CHAPTER

2

Supply Chain Performance

Achieving Strategic Fit and Scope

LEARNING OBJECTIVES

After reading this chapter, you will be able to

1. Explain why achieving strategic fit is critical to a company's overall success.
2. Describe how a company achieves strategic fit between its supply chain strategy and its competitive strategy.
3. Discuss the importance of expanding the scope of strategic fit across the supply chain.
4. Describe the major challenges that must be overcome to manage a supply chain successfully.

In Chapter 1, we discussed what a supply chain is and the importance of supply chain design, planning, and operation to a firm's success. In this chapter, we define supply chain strategy and explain how creating a strategic fit between a company's competitive strategy and its supply chain strategy affects performance. We also discuss the importance of expanding the scope of strategic fit from one operation within a company to all stages of the supply chain.

2.1 COMPETITIVE AND SUPPLY CHAIN STRATEGIES

A company's *competitive strategy* defines, relative to its competitors, the set of customer needs that it seeks to satisfy through its products and services. For example, Walmart aims to provide high availability of a variety of products of reasonable quality at low prices. Most products sold at Walmart are commonplace (everything from home appliances to clothing) and can be purchased elsewhere. What Walmart provides is a low price and product availability. McMaster-Carr sells maintenance, repair, and operations (MRO) products. It offers more than 500,000 products through both a catalog and a website. Its competitive strategy is built around providing the customer with convenience, availability, and responsiveness. With this focus on responsiveness, McMaster does not compete based on low price. Clearly, the competitive strategy at Walmart is different from that at McMaster.

We can also contrast Blue Nile, with its online retailing model for diamonds, with Zales, which sells diamond jewelry through retail outlets. Blue Nile has emphasized the variety of diamonds available from its website and the fact that its margins are significantly lower than its bricks-and-mortar competition. Customers, however, have to wait to get their jewelry and do not have any opportunity to touch and see it before purchase (Blue Nile does provide a 30-day return period, though). At Zales, in contrast, a customer can walk into the retail store, be helped by a salesperson, and leave immediately with a diamond ring. The amount of variety available at a Zales store, however, is limited. Whereas Blue Nile offers more than 90,000 stones on its site, a typical Zales store carries fewer than a thousand.

In each case, the competitive strategy is defined based on how the customer prioritizes product cost, delivery time, variety, and quality. A McMaster-Carr customer places greater emphasis on product variety and response time than on cost. A Walmart customer, in contrast, places greater emphasis on cost. A Blue Nile customer, purchasing online, places great emphasis on product variety and cost. A customer purchasing jewelry at Zales is most concerned with fast response time and help in product selection. Thus, a firm's competitive strategy will be defined based on its customers' priorities. Competitive strategy targets one or more customer segments and aims to provide products and services that satisfy these customers' needs.

To see the relationship between competitive and supply chain strategies, we start with the value chain for a typical organization, as shown in Figure 2-1.

The value chain begins with new product development, which creates specifications for the product. Marketing and sales generate demand by publicizing the customer priorities that the products and services will satisfy. Marketing also brings customer input back to new product development. Operations transforms inputs to outputs to create the product according to new product specifications. Distribution either takes the product to the customer or brings the customer to the product. Service responds to customer requests during or after the sale. These are core processes or functions that must be performed for a successful sale. Finance, accounting, information technology, and human resources support and facilitate the functioning of the value chain.

To execute a company's competitive strategy, all these functions play a role, and each must develop its own strategy. Here, *strategy* refers to what each process or function will try to do particularly well.

A *product development* strategy specifies the portfolio of new products that a company will try to develop. It also dictates whether the development effort will be made internally or outsourced. A *marketing and sales* strategy specifies how the market will be segmented and how the product will be positioned, priced, and promoted. A *supply chain strategy* determines the nature of procurement of raw materials, transportation of materials to and from the company, manufacture of the product or operation to provide the service, and distribution of the product to the customer, along with any follow-up service and a specification of whether these processes will be performed in-house or outsourced. Supply chain strategy specifies what the operations, distribution, and service functions, whether performed in-house or outsourced, should do particularly well. Because our focus here is on supply chain strategy, we define it in

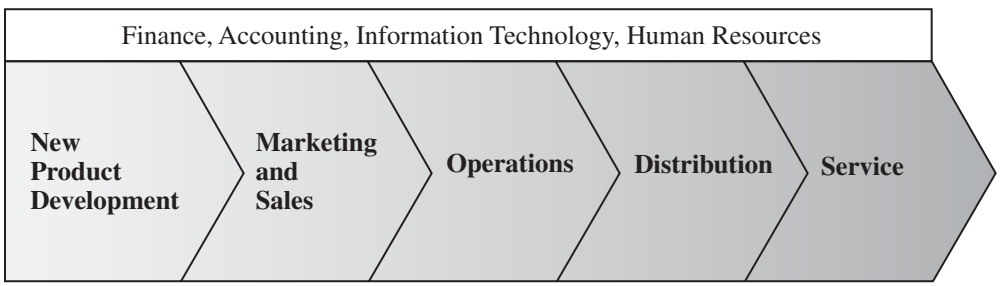


FIGURE 2-1 The Value Chain in a Company

more detail. Supply chain strategy includes a specification of the broad structure of the supply chain and what many traditionally call "supplier strategy," "operations strategy," and "logistics strategy." For example, Dell's initial decision to sell direct, its 2007 decision to start selling PCs through resellers, and Cisco's decision to use contract manufacturers define the broad structure of their supply chains and are all part of their supply chain strategies. Supply chain strategy also includes design decisions regarding inventory, transportation, operating facilities, and information flows. For example, Amazon's decisions to build warehouses to stock some products and to continue using distributors as a source of other products are part of its supply chain strategy. Similarly, Toyota's decision to have production facilities in each of its major markets is part of its supply chain strategy.

For a firm to succeed, all functional strategies must support one another and the competitive strategy. For example, Seven-Eleven Japan's success can be related to the excellent fit among its functional strategies. Marketing at Seven-Eleven has emphasized convenience in the form of easy access to stores and availability of a wide range of products and services. New product development at Seven-Eleven is constantly adding products and services, such as bill payment services that draw customers in and exploit the excellent information infrastructure and the fact that customers frequently visit Seven-Eleven. Operations and distribution at Seven-Eleven have focused on having a high density of stores, being very responsive, and providing an excellent information infrastructure. The result is a virtuous cycle in which supply chain infrastructure is exploited to offer new products and services that increase demand, and the increased demand in turn makes it easier for operations to improve the density of stores, responsiveness in replenishment, and the information infrastructure.

In the next section, we elaborate on this notion of fit and seek to answer this question: Given its competitive strategy, what should a company's supply chain try to do particularly well?

2.2 ACHIEVING STRATEGIC FIT

Strategic fit requires that both the competitive and supply chain strategies of a company have aligned goals. It refers to consistency between the customer priorities that the competitive strategy hopes to satisfy and the supply chain capabilities that the supply chain strategy aims to build. For a company to achieve strategic fit, it must accomplish the following:

1. The competitive strategy and all functional strategies must fit together to form a coordinated overall strategy. Each functional strategy must support other functional strategies and help a firm reach its competitive strategy goal.
2. The different functions in a company must appropriately structure their processes and resources to be able to execute these strategies successfully.
3. The design of the overall supply chain and the role of each stage must be aligned to support the supply chain strategy.

A company may fail either because of a lack of strategic fit or because its overall supply chain design, processes, and resources do not provide the capabilities to support the desired strategic fit. Consider, for example, a situation in which marketing is publicizing a company's ability to provide a large variety of products quickly; simultaneously, distribution is targeting the lowest-cost means of transportation. In this situation, it is likely that distribution will delay orders so it can get better transportation economies by grouping orders together or using inexpensive but slow modes of transportation. This action conflicts with marketing's stated goal of providing variety quickly. Similarly, consider a scenario in which a retailer has decided to provide a high level of variety while carrying low levels of inventory but has selected suppliers and carriers based on their low price and not their responsiveness. In this case, the retailer is likely to end up with unhappy customers because of poor product availability.

To elaborate on strategic fit, let us consider the evolution of Dell and its supply chain between 1993 and the present. Between 1993 and 2006, Dell's competitive strategy was to provide a large

variety of customizable products at a reasonable price. Given the focus on customization, Dell's supply chain was designed to be very responsive. Assembly facilities owned by Dell were designed to be flexible and to easily handle the wide variety of configurations requested by customers. A facility that focused on low cost and efficiency by producing large volumes of the same configuration would not have been appropriate in this setting.

The notion of strategic fit also extended to other functions within Dell. Dell PCs were designed to use common components and to allow rapid assembly. This design strategy clearly aligned well with the supply chain's goal of assembling customized PCs in response to customer orders. Dell worked hard to carry this alignment to its suppliers. Given that Dell produced customized products with low levels of inventory, it was crucial that suppliers and carriers be highly responsive. For example, the ability of carriers to merge a PC from Dell with a monitor from Sony allowed Dell not to carry any Sony monitors in inventory.

Starting in 2007, however, Dell altered its competitive strategy and had to change its supply chain accordingly. With a reduced customer focus on hardware customization, Dell branched out into selling PCs through retail stores such as Walmart. Through Walmart, Dell offers a limited variety of desktops and laptops. It is also essential that monitors and other peripherals be available in inventory because a customer buying a PC at Walmart is not willing to wait for the monitor to show up later. Clearly, the flexible and responsive supply chain that aligns well with customer needs for customization does not necessarily align well when customers no longer want customization but prefer low prices. Given the change in customer priorities, Dell has shifted a greater fraction of its production to a build-to-stock model to maintain strategic fit. Contract manufacturers like Foxconn that are focused on low cost now produce many of Dell's products well in advance of sale. To maintain strategic fit, Dell's supply chain has moved from a relentless focus on responsiveness to a greater focus on low cost.

How Is Strategic Fit Achieved?

What does a company need to do to achieve that all-important strategic fit between the supply chain and competitive strategies? A competitive strategy will specify, either explicitly or implicitly, one or more customer segments that a company hopes to satisfy. To achieve strategic fit, a company must ensure that its supply chain capabilities support its ability to satisfy the needs of the targeted customer segments.

