.6
1986	2,964	521.9	2001	9,060	2,114.0
1987	3,304	599.1	2002	9,690	2,213.2
1988	3,653	686.3	2003	10,303	2,343.2

the total income received from convenience stores by Ito Yokado. Effectively, Seven-Eleven Japan has become the dominant part of the Ito Yokado group.

THE CONVENIENCE STORE INDUSTRY AND SEVEN-ELEVEN IN JAPAN

In Japan, the convenience store sector was one of the few business areas that continued to grow during the prolonged 1990s downturn. From 1991 to 2002 the number of convenience stores in Japan increased from 19,603 to almost 42,000. As a percentage of all retail stores in Japan, this represented an increase from 1.2 percent to 3.2 percent. During that period, annual sales at convenience stores more than doubled, from just over 3 trillion to 6.7 trillion yen. As a percentage of all retail sales in Japan, this represented an increase from 2.2 percent to 5.0 percent.

Japan's convenience store sector gradually consolidated, with larger players growing and smaller operators shutting down. In 2004, the top 10 convenience store chains accounted for approximately 90 percent of Japan's convenience stores. As the chains improved their operating structures and better leveraged economies of scale, smaller operators found it hard to compete.

Seven-Eleven Japan had increased its share of the convenience store market since it opened. In 2002, Seven-Eleven was Japan's leading convenience store operator, accounting for 21.7 percent of all convenience stores and 31.5 percent of total sales. Seven-Eleven was very effective in terms of same-store sales. In 2004 average daily sales at the four major convenience store chains excluding Seven-Eleven Japan totaled 484,000 yen. Seven-Eleven stores, in contrast, had daily sales of 647,000 yen—more than 30 percent higher than the competition put together. In 2004, Seven-Eleven's operating income of 165.7 billion yen positioned it as a leader not only of the convenience store sector but also of Japan's retail industry as a whole. In terms of growth, its performance was even more impressive. In 2004 Seven-Eleven accounted for 60 percent of the total net increase in the number of stores among the top 10 convenience store chains in Japan. This growth had been very carefully planned, exploiting the core strengths that Seven-Eleven Japan had developed in the areas of information systems and distribution systems.

THE SEVEN-ELEVEN JAPAN FRANCHISE SYSTEM

Seven-Eleven Japan developed an extensive franchise network and performed a key role in the daily operations of this network. The Seven-Eleven Japan network included both company-owned stores and third-party-owned franchises. In 2004, franchise commissions accounted for over 68 percent of revenue from operations. To ensure efficiency, Seven-Eleven Japan based its fundamental network expansion policy on a market-dominance strategy. Entry into any new market was built around a cluster of 50 to 60 stores supported by a distribution center. Such clustering gave Seven-Eleven Japan a high-density market presence and allowed it to operate an efficient distribution system. Seven-Eleven Japan, in its 1994 annual report, listed the following six advantages of the market-dominance strategy:

- Boosted distribution efficiency
- Improved brand awareness
- Increased system efficiency
- Enhanced efficiency of franchise support services
- Improved advertising effectiveness
- Prevented competitors' entrance into the dominant area

Adhering to its dominant strategy, Seven-Eleven Japan opened the majority of its new stores in areas with existing clusters of stores. For example, the Aichi prefecture, where Seven-Eleven began opening stores in 2002, saw a large increase in 2004, with 108 new store openings. This represented more than 15 percent of the new Seven-Eleven stores opened in Japan that year.

Geographically, Seven-Eleven has a limited presence in Japan. In 2004 the company had stores in about 70 percent (32 of 47) of the prefectures within Japan. However, within prefectures where they were present, stores tended to be dense. As the 2004 annual report stated, "Filling in the entire map of Japan is not our priority. Instead, we look for demand where Seven-Eleven stores already exist, based on our fundamental area-dominance strategy of concentrating stores in specific areas."

With Seven-Eleven franchises being highly sought after, fewer than one of 100 applicants were awarded a franchise (a testament to store profitability). The franchise owner was required to put a significant amount of money up front. Half of this amount was used to prepare the store and train the owner. The rest was used for purchasing the initial stock for the store. In 1994, 45 percent of total gross profits at a store went to Seven-Eleven Japan, and the rest went to the store owner. The responsibilities of the two parties were as follows.