There are three basic steps to achieving this strategic fit, which we outline here and then discuss in more detail:

1. ***Understanding the customer and supply chain uncertainty:*** First, a company must understand the customer needs for each targeted segment and the uncertainty these needs impose on the supply chain. These needs help the company define the desired cost and service requirements. The supply chain uncertainty helps the company identify the extent of the unpredictability of demand and supply that the supply chain must be prepared for.
2. ***Understanding the supply chain capabilities:*** Each of the many types of supply chains is designed to perform different tasks well. A company must understand what its supply chain is designed to do well.
3. ***Achieving strategic fit:*** If a mismatch exists between what the supply chain does particularly well and the desired customer needs, the company will either need to restructure the supply chain to support the competitive strategy or alter its competitive strategy.

STEP 1: UNDERSTANDING THE CUSTOMER AND SUPPLY CHAIN UNCERTAINTY To understand the customer, a company must identify the needs of the customer segment being served. Let us compare Seven-Eleven Japan and a discounter such as Sam's Club (a part of Walmart). When customers go to Seven-Eleven to purchase detergent, they go there for the convenience of a nearby store and are not necessarily looking for the lowest price. In contrast, low price is very important to a Sam's Club customer. This customer may be willing to tolerate less variety and

even purchase large package sizes as long as the price is low. Even though customers purchase detergent at both places, the demand varies along certain attributes. In the case of Seven-Eleven, customers are in a hurry and want convenience. In the case of Sam's Club, they want a low price and are willing to spend time getting it. In general, customer demand from different segments varies along several attributes, as follows:

- ***Quantity of the product needed in each lot:*** An emergency order for material needed to repair a production line is likely to be small. An order for material to construct a new production line is likely to be large.
- ***Response time that customers are willing to tolerate:*** The tolerable response time for the emergency order is likely to be short, whereas the allowable response time for the construction order is apt to be long.
- ***Variety of products needed:*** A customer may place a high premium on the availability of all parts of an emergency repair order from a single supplier. This may not be the case for the construction order.
- ***Service level required:*** A customer placing an emergency order expects a high level of product availability. This customer may go elsewhere if all parts of the order are not immediately available. This is not apt to happen in the case of the construction order, for which a long lead time is likely.
- ***Price of the product:*** The customer placing the emergency order is apt to be much less sensitive to price than the customer placing the construction order.
- ***Desired rate of innovation in the product:*** Customers at a high-end department store expect a lot of innovation and new designs in the store's apparel. Customers at Walmart may be less sensitive to new product innovation.

Each customer in a particular segment will tend to have similar needs, whereas customers in a different segment can have very different needs.

Although we have described several attributes along which customer demand varies, our goal is to identify one key measure for combining all of these attributes. This single measure then helps define what the supply chain should do particularly well.

Implied Demand Uncertainty. At first glance, it may appear that each of the customer need categories should be viewed differently, but in a fundamental sense, each customer need can be translated into the metric of *implied demand uncertainty,* which is demand uncertainty imposed on the supply chain because of the customer needs it seeks to satisfy.

We make a distinction between demand uncertainty and implied demand uncertainty. *Demand uncertainty* reflects the uncertainty of customer demand for a product. *Implied demand uncertainty*, in contrast, is the resulting uncertainty for only the portion of the demand that the supply chain plans to satisfy based on the attributes the customer desires. For example, a firm supplying only emergency orders for a product will face a higher implied demand uncertainty than a firm that supplies the same product with a long lead time, as the second firm has an opportunity to fulfill the orders evenly over the long lead time.

Another illustration of the need for this distinction is the impact of service level. As a supply chain raises its level of service, it must be able to meet a higher and higher percentage of actual demand, forcing it to prepare for rare surges in demand. Thus, raising the service level increases the implied demand uncertainty even though the product's underlying demand uncertainty does not change.

Both the product demand uncertainty and various customer needs that the supply chain tries to fill affect implied demand uncertainty. Table 2-1 illustrates how various customer needs affect implied demand uncertainty.

As each individual customer need contributes to the implied demand uncertainty, we can use implied demand uncertainty as a common metric with which to distinguish different types of demand.

TABLE 2-1 Impact of Customer Needs on Implied Demand Uncertainty

Customer Need	Causes Implied Demand Uncertainty to . . .
Range of quantity required increases	Increase because a wider range of the quantity required implies greater variance in demand.
Lead time decreases	Increase because there is less time in which to react to orders.
Variety of products required increases	Increase because demand per product becomes less predictable.
Number of channels through which product may be acquired increases	Increase because customer demand per channel becomes less predictable.
Rate of innovation increases	Increase because new products tend to have more uncertain demand.
Required service level increases	Increase because the firm now has to handle unusual surges in demand.

Fisher (1997) pointed out that implied demand uncertainty is often correlated with other characteristics of demand, as shown in Table 2-2. An explanation follows:

1. Products with uncertain demand are often less mature and have less direct competition. As a result, margins tend to be high.
2. Forecasting is more accurate when demand has less uncertainty.
3. Increased implied demand uncertainty leads to increased difficulty in matching supply with demand. For a given product, this dynamic can lead to either a stockout or an oversupply situation. Increased implied demand uncertainty thus leads to both higher oversupply and a higher stockout rate.
4. Markdowns are high for products with greater implied demand uncertainty because oversupply often results.

First, let us take an example of a product with low implied demand uncertainty—such as table salt. Salt has a low margin, accurate demand forecasts, low stockout rates, and virtually no markdowns. These characteristics match well with Fisher's chart of characteristics for products with highly certain demand.

On the other end of the spectrum, a new cell phone has high implied demand uncertainty. It will likely have a high margin, inaccurate demand forecasts, high stockout rates (if it is successful), and large markdowns (if it is a failure). This, too, matches well with Table 2-2.

Lee (2002) pointed out that along with demand uncertainty, it is important to consider uncertainty resulting from the capability of the supply chain. For example, when a new component is introduced in the consumer electronics industry, the quality yields of the production process tend to be low and breakdowns are frequent. As a result, companies have difficulty delivering

TABLE 2-2 Correlation Between Implied Demand Uncertainty and Other Attributes

	Low Implied Uncertainty	High Implied Uncertainty
Product margin	Low	High
Average forecast error	10%	40% to 100%
Average stockout rate	1% to 2%	10% to 40%
Average forced season-end markdown	0%	10% to 25%

Source: Adapted from Marshall L. Fisher, "What Is the Right Supply Chain for Your Product?" *Harvard Business Review* (March–April 1997), 83–93.

TABLE 2-3 Impact of Supply Source Capability on Supply Uncertainty

Supply Source Capability	Causes Supply Uncertainty to . . .
Frequent breakdowns	Increase
Unpredictable and low yields	Increase
Poor quality	Increase
Limited supply capacity	Increase
Inflexible supply capacity	Increase
Evolving production process	Increase

Source: Adapted from Hau L. Lee, "Aligning Supply Chain Strategies with Product Uncertainties." *California Management Review* (Spring 2002), 105–119.

according to a well-defined schedule, resulting in high supply uncertainty for electronics manufacturers. As the production technology matures and yields improve, companies are able to follow a fixed delivery schedule, resulting in low supply uncertainty. Table 2-3 illustrates how various characteristics of supply sources affect the supply uncertainty.

Supply uncertainty is also strongly affected by the life-cycle position of the product. New products being introduced have higher supply uncertainty because designs and production processes are still evolving. In contrast, mature products have less supply uncertainty.

We can create a spectrum of uncertainty by combining the demand and supply uncertainty. This implied uncertainty spectrum is shown in Figure 2-2.

A company introducing a brand-new cell phone based on entirely new components and technology faces high implied demand uncertainty and high supply uncertainty. As a result, the implied uncertainty faced by the supply chain is extremely high. In contrast, a supermarket selling salt faces low implied demand uncertainty and low levels of supply uncertainty, resulting in a low implied uncertainty. Many agricultural products, such as coffee, are examples of supply chains facing low levels of implied demand uncertainty but significant supply uncertainty based on weather. The supply chain thus faces an intermediate level of implied uncertainty.

Key Point

The first step in achieving strategic fit between competitive and supply chain strategies is to understand customers and supply chain uncertainty. Uncertainty from the customer and the supply chain can be combined and mapped on the implied uncertainty spectrum.

STEP 2: UNDERSTANDING THE SUPPLY CHAIN CAPABILITIES After understanding the uncertainty that the company faces, the next question is: How does the firm best meet demand in that uncertain environment? Creating strategic fit is all about designing a supply chain whose responsiveness aligns with the implied uncertainty it faces.

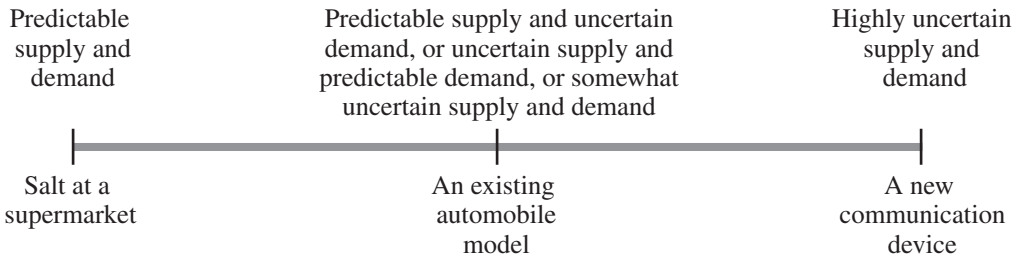


FIGURE 2-2 The Implied Uncertainty (Demand and Supply) Spectrum

We now categorize supply chains based on different characteristics that influence their responsiveness and efficiency.

First, we provide some definitions. *Supply chain responsiveness* includes a supply chain's ability to do the following:

- Respond to wide ranges of quantities demanded
- Meet short lead times
- Handle a large variety of products
- Build highly innovative products
- Meet a high service level
- Handle supply uncertainty

These abilities are similar to many of the characteristics of demand and supply that led to high implied uncertainty. The more of these abilities a supply chain has, the more responsive it is.

Responsiveness, however, comes at a cost. For instance, to respond to a wider range of quantities demanded, capacity must be increased, which increases costs. This increase in cost leads to the second definition: *Supply chain efficiency* is the inverse of the cost of making and delivering a product to the customer. Increases in cost lower efficiency. For every strategic choice to increase responsiveness, there are additional costs that lower efficiency.