Seven-Eleven Japan responsibilities:

- Develop supply and merchandise
- Provide the ordering system
- Pay for the system operation
- Supply accounting services
- Provide advertising
- Install and remodel facilities
- Pay 80 percent of utility costs

Franchise owner responsibilities:

- Operate and manage store
- Hire and pay staff
- Order supplies
- Maintain store appearance
- Provide customer service

TABLE 3-2 Financial Figures for Seven-Eleven Japan (2000–2004)

For Fiscal Years Ending February 28/29	*2000*	*2001*	*2002*	*2003*	*2004*
Net sales (billion yen)	1,964.0	2,046.6	2,114.0	2,213.3	2,343.2
Revenue (billion yen)	327.0	346.9	365.9	400.7	445.4
Ordinary income (billion yen)	140.2	147.2	153.8	159.6	168.9
Net income (billion yen)	68.2	78.4	83.2	86.5	91.5
Number of stores	8,153	8,602	9,060	9,690	10,303

STORE INFORMATION AND CONTENTS

Seven-Eleven had 10,303 stores in Japan and Hawaii as of 2003 (see Table 3-2). In 2004, Seven-Eleven Japan changed the standard size of new stores from 125 square meters to 150 square meters, still significantly smaller than the size of most U.S. 7-Eleven stores. Daily sales at a store averaged 647,000 yen (about $6,100), which was about twice the average at a U.S. store.

Seven-Eleven Japan offered its stores a choice from a set of 5,000 SKUs (stock keeping units). Each store carried on average about 3,000 SKUs depending on local customer demand. Seven-Eleven emphasized regional merchandizing to cater precisely to local preferences. Each store carried food items, beverages, magazines, and consumer items such as soaps and detergents. Sales across product categories from 2002 to 2004 are given in Table 3-3.

The food items were classified in four broad categories: (1) chilled-temperature items including sandwiches, delicatessen products, and milk; (2) warm-temperature items including box lunches, rice balls, and fresh bread; (3) frozen items including ice cream, frozen foods, and ice cubes; (4) and room-temperature items including canned food, instant noodles, and seasonings. Processed food and fast-food items were big sellers for the stores. In 2004, processed and fast foods contributed about 60 percent of the total sales at each store. Over 1 billion rice balls were sold in 2004; this amounted to each Japanese citizen eating approximately eight Seven-Eleven rice balls a year. The top-selling products in the fast-food category were lunch boxes, rice balls, bread-based products, and pasta. As of February 2004, Seven-Eleven Japan had 290 dedicated manufacturing plants that produced only fast food for their stores.

Other products sold at Seven-Eleven stores included soft drinks, nutritional drinks, alcoholic beverages such as beer and wine, game software, music CDs, and magazines.

In 2004, Seven-Eleven was focused on increasing the number of original items that were available only at their stores. At that time, original items accounted for roughly 52 percent of total store sales. The company aimed to increase the percentage to 60 percent in the medium to long term.

STORE SERVICES

Besides products, Seven-Eleven Japan gradually added a variety of services that customers could obtain at its stores. The first service, added in October 1987, was the in-store payment of Tokyo Electric Power bills. The company later expanded the set of utilities for which customers could pay their bills in the stores to include gas, insurance premiums, and telephone. With more convenient operating hours and locations than banks or other financial institutions, the bill payment service attracted millions of additional customers every year. In April 1994, Seven-Eleven Japan began accepting installment payments on behalf of credit companies. It started selling ski-lift pass vouchers in November 1994. In 1995 it began to accept payment for mail-order purchases. This was expanded to include payment for Internet shopping in November 1999. In August 2000, a meal delivery service company, Seven-Meal Service Co. Ltd., was established to serve the aging Japanese population. In 2001, IYBank Co. was established through a joint investment with Ito Yokado. By April 2004, ATMs had been installed in about 75 percent of the total store network in Japan, with the goal to achieve 100 percent ATM installation.

Other services offered at stores include photocopying, ticket sales using multifunctional copiers, and being a pick-up location for parcel delivery companies that typically do not leave the parcel outside if the customer is not at home. The major thrust for offering these services was to make Seven-Eleven stores in Japan more convenient places to shop. Several of these services exploited the existing Total Information System (see text following) in the store.