The *cost-responsiveness efficient frontier* is the curve in Figure 2-3 showing the lowest possible cost for a given level of responsiveness. Lowest cost is defined based on existing technology; not every firm is able to operate on the efficient frontier, which represents the cost-responsiveness performance of the best supply chains. A firm that is not on the efficient frontier can improve both its responsiveness and its cost performance by moving toward the efficient frontier. In contrast, a firm on the efficient frontier can improve its responsiveness only by increasing cost and becoming less efficient. Such a firm must then make a trade-off between efficiency and responsiveness. Of course, firms on the efficient frontier are also continuously improving their processes and changing technology to shift the efficient frontier itself. Given the trade-off between cost and responsiveness, a key strategic choice for any supply chain is the level of responsiveness it seeks to provide.

Supply chains range from those that focus solely on being responsive to those that focus on a goal of producing and supplying at the lowest possible cost. Figure 2-4 shows the responsiveness spectrum and where some supply chains fall on this spectrum.

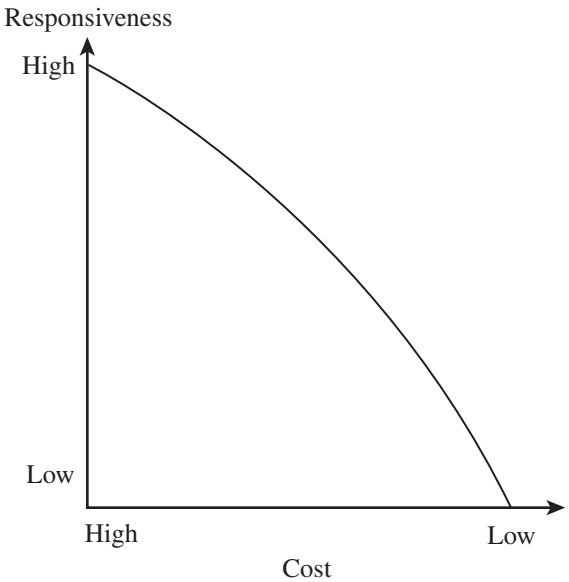


FIGURE 2-3 Cost-Responsiveness Efficient Frontier

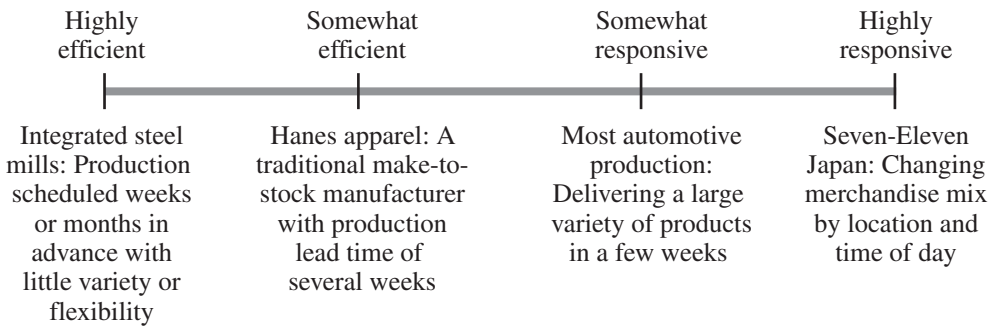


FIGURE 2-4 The Responsiveness Spectrum

The more capabilities constituting responsiveness a supply chain has, the more responsive it is. Seven-Eleven Japan replenishes its stores with breakfast items in the morning, lunch items in the afternoon, and dinner items at night. As a result, the available product variety changes by time of day. Seven-Eleven responds quickly to orders, with store managers placing replenishment orders less than 12 hours before they are supplied. This practice makes the Seven-Eleven supply chain very responsive. Another example of a responsive supply chain is W.W. Grainger. The company faces both demand and supply uncertainty; therefore, the supply chain has been designed to deal effectively with both to provide customers with a wide variety of MRO products within 24 hours. An efficient supply chain, in contrast, lowers cost by eliminating some of its responsive capabilities. For example, Sam's Club sells a limited variety of products in large package sizes. The supply chain is capable of low costs, and the focus of this supply chain is clearly on efficiency.

Key Point

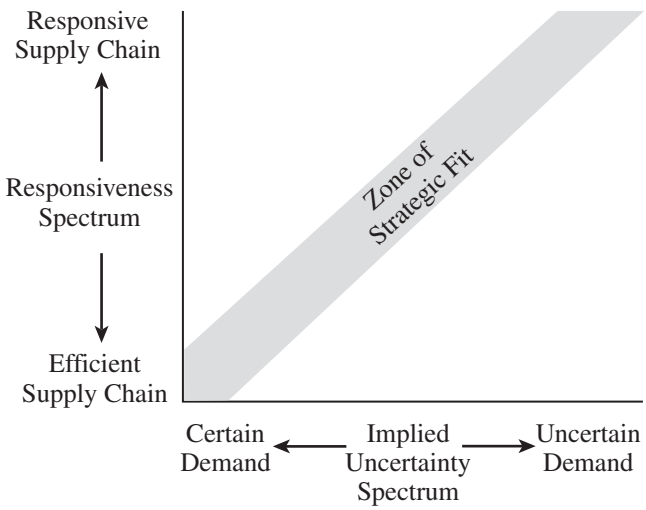
The second step in achieving strategic fit between competitive and supply chain strategies is to understand the supply chain and map it on the responsiveness spectrum.

STEP 3: ACHIEVING STRATEGIC FIT After mapping the level of implied uncertainty and understanding the supply chain position on the responsiveness spectrum, the third and final step is to ensure that the degree of supply chain responsiveness is consistent with the implied uncertainty. The goal is to target high responsiveness for a supply chain facing high implied uncertainty, and efficiency for a supply chain facing low implied uncertainty.

For example, the competitive strategy of McMaster-Carr targets customers that value having a large variety of MRO products delivered to them within 24 hours. Given the large variety of products and rapid desired delivery, demand from McMaster-Carr customers can be characterized as having high implied demand uncertainty. If McMaster-Carr designed an efficient supply chain, it may carry less inventory and maintain a level load on the warehouse to lower picking and packing costs. These choices, however, would make it difficult for the company to support the customer's desire for a wide variety of products that are delivered within 24 hours. To serve its customers effectively, McMaster-Carr carries a high level of inventory and picking and packing capacity. Clearly, a responsive supply chain is better suited to meet the needs of customers targeted by McMaster-Carr even if it results in higher costs.

Now, consider a pasta manufacturer such as Barilla. Pasta is a product with relatively stable customer demand, giving it a low implied demand uncertainty. Supply is also quite predictable. Barilla could design a highly responsive supply chain in which pasta is custom made in small batches in response to customer orders and shipped via a rapid transportation mode such as FedEx. This choice would obviously make the pasta prohibitively expensive, resulting in a loss of customers. Barilla, therefore, is in a much better position if it designs a more efficient supply chain with a focus on cost reduction.

FIGURE 2-5 Finding the Zone of Strategic Fit



From the preceding discussion, it follows that increasing implied uncertainty from customers and supply sources is best served by increasing responsiveness from the supply chain. This relationship is represented by the "zone of strategic fit" illustrated in Figure 2-5. For a high level of performance, companies should move their competitive strategy (and resulting implied uncertainty) and supply chain strategy (and resulting responsiveness) toward the zone of strategic fit.

The next step in achieving strategic fit is to assign roles to different stages of the supply chain that ensure the appropriate level of responsiveness. It is important to understand that the desired level of responsiveness required across the supply chain may be attained by assigning different levels of responsiveness and efficiency to each stage of the supply chain as illustrated by the following examples.

IKEA is a Swedish furniture retailer with large stores in more than forty countries. IKEA has targeted customers who want stylish furniture at a reasonable cost. The company limits the variety of styles that it sells through modular design. The large scale of each store and the limited variety of furniture (through modular design) decrease the implied uncertainty faced by the supply chain. IKEA stocks all styles in inventory and serves customers from stock. Thus, it uses inventory to absorb all the uncertainty faced by the supply chain. The presence of inventory at large IKEA stores allows replenishment orders to its manufacturers to be more stable and predictable. As a result, IKEA passes along little uncertainty to its manufacturers, who tend to be located in low-cost countries and focus on efficiency. IKEA provides responsiveness in the supply chain, with the stores absorbing most of the uncertainty and being responsive, and the suppliers absorbing little uncertainty and being efficient.

In contrast, another approach for responsiveness may involve the retailer holding little inventory. In this case, the retailer does not contribute significantly to supply chain responsiveness, and most of the implied demand uncertainty is passed on to the manufacturer. For the supply chain to be responsive, the manufacturer now needs to be flexible and have low response times. An example of this approach is England, Inc., a furniture manufacturer located in Tennessee. Every week, the company makes several thousand sofas and chairs to order, delivering them to furniture stores across the country within three weeks. England, Inc.'s retailers allow customers to select from a wide variety of styles and promise relatively quick delivery. This imposes a high level of implied uncertainty on the supply chain. The retailers, however, do not carry much inventory and pass most of the implied uncertainty on to England, Inc. The retailers can thus be efficient because most of the implied uncertainty for the supply chain is absorbed by England, Inc., with its flexible manufacturing process. England, Inc., itself has a choice of how much

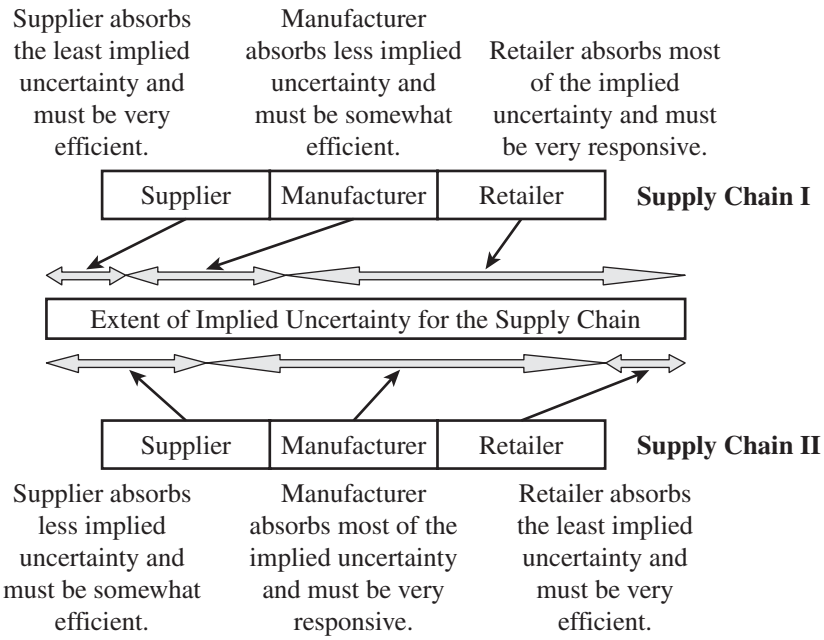


FIGURE 2-6 Different Roles and Allocations of Implied Uncertainty for a Given Level of Supply Chain Responsiveness

uncertainty it passes along to its suppliers. By holding more raw material inventories, the company allows its suppliers to focus on efficiency. If it decreases its raw material inventories, its suppliers must become more responsive.