In February 2000, Seven-Eleven Japan established 7dream.com, an e-commerce company. The goal was to exploit the existing distribution system and the fact that stores were easily accessible to most Japanese. Stores served as drop-off and collection points for Japanese customers. A survey by eSBook (a joint venture among Softbank, Seven-Eleven Japan, Yahoo!Japan, and Tohan, a publisher) discovered that 92 percent of its customers preferred to pick up their online purchases at the local convenience store, rather than have them delivered to their homes. This was understandable given the frequency with which Japanese customers visit their local convenience store. 7dream hoped to build on this

TABLE 3-3 Sales by Product Category Between 2002 and 2004

	2002				*2003*				*2004*			
	Sales (billion yen)	*Gross Margin (percent)*	*Percent of Total Sales*	*Percent Increase from Prior Year*	*Sales (billion yen)*	*Gross Margin (percent)*	*Percent of Total Sales*	*Percent Increase from Prior Year*	*Sales (billion yen)*	*Gross Margin (percent)*	*Percent of Total Sales*	*Percent Increase from Prior Year*
Processed foods	681.5	34.4	32.0	5.3	696.0	34.9	31.2	2.1	725.4	36.0	30.8	4.2
Fast foods	642.2	32.3	30.2	3.1	674.7	32.4	30.3	5.1	704.4	32.2	29.9	4.4
Fresh foods	264.9	30.5	12.4	3.3	284.0	30.9	12.7	7.2	305.0	31.1	12.9	7.4
Nonfoods	540.2	22.9	25.4	1.7	573.6	22.6	25.8	6.2	624.0	22.1	26.4	8.8
Total	2,128.7	30.4	100.0	3.5	2,228.2	30.5	100.0	4.7	2,358.8	30.6	100.0	5.9

preference along with the synergies from the existing distribution system.

SEVEN-ELEVEN JAPAN'S INTEGRATED STORE INFORMATION SYSTEM

From its start, Seven-Eleven Japan sought to simplify its operations by using advanced information technology. Seven-Eleven Japan attributed a significant part of its success to the Total Information System installed in every outlet and linked to headquarters, suppliers, and the Seven-Eleven distribution centers. The first online network linking the head office, stores, and vendors was established in 1979, though the company did not collect point-of-sales (POS) information at that time. In 1982, Seven-Eleven became the first company in Japan to introduce a POS system comprising POS cash registers and terminal control equipment. In 1985 the company developed, jointly with NEC, personal computers using color graphics that were installed at each store and linked to the POS cash registers. These computers were also on the network linking the store to the head office as well as the vendors. Until July 1991, head office, stores, distribution centers, and suppliers were linked only by a traditional analog network. At that time, an integrated services digital network (ISDN) was installed. Linking more than 5,000 stores, it became one of the world's largest ISDN systems at that time.

The two-way, high-speed, online communication capability of ISDN enabled Seven-Eleven Japan to collect, process, and feed back POS data quickly. Sales data gathered in each store by 11:00 P.M. were processed and ready for analysis the next morning. In 1997, Seven-Eleven Japan introduced its fifth generation of the Total Information System, which was still in use in 2004.

The hardware system at a 1994 Seven-Eleven store included the following:

- ***Graphic order terminal:*** This was a hand-held device with a wide-screen graphic display, used by the store owner or manager to place orders. The items were recorded and brought up in the order in which they were arranged on the shelves. The store manager/owner walked down the aisles and placed orders by item. When placing an order, the store manager had access (from the store computer) to detailed analysis of POS data related to the particular item. This included sales analysis of product categories and SKUs over time, analysis of waste, 10-week sales trends by SKU, 10-day sales trends by SKU, sales trends for new products, sales analysis by day and time, list of slow-moving items, analysis of sales and number of customers over time, contribution of product to sections in store display, and sales growth by product categories. The store manager used this information when placing his order, which was entered directly into the terminal. Once all the orders were placed, the terminal was returned to its slot, at which point the orders were relayed by the store computer to both the appropriate vendor and the Seven-Eleven distribution center.
- ***Scanner terminal:*** These scanners read bar codes and recorded inventory. They were used to receive products coming in from a distribution center. This was automatically checked against a previously placed order, and the two were reconciled. Before the scanner terminals were introduced, truck drivers waited in the store until the delivery was checked. Once they were introduced, the driver simply dropped the delivery in the store, and a store clerk received it at a suitable time when there were few customers. The scanner terminals were also used when examining inventory at stores.
- ***Store computer:*** This linked to the ISDN network, the POS register, the graphic order terminal, and the scanner terminal. It communicated among the various input sources, tracked store inventory and sales, placed orders, provided detailed analysis of POS data, and maintained and regulated store equipment.
- ***POS register:*** To better understand the functioning of this information network, one needs to consider a sampling of daily operations. As soon as a customer purchased an item and paid at the POS register, the item information was retrieved from the store computer and the time of sale was automatically recorded. In addition, the cashier recorded the age and sex of the customer. To do this, the cashier used five register keys for the categories: under-13, 13–19, 20–29, 30–49, and 50+. This POS data was automatically transmitted online to a host computer. All sales data collected by 11:00 P.M. were organized and ready for analysis by the next morning. The data were evaluated on a company-wide, district, and store basis.

The analyzed and updated data were then sent back to the Seven-Eleven Japan stores via the network. Each store computer automatically updated its product master file to analyze its recent sales and stock movements. The main objective of the analysis was to improve the ordering process. All this information was available on the graphic order terminal used for order placement.

The information system allowed Seven-Eleven stores to better match supply with demand. Store staff could adjust the merchandising mix on the shelves according to consumption patterns throughout the day. For example, popular breakfast items were stocked earlier during the day, while popular dinner items were stocked later in the evening. The identification of slow and nonmoving items allowed a store to convert shelf space to introduce new items. More than 50 percent of the items sold at a Seven-Eleven store changed in the

course of a year. This was due partly to seasonal demand and partly to new products. When a new product was introduced, the decision whether to continue stocking it was made within the first three weeks. Each item on the shelf contributed to sales and margin and did not waste valuable shelf space.

SEVEN-ELEVEN'S DISTRIBUTION SYSTEM

The Seven-Eleven distribution system tightly linked the entire supply chain for all product categories. The Seven-Eleven distribution centers and the information network played a key role in that regard. The major objective was to carefully track sales of items and offer short replenishment cycle times. This allowed a store manager to forecast sales corresponding to each order accurately.

From March 1987, Seven-Eleven, offered three-times-a-day store delivery of all rice dishes (which comprised most of the fast-food items sold). Bread and other fresh food were delivered twice a day. The distribution system was flexible enough to alter delivery schedules depending on customer demand. For example, ice cream was delivered daily during the summer but only three times a week at other times. The replenishment cycle time for fresh and fast-food items had been shortened to less than 12 hours. A store order for rice balls by 10:00 A.M. was delivered before the dinner rush.

As discussed earlier, the store manager used a graphic order terminal to place an order. All stores were given cutoff times for breakfast, lunch, and dinner ordering. When a store placed an order, it was immediately transmitted to the supplier as well as the distribution center. The supplier received orders from all Seven-Eleven stores and started production to fill the orders. The supplier then sent the orders by truck to the distribution center. Each store order was separated so the distribution center could easily assign it to the appropriate store truck using the order information it already had. The key to store delivery was what Seven-Eleven called the combined delivery system. At the distribution center, delivery of like products from different suppliers (for example, milk and sandwiches) was directed into a single temperature-controlled truck. There were four categories of temperature-controlled trucks: frozen foods, chilled foods, room-temperature processed foods, and warm foods. Each truck made deliveries to multiple retail stores. The number of stores per truck depended on the sales volume. All deliveries were made during off-peak hours and were received using the scanner terminals. The system worked on trust and did not require the delivery person to be present when the store personnel scanned in the delivery. That reduced the delivery time spent at each store.

This distribution system enabled Seven-Eleven to reduce the number of vehicles required for daily delivery service to each store, even though the delivery frequency of each item was quite high. In 1974, 70 vehicles visited each store every day. In 1994, only 11 were necessary. This dramatically reduced delivery costs and enabled rapid deliver of a variety of fresh foods.