The preceding discussion illustrates that the supply chain can achieve a given level of responsiveness by adjusting the role of each of its stages. Making one stage more responsive allows other stages to focus on becoming more efficient. The best combination of roles depends on the efficiency and flexibility available at each stage. The notion of achieving a given level of responsiveness by assigning different roles and levels of uncertainty to different stages of the supply chain is illustrated in Figure 2-6. The figure shows two supply chains that face the same implied uncertainty but achieve the desired level of responsiveness with different allocations of uncertainty and responsiveness across the supply chain. Supply Chain I has a very responsive retailer that absorbs most of the uncertainty, allowing (actually requiring) the manufacturer and supplier to be efficient. Supply Chain II, in contrast, has a very responsive manufacturer that absorbs most of the uncertainty, thus allowing the other stages to focus on efficiency.

To achieve complete strategic fit, a firm must also ensure that all its functions maintain consistent strategies that support the competitive strategy. All functional strategies must support the goals of the competitive strategy. All substrategies within the supply chain—such as manufacturing, inventory, and purchasing—must also be consistent with the supply chain's level of responsiveness. Table 2-4 lists some of the major differences in functional strategy between supply chains that are efficient and those that are responsive.

Key Point

The final step in achieving strategic fit is to match supply chain responsiveness with the implied uncertainty from demand and supply. The supply chain design and all functional strategies within the firm must also support the supply chain's level of responsiveness.

TABLE 2-4 Comparison of Efficient and Responsive Supply Chains

	Efficient Supply Chains	Responsive Supply Chains
Primary goal	Supply demand at the lowest cost	Respond quickly to demand
Product design strategy	Maximize performance at a minimum product cost	Create *modularity* to allow postponement of product differentiation
Pricing strategy	Lower margins because price is a prime customer driver	Higher margins because price is not a prime customer driver
Manufacturing strategy	Lower costs through high utilization	Maintain capacity flexibility to buffer against demand/supply uncertainty
Inventory strategy	Minimize inventory to lower cost	Maintain *buffer inventory* to deal with demand/supply uncertainty
Lead-time strategy	Reduce, but not at the expense of costs	Reduce aggressively, even if the costs are significant
Supplier strategy	Select based on cost and quality	Select based on speed, flexibility, reliability, and quality

Source: Adapted from Marshall L. Fisher, "What Is the Right Supply Chain for Your Product?" *Harvard Business Review* (March–April 1997), 83–93.

Tailoring the Supply Chain for Strategic Fit

Our previous discussion focused on achieving strategic fit when a firm serves a single market segment and the result is a well-defined and narrow strategic position. Although such a scenario holds for firms like IKEA, many firms are required to achieve strategic fit while serving many customer segments with a variety of products across multiple channels. In such a scenario, a "one size fits all" supply chain cannot provide strategic fit, and a tailored supply chain strategy is required. For example, Zara sells trendy items with unpredictable demand along with basics, such as white T-shirts, with a more predictable demand. Whereas Zara uses a responsive supply chain with production in Europe for trendy items, it uses a more efficient supply chain with production in Asia for the basics. This tailored supply chain strategy provides a better strategic fit for Zara compared with using a single supply chain. Another example is Levi Strauss, which sells both customized and standard-sized jeans. Demand for standard-sized jeans has a much lower demand uncertainty than demand for customized jeans. As a result, Levi Strauss must tailor its supply chain to meet both sets of needs.

In each of the previous examples, the products sold and the customer segments served have different implied demand uncertainty. When devising supply chain strategy in these cases, the key issue for a company is to design a tailored supply chain that is able to be efficient when implied uncertainty is low and responsive when it is high. By tailoring its supply chain, a company can provide responsiveness to fast-growing products, customer segments, and channels while maintaining low cost for mature, stable products and customer segments.

Tailoring the supply chain requires sharing operations for some links in the supply chain, while having separate operations for other links. The links are shared to achieve maximum possible efficiency while providing the appropriate level of responsiveness to each segment. For instance, all products may be made on the same line in a plant, but products requiring a high level of responsiveness may be shipped using a fast mode of transportation, such as FedEx. Products that do not have high responsiveness needs may be sent by slower and less expensive means such as truck, rail, or even ship. In other instances, products requiring high responsiveness may be manufactured using a flexible process, whereas products requiring less responsiveness may be manufactured using a less responsive but more efficient process. The mode of transportation

used in both cases, however, may be the same. In other cases, some products may be held at regional warehouses close to the customer, whereas others may be held in a centralized warehouse far from the customer. W.W. Grainger holds fast-moving items with low implied uncertainty in its decentralized locations close to the customer. It holds slow-moving items with higher implied demand uncertainty in a centralized warehouse. Appropriate tailoring of the supply chain helps a firm achieve varying levels of responsiveness for a low overall cost. The level of responsiveness is tailored to each product, channel, or customer segment. Tailoring of the supply chain is an important concept that we develop further in subsequent chapters.

The concept of tailoring to achieve strategic fit is important in industries such as high-tech and pharmaceuticals, in which innovation is critical and products move through a life cycle. Let us consider changes in demand and supply characteristics over the life cycle of a product. Toward the beginning stages of a product's life cycle:

1. Demand is very uncertain, and supply may be unpredictable.
2. Margins are often high, and time is crucial to gaining sales.
3. Product availability is crucial to capturing the market.
4. Cost is often a secondary consideration.

Consider a pharmaceutical firm introducing a new drug. Initial demand for the drug is highly uncertain, margins are typically high, and product availability is the key to capturing market share. The introductory phase of a product's life cycle corresponds to high implied uncertainty, given the high demand uncertainty and the need for a high level of product availability. In such a situation, responsiveness is the most important characteristic of the supply chain.

As the product becomes a commodity product later in its life cycle, the demand and supply characteristics change. At this stage, it is typically the case that:

1. Demand has become more certain, and supply is predictable.
2. Margins are lower as a result of an increase in competitive pressure.
3. Price becomes a significant factor in customer choice.

In the case of a pharmaceutical company, these changes occur when demand for the drug stabilizes, production technologies are well developed, and supply is predictable. This stage corresponds to a low level of implied uncertainty. As a result, the supply chain must change. In such a situation, efficiency becomes the most important characteristic of the supply chain. The pharmaceutical industry has reacted by building a mix of flexible and efficient capacity whose use is tailored to the product life cycle. New products are typically introduced using flexible capacity that is more expensive but responsive enough to deal with the high level of uncertainty during the early stages of the life cycle. Mature products with high demand are shifted to dedicated capacity that is highly efficient because it handles low levels of uncertainty and enjoys the advantage of high scale. The tailored capacity strategy has allowed pharmaceutical firms to maintain strategic fit for a wide range of products at different stages of their life cycle.

In the next section, we describe how the scope of the supply chain has expanded when achieving strategic fit. We also discuss why expanding the scope of strategic fit is critical to supply chain success.

Key Point

When supplying multiple customer segments with a wide variety of products through several channels, a firm must tailor its supply chain to achieve strategic fit.

2.3 EXPANDING STRATEGIC SCOPE

A key issue relating to strategic fit is the scope, in terms of supply chain stages, across which the strategic fit applies. *Scope of strategic fit* refers to the functions within the firm and stages across the supply chain that devise an integrated strategy with an aligned objective. At one extreme,

every operation within each functional area devises its own independent strategy, with the objective of optimizing its local performance. In this case, the scope of strategic fit is restricted to an operation in a functional area within a stage of the supply chain. At the opposite extreme, all functional areas across all stages of the supply chain devise aligned strategies that maximize supply chain surplus. In this case, the scope of strategic fit extends to the entire supply chain.

In this section, we discuss how expanding the scope of strategic fit improves supply chain performance. For example, IKEA has achieved great success by expanding its scope of strategic fit to include all functions and stages within the supply chain. Its competitive strategy is to offer a reasonable variety of furniture and home furnishings at low prices. Its stores are large and carry all products in inventory. Its products are designed to be modular and easy to assemble. The large stores and modular design allow IKEA to move final assembly and last-mile delivery (two high-cost operations) to the customer. As a result, all functions within the IKEA supply chain focus on efficiency. Its suppliers concentrate on producing large volumes of a few modules at low cost. Its transportation function focuses on shipping large quantities of high-density unassembled modules at low cost to the large stores. The strategy at every stage and function of the IKEA supply chain is aligned to increase the supply chain surplus.

Intraoperation Scope: Minimizing Local Cost

The *intraoperation scope* has each stage of the supply chain devising its strategy independently. In such a setting, the resulting collection of strategies typically does not align, resulting in conflict. This limited scope was the dominant practice during the 1950s and 1960s, when each operation within each stage of the supply chain attempted to minimize its own costs. As a result of this narrow scope, the transportation function at many firms may have shipped full truckloads without any regard for the resulting impact on inventories or responsiveness, or the sales function may have offered trade promotions to enhance revenue without any consideration for how those promotions affected production, warehousing, and transportation costs. The resulting lack of alignment diminished the supply chain surplus.

Intrafunctional Scope: Minimizing Functional Cost

Over time, managers recognized the weakness of the intraoperation scope and attempted to align all operations within a function. For example, the use of air freight could be justified only if the resulting savings in inventories and improved responsiveness justified the increased transportation cost. With the *intrafunctional* view, firms attempted to align all operations within a function. All supply chain functions, including sourcing, manufacturing, warehousing, and transportation, had to align their strategies to minimize total functional cost. As a result, product could be sourced from a higher-cost local supplier because the resulting decrease in inventory and transportation costs more than compensated for the higher unit cost.

Interfunctional Scope: Maximizing Company Profit

The key weakness of the intrafunctional view is that different functions within a firm may have conflicting objectives. Over time, companies became aware of this weakness as they saw, for example, marketing and sales focusing on revenue generation, and manufacturing and distribution focusing on cost reduction. Actions the two functions took were often in conflict, hurting the firm's overall performance. Companies realized the importance of expanding the scope of strategic fit and aligning strategy across all functions within the firm. With the interfunctional scope, the goal is to maximize company profit. To achieve this goal, all functional strategies are developed to align with one another and with the competitive strategy.

The goal of aligning strategies across functions results in warehouse operations within McMaster-Carr carrying high inventory and excess capacity to ensure that marketing's promise of next-day delivery is always met. The company's profits grow because the increased margin

that customers are willing to pay for high reliability more than compensates for the higher inventory and warehouse expense. The company enjoys high profits because all functions align their strategy around the common objective of customer convenience in the form of next-day delivery of a wide variety of MRO products.

Intercompany Scope: Maximizing Supply Chain Surplus

The goal of only maximizing company profits can sometimes lead to conflict between stages of a supply chain. For example, both the supplier and the manufacturer in a supply chain may prefer to have the other side hold most of the inventory, with the goal of improving their own profits. If the two parties cannot look beyond their own profits, the more powerful party will simply force the other to hold inventories without any regard for where inventories are best held. The result is a decrease in the supply chain surplus—the total pie that both parties get to share.

The intercompany scope proposes a different approach. Instead of just forcing the inventory onto the weaker party, the two parties work together to reduce the amount of inventory required. By working together and sharing information, they can reduce inventories and total cost, thus increasing the supply chain surplus. The higher the supply chain surplus, the more competitive the supply chain is.

Key Point

The intercompany scope of strategic fit requires firms to evaluate every action in the context of the entire supply chain. This broad scope increases the size of the surplus to be shared among all stages of the supply chain. The intercompany scope of strategic fit is essential today because the competitive playing field has shifted from company versus company to supply chain versus supply chain. A company's partners in the supply chain may well determine the company's success, as the company is intimately tied to its supply chain.

A good example of the intercompany approach is how Walmart and P&G plan promotions jointly. The two companies have a team (with employees from both parties) that works to ensure that the promotion is timed and executed to benefit both sides. Before the initiation of this collaborative effort, promotions at Walmart sometimes required P&G to run its facilities with overtime at high cost. The result was a decrease in the supply chain surplus because the product was sold at a discount at a time when it was being produced at high marginal cost. The collaborative teams now try to increase the supply chain surplus by timing the promotion to have high sales impact while minimizing the marginal cost increase. They work to ensure that the product is produced in such a manner that all promotion demand is met without generating excess unsold inventories.

Agile Intercompany Scope

Up to this point, we have discussed strategic fit in a static context; that is, the players in a supply chain and the customers' needs do not change over time. In reality, the situation is much more dynamic. Product life cycles are getting shorter, and companies must satisfy the changing needs of individual customers. A company may have to partner with many firms, depending on the product being produced and the customer being served. Firms' strategies and operations must be agile enough to maintain strategic fit in a changing environment.

Agile intercompany scope refers to a firm's ability to achieve strategic fit when partnering with supply chain stages that change over time. Firms must think in terms of supply chains consisting of many players at each stage. For example, a manufacturer may interface with a different set of suppliers and distributors depending on the product being produced and the customer being served. Furthermore, as customers' needs vary over time, firms must have the ability to become part of new supply chains while ensuring strategic fit. This level of agility becomes more important as the competitive environment becomes more dynamic.

2.4 CHALLENGES TO ACHIEVING AND MAINTAINING 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 customers. In deciding where this balance should be located on the responsiveness spectrum, companies face many challenges. On one hand, these challenges 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 challenges because they are critical to a company's ability to grow its supply chain surplus.

Increasing Product Variety and Shrinking Life Cycles

One of the biggest challenges to maintaining strategic fit is the growth in product variety and the decrease in the life cycle of many products. Greater product variety and shorter life cycles increase uncertainty while reducing the window of opportunity within which the supply chain can achieve fit. The challenge gets magnified when companies continue to increase new products without maintaining the discipline of eliminating older ones. Apple, for example, has had great success limiting its product variety while continuing to introduce new products. This has allowed the company the luxury of dealing only with high-demand products, for which it becomes easier to design an aligned supply chain. In general, however, firms must design product platforms with common components and maintain a tailored supply chain that contains a responsive solution to handle new products and other low-volume products and a low-cost solution to handle successful high-volume products. Simultaneously, variety must be limited to what truly adds value to the customer. This often requires the continual elimination of older products.

Globalization and Increasing Uncertainty

Globalization has increased both the opportunities and risks for supply chains. The twenty-first century has started with significant fluctuations in exchange rates, global demand, and the price of crude oil, all factors that affect supply chain performance. In 2008 alone, the euro peaked in value at about $1.59 and went as low as $1.25. In 2001, the euro went as low as $0.85. After demand for automobiles in the United States peaked at more than 17 million vehicles, demand dropped significantly between November 2007 and October 2008. In October 2008, auto sales in the United States dropped by more than 30 percent relative to the same month the previous year. The drop in sales of larger vehicles was much more significant than the drop for smaller, more fuel efficient, cars. Crude oil peaked at more than $145 a barrel in July 2008 and was less than $50 a barrel by November 2008.

Supply chains designed to handle these uncertainties have performed much better than those that ignored them. For example, Honda built flexible plants that were a great help in 2008 as demand for sport-utility vehicles (SUVs) dropped but demand for small cars increased. Honda's flexible plants that produced both the CRV and small cars on the same line continued strong operations. In contrast, companies that had built plants dedicated to producing only large trucks and SUVs had a great deal of difficulty in 2008 as demand dried up. Clearly, firms must account for global risks and uncertainties if they want to maintain strategic fit.

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 aligning and 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. This problem could potentially cause each stage of a supply chain to work only toward its local objectives rather

than those of the whole chain, resulting in the reduction of overall supply chain profitability. Aligning all members of a supply chain has become critical to achieving supply chain fit.

Changing Technology and Business Environment

With a changing environment in terms of customer needs and technology, companies must constantly evaluate their supply chain strategy to maintain strategic fit. A strategy that may have been very successful in one environment can easily become a weakness in a changed setting. Dell is an excellent example of this difficulty. For more than a decade, Dell enjoyed tremendous success with a supply chain strategy based on selling customized PCs direct to customers. These PCs were built to order in flexible facilities. By about 2005, though, the market had moved toward laptops, and customers started to place less value on customization. As a result, Dell was forced to rethink its supply chain strategy and start selling through retail outlets. Simultaneously, it started to increase the amount of assembly that was outsourced to low-cost contract manufacturers.

Another example is that of Blockbuster (see the Case Study at the end of the chapter), which achieved tremendous success in the 1990s with stores that carried a larger variety of VHS tapes than existing video rental stores. With the growth of DVDs, however, Netflix used the postal system to ship an even greater variety of films at low cost from centralized distribution centers. The growth in bandwidth allowed Netflix to stream digital content directly to customer homes. Simultaneously, Redbox developed vending machines that allowed some DVDs to be rented at low cost. Blockbuster's inability to adjust to this transformation in technology and the business environment resulted in its bankruptcy in 2010.

The Environment and Sustainability

Issues related to the environment and sustainability have grown in relevance and must be accounted for when designing supply chain strategy. In some instances, regulation has been driving changes; in others, change has been driven by the perception of the lack of sustainability as a risk factor. For example, the Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) directives from the European Union forced cell phone manufacturers to rethink their design and sourcing strategies. Starbucks, in contrast, was forced to focus on local sustainability of its supply sources because a supply failure, especially for higher-quality coffee, would have significantly affected its ability to grow. The company developed sourcing guidelines to ensure that produced coffee met environmental and social performance criteria at each stage of the supply chain. Environmental issues represent a tremendous opportunity to firms that can often add value to customers and lower their own costs along this dimension (for example, with more appropriate packaging). These issues also represent a major challenge because some of the greatest opportunities require coordination across different members of the supply chain. To be successful, firms will need to design a strategy that engages the entire supply chain to identify and address opportunities for improved sustainability.

Key Point

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

2.5 SUMMARY OF LEARNING OBJECTIVES

1. ***Explain why achieving strategic fit is critical to a company's overall success.*** A lack of strategic fit between the competitive and supply chain strategies can result in the supply chain taking actions that are not consistent with customer needs, leading to a reduction in supply chain surplus and decreasing supply chain profitability. Strategic fit requires that all functions within a firm and stages in the supply chain target the same goal—one that is consistent with customer needs.

2. ***Describe how a company achieves strategic fit between its supply chain strategy and its competitive strategy.*** To achieve strategic fit, a company must first understand the needs of the customers being served, understand the uncertainty of the supply chain, and identify the implied uncertainty. The second step is to understand the supply chain's capabilities in terms of efficiency and responsiveness. The key to strategic fit is ensuring that supply chain responsiveness is consistent with customer needs, supply capabilities, and the resulting implied uncertainty. Tailoring the supply chain is essential to achieving strategic fit when supplying a wide variety of customers with many products through different channels.

3. ***Discuss the importance of expanding the scope of strategic fit across the supply chain.*** The scope of strategic fit refers to the functions and stages within a supply chain that coordinate strategy and target a common goal. When the scope is narrow, individual functions try to optimize their performance based on their own goals. This practice often results in conflicting actions that reduce the supply chain surplus. As the scope of strategic fit is enlarged to include the entire supply chain, actions are evaluated based on their impact on overall supply chain performance, which helps increase supply chain surplus.

4. ***Describe the major challenges that must be overcome to manage a supply chain successfully.*** Globalization, increasing product variety, decreasing product life cycles, fragmentation of supply chains, changing technologies, and an increased focus on sustainability represent significant challenges to achieving strategic fit. They also represent great opportunities for firms that can successfully address these challenges with their supply chain strategies.