As of February 2004, Seven-Eleven Japan had a total of 290 dedicated manufacturing plants throughout the country that produced only fast food for Seven-Eleven stores. These items were distributed through 293 dedicated distribution centers (DCs) that ensured rapid, reliable delivery. None of these DCs carried any inventory; they merely transferred inventory from supplier trucks to Seven-Eleven distribution trucks. The transportation was provided by Transfleet Ltd., a company set up by Mitsui and Co. for the exclusive use of Seven-Eleven Japan.

7-ELEVEN IN THE UNITED STATES

Seven-Eleven had expanded rapidly around the world (see Table 3-4). The major growth was in Asia, though the United States continued to be the second largest market for Seven-Eleven. Once Seven-Eleven Japan acquired Southland Corporation, it set about improving operations in the United States. In the initial years, several 7-Eleven stores in the United States were shut down. The number of stores started to grow beginning in 1998. Historically, the distribution structure in the United States was completely different from that of Japan. Stores in the United States were replenished using direct store delivery (DSD) by some manufacturers, with the remain-

TABLE 3-4 Global Store Distribution for Seven-Eleven in 2004

Country	*Stores*
Japan	10,615
United States	5,798
Taiwan	3,680
Thailand	2,861
South Korea	1,179
China	808
Mexico	491
Canada	488
Malaysia	460
Australia	345
Singapore	261
Philippines	257
Norway	78
Sweden	74
Turkey	65
Denmark	46
Puerto Rico	12
Guam	8
Total	27,526

ing products delivered by wholesalers. DSD accounted for about half the total volume, with the rest coming from wholesalers.

With the goal of introducing "fresh" products, 7-Eleven introduced the concept of combined distribution centers (CDCs) around 2000. By 2003, 7-Eleven had 23 CDCs located throughout North America supporting about 80 percent of the store network. CDCs delivered fresh items such as sandwiches, bakery products, bread, produce, and other perishables once a day. A variety of fresh-food suppliers sent product to the CDC throughout the day, where they were sorted for delivery to stores at night. Requests from store managers were sent to the nearest CDC, and by 10:00 P.M. the products were en route to the stores. Fresh-food sales in North America exceeded $450 million in 2003. During this period, DSD by manufacturers and wholesaler delivery to stores also continued.

This was a period when 7-Eleven worked very hard to introduce new fresh-food items with a goal of competing more directly with the likes of Starbucks than with traditional gas station food marts. 7-Eleven in the United States had over 68 percent of its sales from nongasoline products compared to the rest of the industry, for which this number was closer to 35 percent. The goal was to continue to increase sales in the fresh-food and fast-food categories.

In 2003 revenue in the United States and Canada totaled $10.9 billion, with about 69 percent coming from merchandise and the rest from the sale of gasoline. The North American inventory turnover rate in 2004 was about 19, compared to over 50 in Japan. This performance, however, represented a significant improvement in North American performance, where inventory turns in 1992 were around 12.

STUDY QUESTIONS

1. A convenience store chain attempts to be responsive and provide customers what they need, when they need it, where they need it. What are some different ways that a convenience store supply chain can be responsive? What are some risks in each case?
2. Seven-Eleven's supply chain strategy in Japan can be described as attempting to micro-match supply and demand using rapid replenishment. What are some risks associated with this choice?
3. What has Seven-Eleven done in its choice of facility location, inventory management, transportation, and information infrastructure to develop capabilities that support its supply chain strategy in Japan?
4. Seven-Eleven does not allow direct store delivery in Japan but has all products flow through its distribution center. What benefit does Seven-Eleven derive from this policy? When is direct store delivery more appropriate?
5. What do you think about the 7dream concept for Seven-Eleven Japan? From a supply chain perspective, is it likely to be more successful in Japan or the United States? Why?
6. Seven-Eleven is attempting to duplicate the supply chain structure that has succeeded in Japan in the United States with the introduction of CDCs. What are the pros and cons of this approach? Keep in mind that stores are also replenished by wholesalers and DSD by manufacturers.
7. The United States has food service distributors that also replenish convenience stores. What are the pros and cons to having a distributor replenish convenience stores versus a company like Seven-Eleven managing its own distribution function?