Discussion Questions

1. How would you characterize the competitive strategy of a high-end department store chain such as Nordstrom? What are the key customer needs that Nordstrom aims to fill?
2. Explain the major difference between demand uncertainty and implied demand uncertainty using the example of the iPhone 6 Plus.
3. What would be the impact of increasing product variety on implied demand uncertainty in the case of a convenience store like 7-11?
4. Is it correct to say that the implied demand uncertainty will correlate with the characteristics of demand, particularly for high-markdown products? Why?
5. Reconsider the previous four questions for other companies such as Amazon, a supermarket chain, an auto manufacturer, and a discount retailer such as Walmart.
6. What do you expect the level of implied demand uncertainty to be for jasmine rice produced by Thailand at a supermarket? Explain your answer with reference to Fisher's model.
7. It is important to have strategic fit between the supply chain and its competitive strategy. Given that creating strategic fit requires designing a supply chain whose responsiveness aligns with the implied uncertainty, list the supply chain's abilities with regard to responsiveness.
8. Assume a new drug has been developed for the Ebola virus (EVD). Briefly describe its demand and supply characteristics at the beginning of the product life cycle.
9. A successful company needs to strike a balance between responsiveness and efficiency. Discuss how companies should prepare for globalization in terms of responsiveness.

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CASE STUDY

The Demise of Blockbuster

After struggling with debt and strong competition from Netflix and Redbox, Blockbuster, Inc. filed for bankruptcy in September 2010. This was a sad end for a company that had dominated the movie rental business in the 1990s. Blockbuster Inc. was founded by David Cook in 1985 with its first rental outlet in Dallas. Cook planned to take advantage of a highly fragmented video rental market, in which most of the stores were relatively modest family operations that carried a small selection of former big hit movies mainly due to the high cost distributors typically charged (about $65 per tape). With 8,000 tapes covering 6,500 titles, Blockbuster had a much broader and deeper inventory compared with that of its nearest competitor. The store operations were also greatly streamlined by a computerized system for inventory control and checkout. The store was a huge success, which prompted the addition of three more locations by mid-1986.

In 1986, because of liquidity problems, Cook was forced to turn over the whole company to a group of investors led by Wayne Huizenga. Between 1987 and 1993, Huizenga grew Blockbuster into an enormous success. During this period, Blockbuster opened stores around the globe at the rate of about one every 24 hours. By 1993, Blockbuster was the leading global provider of in-home movie and game entertainment, with more than 3,400 stores throughout the Americas, Europe, Asia, and Australia. Blockbuster stores were a ubiquitous neighborhood feature that stayed open 365 days a year, generally from 10 a.m. to midnight. Merchandise selection, quantity, and formats were customized at the store level to meet the needs and preferences of local customers.

In the early 2000s, though, Blockbuster began to see real competition from the burgeoning online rental market as DVDs started to replace tapes. Its major competitor was Netflix, launched in 1997. In addition to being cheaper to purchase than tapes, DVDs were well suited for shipping by mail because they were less expensive to ship and less fragile than tapes.

Netflix challenged Blockbuster on two key dimensions—variety and late fees. Whereas Blockbuster stores generally carried about 3,000 titles, Netflix initially offered more than ten times that amount. In addition, Netflix did not charge Blockbuster's greatly disliked "late fees," instead allowing customers to keep titles as long as they wanted. Netflix's monthly subscription plan offered unlimited mail-order rentals for $9, the cost of two rentals at a Blockbuster store.

Meanwhile, Redbox, a unit of Coinstar Inc., operated vending machines that rented DVDs for as little as $1 a night. Despite its best efforts, Blockbuster's brick-and-mortar stores could not match the low-cost operating models of Netflix and Redbox, leading to its bankruptcy (see financial results in Table 2-5).

Netflix

Netflix was founded in 1997 by Reed Hastings as a pay-per-rental mail-order video rental company. After

TABLE 2-5 Financial Results for Blockbuster, Netflix, and Coinstar in 2009 (in millions of dollars)

	Blockbuster	Netflix	Coinstar
Revenue	4,062	1,670	1,145
Cost of revenue	1,884	1,079	793
Gross profit	2,178	591	351
Operating expenses			
Sales, general, and administrative	2,020	289	150
Total operating expenses	2,533	399	267
Operating income	(355)	192	84
Net income from continuing operations	(518)	116	29
Net income	(558)	116	54
ASSETS			
Receivables	79	—	61
Inventories	639	37	104
Total current assets	1,060	411	391
Property and equipment at cost	2,374	266	759
Accumulated depreciation	(2,125)	(134)	(358)
Net property, plant, and equipment	249	132	400
Total assets	1,538	680	1,223

experimenting with both pay-per-rental and subscription, the company settled on a subscription-based strategy by the end of 1999. By 2010, Netflix had 13 million members and was the world's largest subscription service, sending DVDs by mail and streaming movies and television episodes over the Internet. For $8.99 a month, Netflix members could have any of more than 100,000 DVD titles delivered to their homes and could instantly watch a smaller set of television episodes and movies streamed to their televisions and computers. Netflix shipped some 2 million discs daily in the United States.

Netflix focused its strategy around offering a large variety of titles, helping customers navigate titles with a sophisticated recommendation engine, and ensuring that titles reached customers quickly. Whereas a bricks-and-mortar rental store typically carried about 3,000 titles, in 2010 Netflix offered its customers a selection of more than 100,000 DVD titles, most of which were old releases. In 2009, about 70 percent of the DVDs shipped by Netflix were titles with release dates older than thirteen weeks.

In 2010, Netflix had about 60 regional distribution centers across the United States, with sophisticated systems to track customers' DVD queues. As the distribution center processes were linked to the recommendation software, movies that were likely to be in stock were recommended to customers. When the distribution center received a watched DVD back from a customer, a new one from the customer's rental queue was shipped out. These distribution centers were highly automated for rapid processing and were located within driving distance of several U.S. Postal Service processing facilities. Netflix estimated that it would spend about $600 million in 2010 on shipping expenses.

Netflix's ability to rent older titles was very appealing to studios that had historically seen little revenue from this content. Netflix bought older DVDs from studios at cost and, in turn, provided them a percentage of the subscription revenue based on utilization for rentals over a specified period (typically 6–12 months). For newer content, Netflix did not attempt to serve the entire initial rush of rental demand. Given the higher initial cost of purchase, the company purchased only a limited number of new release DVDs, preferring instead to wait a few weeks and buy the bulk of its supply at lower cost. Customers could put new titles into their queues and receive them when the DVDs became available in stock.

Between 2005 and 2009, Netflix delivered excellent financial results and grew revenues by 150 percent and profits by about 175 percent. Despite the strong

performance of its DVD rental business, however, the company was focused on increasing the fraction of digital content it delivered. Its streaming service, launched in 2007, allowed customers to watch select movies and content on the Netflix website via their PCs. By 2009, the Netflix service offered more than 17,000 titles (although most new releases were not included in the selection) streamed through a variety of devices. By 2013, the streaming service contributed majority of Netflix's revenue, although most of the profits still came from the DVD mailing business.

Redbox

The concept of Redbox originated in 2002 within McDonald's Ventures, LLC, which was working to identify new ways to drive traffic to its restaurants and provide added convenience and relevance to customers. Redbox's first kiosk was launched in 2004 in Denver. Coinstar, Inc. purchased Redbox in early 2009.

Redbox's strategy was based on targeting the budget-conscious movie renter who wanted to quickly rent a DVD for immediate use. Redbox met this need by placing its automated red kiosks at easily accessible locations, where customers could rent movies for $1 per night. Movies could be returned to any Redbox machine and no membership was required.

By early 2010, Redbox had approximately 23,000 kiosks nationwide, including in select McDonald's restaurants, leading grocery stores, and Walmart, Walgreens, and 7-Eleven stores. Redbox planned to more than double the number of its kiosks by 2012. Retailers, who were struggling to keep people shopping, realized that having a DVD kiosk in a store created foot traffic. In some cases, retailers even offered discounts that essentially made it free for Redbox to install a kiosk.

Each Redbox kiosk carried about 630 discs, comprising 200 of the newest movie titles. A Redbox kiosk rented its average DVD 15 times at an average of $2 per transaction. After that, the used DVDs were made available for sale to customers for $7.

By mid-2010, Redbox accounted for 25 percent of DVD rental volume, more than Blockbuster. The company was on course to generate more than $1 billion in annual sales, faster than Netflix was able to achieve that milestone.

Study Questions

1. In what ways did Blockbuster achieve better strategic fit than local stores?
2. How did Netflix and Redbox achieve better strategic fit than Blockbuster?

CHAPTER

3

Supply Chain Drivers and Metrics

LEARNING OBJECTIVES

After reading this chapter, you will be able to

1. Describe key financial measures of firm performance.
2. Identify the major drivers of supply chain performance.
3. Discuss the role of each driver in creating strategic fit between the supply chain strategy and the competitive strategy.
4. Define the key metrics that track the performance of the supply chain in terms of each driver.

In this chapter, our goal is to link key financial measures of firm performance to supply chain performance. 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 and its impact on financial performance.

3.1 FINANCIAL MEASURES OF PERFORMANCE

In Chapter 1, we discussed how growing the supply chain surplus is the ultimate goal of a supply chain. Our premise was that increasing the surplus allows for a growth of supply chain profitability, which facilitates an improvement in the financial performance of each member of the supply chain. In this section, we define important financial measures that are reported by a firm and affected by supply chain performance. In later sections, we link supply chain drivers and associated metrics to the various financial measures. The definitions of financial measures in this section are taken from Dyckman, Magee, and Pfeiffer (2011). To illustrate the various financial measures, we use the financial results reported in 2013 by Amazon.com and Nordstrom Inc. and assume a tax rate of 0.35.

From a shareholder perspective, return on equity (ROE) is the main summary measure of a firm's performance.

$$ROE = \frac{Net\ Income}{Average\ Shareholder\ Equity}$$

Whereas ROE measures the return on investment made by a firm's shareholders, return on assets (ROA) measures the return earned on each dollar invested by the firm in assets.

$$ROA = \frac{Earnings\ before\ Interest}{Average\ Total\ Assets} = \frac{Net\ Income + [Interest\ Expense \times (1 - Tax\ Rate)]}{Average\ Total\ Assets}$$

Consider the financial performance shown in Table 3-1 for Amazon.com and Nordstrom Inc. In 2013, Amazon {Nordstrom} achieved ROE = 274/9,746 = 2.81 percent {613/1,913 = 32.04 percent} and ROA = [274 + 141 × (1 – 0.35)]/40,159 = 0.91 percent{[613 + 160 × (1 − 0.35)]/8,089 = 8.86 percent}. The difference between ROE and ROA is referred to as *return on financial leverage* (ROFL). In 2013, Amazon {Nordstrom} had ROFL = 2.81 – 0.91 = 1.90 percent {32.04 − 8.86 = 23.18 percent}. ROFL captures the amount of ROE that can be attributed to financial leverage (such as accounts payable and debt). In Amazon's case, a significant portion of the financial leverage in 2013 came from accounts payable rather than debt. Thus, an important ratio that defines financial leverage is accounts payable turnover (APT).

$$APT = \frac{Cost\ of\ Goods\ Sold}{Accounts\ Payable}$$

In Amazon's {Nordstrom's} case, in 2013 APT = 54,181/21,821= 2.48 {7,432/1,415 = 5.25}. The small APT indicates that Amazon was able to use the money it owed suppliers to finance a considerable fraction of its operations. In 2013, Amazon effectively financed its own operations for about 52/2.48 = 20.97 weeks with its suppliers' money.

ROA can be written as the product of two ratios—profit margin and asset turnover—as shown below:

$$ROA = \frac{Earnings\ before\ Interest}{Sales\ Revenue} \times \frac{Sales\ Revenue}{Total\ Assets} = Profit\ Margin \times Asset\ Turnover$$

Thus, a firm can increase ROA by growing the profit margin and/or increasing the asset turnover. In 2013, Amazon {Nordstrom} achieved a profit margin of 647/74,452 = 0.87 percent {1,345/12,148 = 11.07 percent} and an asset turnover of 74,452/40,159 = 1.85 {12,148/8,089 = 1.50}. Despite a lower asset turnover than Amazon, Nordstrom had a better ROA because it achieved much higher profit margins. Profit margin can be improved by receiving better prices or by reducing the various expenses incurred. Although Nordstrom's higher profit margin can be explained partly by its customers' willingness to pay for the greater responsiveness that Nordstrom provides, good supply chain management also allows a firm to decrease the expenses incurred to serve customer demand. In Amazon's case, a significant expense is outbound shipping cost. In its 2013 annual report, the company reported outbound shipping costs of $5.13 billion. After accounting for shipping revenue, the net loss on outbound shipping was reported to be $2.85 billion, about ten times its net income. Clearly, a reduction in outbound shipping costs can have a significant impact on Amazon's profit margin.

The key components of asset turnover are accounts receivable turnover (ART); inventory turnover (INVT); and property, plant, and equipment turnover (PPET). These are defined as follows:

$$ART = \frac{Sales\ Revenue}{Accounts\ Receivable}; INVT = \frac{Cost\ of\ Goods\ Sold}{Inventories}; PPET = \frac{Sales\ Revenue}{PP\&E}$$

TABLE 3-1 Selected Financial Data for Amazon.com and Nordstrom Inc.

	Amazon.com	Nordstrom Inc.
Period Ending	**31-Dec-13**	**2-Feb-13**
Total Revenue	74,452,000	12,148,000
Cost of Goods Sold	54,181,000	7,432,000
Gross Profit	20,271,000	4,716,000
Selling, General, and Administrative	19,526,000	3,371,000
Operating Income or Loss	745,000	1,345,000
Total Other Income/Expenses Net	−98,000	–
Earnings Before Interest and Taxes	647,000	1,345,000
Interest Expense	141,000	160,000
Income Before Tax	506,000	1,185,000
Income Tax Expense	161,000	450,000
Minority Interest	–	–
Net Income	274,000	613,000
Assets		
Cash and Cash Equivalents	8,658,000	1,285,000
Short-Term Investments	3,789,000	–
Net Receivables	4,767,000	2,356,000
Inventory	7,411,000	1,360,000
Other Current Assets	–	80,000
Total Current Assets	24,625,000	5,081,000
Property, Plant, and Equipment (PP&E)	10,949,000	2,579,000
Goodwill	2,655,000	175,000
Other Assets	1,930,000	254,000
Total Assets	40,159,000	8,089,000
Liabilities and Stockholder Equity		
Accounts Payable	21,821,000	1,415,000
Short-/Current Long-Term Debt	–	7,000
Other Current Liabilities	1,159,000	804,000
Long-Term Debt	3,191,000	3,124,000
Other Liabilities	4,242,000	341,000
Deferred Long-Term Liability Charges	–	485,000
Total Liabilities	30,413,000	6,176,000
Total Stockholder Equity	9,746,000	1,913,000

Amazon {Nordstrom} achieved accounts receivable turnover of 74,452/4,767 = 15.62 {12,148/2,356 = 5.16} in 2013. Amazon collected its money from sales relatively quickly (in about 52/15.62 = 3.33 weeks on average in 2013) after it made a sale, whereas Nordstrom took longer (about 10 weeks). Amazon {Nordstrom} turned its inventory about 54,181/7,411 = 7.31 {7,432/1,360 = 5.46} times and had PPET = 74,452/10,949 = 6.80 {12,148/2,579 = 4.71} in 2013. Thus, inventory sat with Amazon {Nordstrom} in 2013 for about 52/7.31 = 7.11 {52/5.46 = 9.52} weeks on average, and each dollar invested in PP&E supported about $6.80 {$4.71} of

sales in 2013. Amazon achieved a higher asset turnover than Nordstrom by turning its inventory faster and generating higher revenue per dollar invested in PP&E. Nordstrom, however, achieved a much higher ROA compared with Amazon because it had a much higher profit margin. A company can improve its asset turnover by turning its inventory more quickly or using its existing warehousing and technology infrastructure to support a higher level of sales (or decreasing the warehousing and technology infrastructure needed to support the existing level of sales). A company can improve its profit margin by increasing a customer's willingness to pay or decreasing operating expense.

Another useful metric is the cash-to-cash (C2C) cycle, which roughly measures the average amount of time from when cash enters the process as cost to when it returns as collected revenue.

$$\text{C2C} = -\textit{Weeks Payable}\ (1/\text{APT}) + \textit{Weeks in Inventory}\ (1/\text{INVT}) + \textit{Weeks Receivable}\ (1/\text{ART})$$

In Amazon's case, we obtain $\text{C2C} = -20.97 + 7.11 + 3.33 = -10.53$ in 2013. In 2013, Amazon collected its money from the sale of products more than 10 weeks before it had to pay its suppliers. Table 3-2 shows selected financial metrics across industries. It is interesting to observe that the consumer electronics industry has an average C2C cycle of only 9.3 days, whereas medical device manufacturers average more than 200 days.

There are two important measures, however, that are not explicitly part of a firm's financial statements: markdowns and lost sales. *Markdowns* represent the discounts required to convince customers to buy excess inventory. Financial statements show only the revenue received from sales, not the revenue that "could" have been received. For General Motors (GM), one of the biggest problems in the early part of the twenty-first century was the discounts required to move excess inventory from dealer lots. These discounts significantly hurt financial performance. In 2010, one of the biggest improvements in financial performance for GM was its ability to sell its cars with much smaller discounts because the supply chain had far less excess inventory. *Lost sales* represent customer sales that did not materialize because of the absence of products the customer wanted to buy. Every lost sale corresponds to product margin that is lost. Both markdowns and lost sales reduce net income and arguably represent the biggest impact of supply chain performance on the financial performance of a firm. Firms such as Walmart and Zara have achieved strong financial performance in large part because their supply chains allow a better matching of supply and demand, thereby reducing markdowns and lost sales.

TABLE 3-2 Selected Financial Metrics Across Industries, 2000–2012

Industry	Average Operating Margin	Average C2C Cycle	Average Inventory Turns	Average SG&A Cost/ Revenue
Pharmaceutical	0.25	190.3	2.0	0.31
Medical device manufacturers	0.18	211.6	2.2	0.36
Consumer packaged goods	0.17	28.3	5.6	0.31
Food	0.16	37.4	6.2	0.23
Consumer electronics	0.12	9.3	43.8	0.14
Apparel	0.10	127.7	3.2	0.35
Chemical	0.09	78.1	5.3	0.09
Automotive	0.04	75.9	9.9	0.13

Source: Adapted from Abby Mayer, "Supply Chain Metrics That Matter: A Closer Look at the Cash-to-Cash Cycle (2000–2012)." *Supply Chain Insights LLC* report, November 11, 2013.

In the next section, we identify key drivers of supply chain performance that influence the financial performance of a firm. Our goal is to understand how these drivers may explain the difference in financial performance between firms such as Amazon and Nordstrom.

3.2 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 supports the company's competitive strategy. A supply chain's performance in terms of responsiveness and efficiency is based on the interaction between the following logistical and cross-functional drivers of supply chain performance: facilities, inventory, transportation, information, sourcing, and pricing. The structure of these drivers also affects the financial measures discussed in Section 3.1. The goal is to structure the drivers to achieve the desired level of responsiveness at the lowest possible cost, thus improving the supply chain surplus and the firm's financial performance.

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 example, in 2013, Amazon increased the number of warehousing facilities (and, as a result, experienced an increase in PP&E) located close to customers to improve its responsiveness. In contrast, Best Buy tried to improve its efficiency in 2013 by shutting down retail facilities even though it reduced responsiveness. Facility costs show up under PP&E if facilities are owned by the firm or under selling, general, and administrative if they are leased.

2. ***Inventory*** encompasses all raw materials, work in process, and finished goods within a supply chain. The inventory belonging to a firm is reported under assets. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness. For example, W.W. Grainger makes itself responsive by stocking large amounts of inventory and satisfying customer demand from stock even though the high inventory levels reduce efficiency. Such a practice makes sense for Grainger because its products hold their value for a long time. A strategy using high inventory levels can be dangerous in the fashion apparel business, though, in which inventory loses value relatively quickly with changing seasons and trends. Rather than hold high levels of inventory, Spanish apparel retailer Zara has worked hard to shorten new product and replenishment lead times. As a result, the company is very responsive but carries low levels of inventory.

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. McMaster-Carr and W.W. Grainger, however, have structured their supply chains to provide next-day service to most of their customers using ground transportation. They are providing a high level of responsiveness at lower cost. Outbound transportation costs of shipping to the customer are typically included in selling, general, and administrative expense, whereas inbound transportation costs are typically included in the cost of goods sold.

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, Seven-Eleven Japan has used information to better match supply and demand while achieving production and distribution economies. The result is a high level of responsiveness to customer demand while production and replenishment costs are lowered. Information technology-related expenses are typically included under either operating expense (typically under selling, general, and administrative expense) or assets. For example, in 2012, Amazon included $4.54 billion in technology expense under operating expense and another $454 million under fixed assets to be depreciated.

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, for instance, it saw its efficiency improve but its responsiveness suffer because of the long lead times. 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 high-cost locations 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. Sourcing costs show up in the cost of goods sold, and monies owed to suppliers are recorded under accounts payable.

6. ***Pricing*** determines how much a firm will charge for the 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 demand and supply chain performance. For example, if a transportation company varies its charges based on the lead time provided by the customers, it is 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. Differential pricing provides responsiveness to customers that value it and low cost to customers that do not value responsiveness as much. Any change in pricing affects revenues directly but could also affect costs based on the impact of this change on the other drivers.

Our definitions of these drivers attempt 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. Although 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 to determine the overall supply chain performance. Good supply chain design and operation recognize this interaction and make the appropriate trade-offs to deliver the desired level of responsiveness. Consider, for example, the sale of furniture at IKEA. The primary goal of this supply chain is to deliver a low price and acceptable quality. Modular design and unassembled furniture allows IKEA to carry components in inventory at its stores. The low component variety and stable replenishment orders allow IKEA's suppliers to focus on efficiency. Given the available inventory, low-cost modes of transportation are used to ship densely packed components. In this instance, relatively low-cost inventory at IKEA 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 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 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 rest of this chapter will illustrate, the key to achieving strategic fit and strong financial performance across the supply chain is to structure the supply chain drivers appropriately to provide the desired level of responsiveness at the lowest possible cost.

Doheny et al. (2010) point out that supply chain performance affects nearly 35 percent of the financial performance of apparel retailers. As a percentage of sales, they state that markdowns, representing 10 to 30 percent of sales, and lost sales, representing 5 to 10 percent of sales, are the dominant drivers of retailers' financial performance. They further state that transportation represents 2 to 5 percent, warehousing 1 to 3 percent, store product handling 3 to 5 percent, and inventory costs 2 to 5 percent of sales. Although the precise fraction will vary for different supply chains, it is evident that supply chain performance along the six drivers has a significant influence on a firm's financial performance.

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

3.3 FRAMEWORK FOR STRUCTURING DRIVERS

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

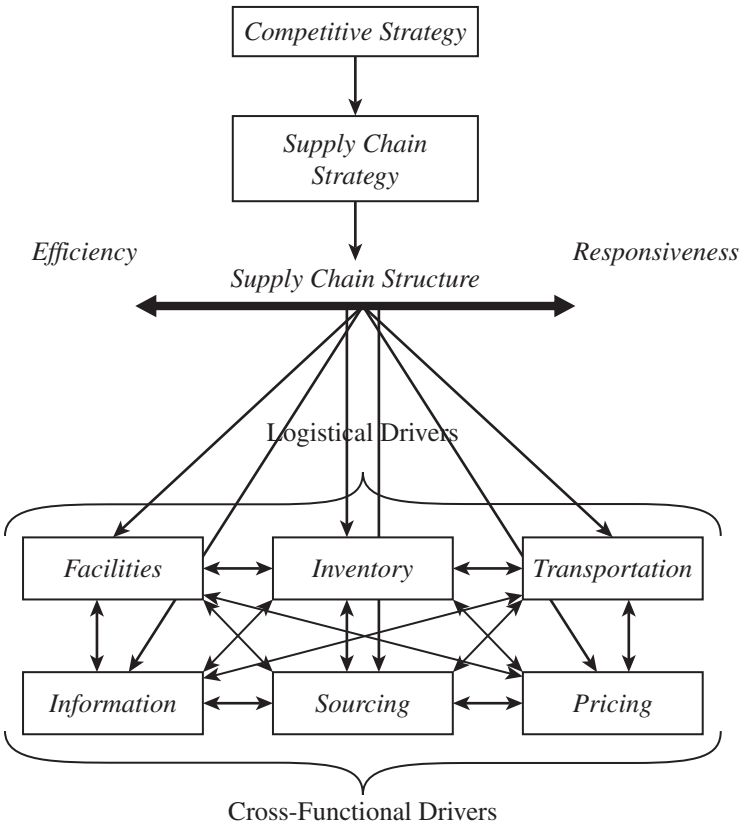

FIGURE 3-1 Supply Chain Decision-Making Framework

many instances a study of the six drivers may indicate the need to change the supply chain strategy and, potentially, even the competitive strategy.

Consider this framework using Walmart as an example. Walmart's competitive strategy is to be a reliable, low-cost retailer for a wide variety of mass-consumption goods. This strategy dictates that the ideal supply chain will emphasize efficiency but also maintain an adequate level of responsiveness in terms of product availability. Walmart uses the three logistical and three cross-functional drivers effectively to achieve this type of supply chain performance. With the inventory driver, Walmart maintains an efficient supply chain by keeping low levels of inventory. For instance, Walmart pioneered cross-docking, a system in which inventory is not stocked in a warehouse but rather is shipped to stores from the manufacturer with a brief stop at a distribution center (DC), where product is transferred from inbound trucks from the supplier to outbound trucks to the retail store. This lowers inventory significantly because products are stocked only at stores, not at both stores and warehouses. With respect to inventory, Walmart favors efficiency over responsiveness. On the transportation front, Walmart 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 Walmart's case. In the case of facilities, Walmart uses centrally located DCs within its network of stores to decrease the number of facilities and increase efficiency at each DC. Walmart 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. Walmart has invested significantly more than its competitors in information technology, allowing the company to feed demand information across the supply chain to suppliers that manufacture only what is being demanded. As a result, Walmart is a leader in its use of the information driver to improve responsiveness and decrease inventory investment. With regard to the sourcing driver, Walmart identifies efficient sources for each product it sells. Walmart feeds them large orders, allowing them to be efficient by exploiting economies of scale. Finally, for the pricing driver, Walmart practices "everyday 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. Walmart uses all the supply chain drivers to achieve the right balance between responsiveness and efficiency so 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, their roles in the supply chain, and their impact on financial performance.

3.4 FACILITIES

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

Role in the Supply Chain

Firms can increase responsiveness by increasing the number of facilities, making them more flexible, or increasing capacity. Each of these actions, however, comes at a cost. Increasing the number of facilities increases facility and inventory costs but decreases transportation costs and reduces response time. Increasing the flexibility or capacity of a facility increases facility costs but decreases inventory costs and response time. Thus, each supply chain must find the appropriate tradeoff when designing its facilities network. Whereas IKEA has become profitable by opening a few hundred large stores (no more than one or two per city) to grow efficiency, Seven-Eleven Japan has grown profitability by opening a highly dense network of stores (often hundreds per city) to provide responsiveness. Both companies are successful because the facility decisions are aligned with the supply chain strategy.

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. Although 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's and Honda's decision to place facilities in their local markets. The flexibility of Honda facilities to assemble both SUVs and cars in the same plant allowed the company to keep costs down in the downturn of 2008. While competitors' SUV production facilities were idle, Honda facilities maintained a high level of utilization.

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 Firms must decide whether production facilities 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 all functions (e.g., fabrication *and* assembly) needed for producing a single type of product. A functional-focused facility performs a given set of functions (e.g., fabrication *or* 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 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 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 Facility-related decisions affect both the financial performance of the firm and the supply chain's responsiveness to customers. On the financial side, facilities decisions have an impact on the cost of goods sold, assets in PP&E (if facilities are owned), and

selling, general, and administrative expense (if facilities are leased). 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 (PPET increases) and delays increase with increasing utilization.
- ***Processing/setup/down/idle time*** measures 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. Ideally, utilization should be limited by demand and not setup or downtime.
- ***Production cost per unit*** measures the average cost to produce a unit of output. These costs may be measured per unit, per case, or per pound, depending on the product.
- ***Quality losses*** measure the fraction of production lost as a result of defects. Quality losses hurt both financial performance and responsiveness.
- ***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 a month. The actual flow/cycle time includes the theoretical time and any delays. This metric should be used when setting due dates for orders.
- ***Flow time efficiency*** is the ratio of the theoretical flow time to the actual average flow time. Low values for flow time efficiency indicate that a large fraction of time is spent waiting.
- ***Product variety*** measures the number of products or 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 of 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 so separate processes are used to process the top 20 percent and the remaining 80 percent.
- ***Average production batch size*** measures the average amount produced in each production batch. Large batch sizes will decrease production cost but increase inventories.
- ***Production service level*** measures the fraction of production orders completed on time and in full.

3.5 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 or when the retail store builds up inventory to prepare for a surge in sales during the holiday season. In these instances, inventory is held to reduce cost or increase the level of product availability.

Inventory affects the assets held, the costs incurred, and responsiveness provided in the supply chain. High levels of inventory in an apparel supply chain improve responsiveness but also leave the supply chain vulnerable to the need for markdowns, lowering profit margins. 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. Low levels of inventory improve inventory turns but may result in lost sales if customers are unable to find products they are ready to buy. In general, managers should aim to reduce inventory in ways that do not increase cost or reduce responsiveness.

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:

$$I = DT \tag{3.1}$$

For example, if an Amazon warehouse holds 100,000 units in inventory and sells 1,000 units daily, Little's law tells us that the average unit will spend 100,000/1,000 = 100 days in inventory. If Amazon were able to reduce flow time to 50 days while holding throughput constant, it would reduce inventory to 50,000 units. Note that in this relationship, inventory and throughput must have consistent units.

EXAMPLE 3-2 Amazon.com

Amazon attempts to provide a wide variety of books (among other products) to its customers. Best-selling books are stocked in many regional warehouses close to customers for high responsiveness. Slower-moving books are stocked at fewer warehouses to lower the cost of inventory at the expense of some responsiveness. Some of the slowest-moving books are not held in inventory but are obtained from the publisher/distributor or printed on demand when requested by a customer. Amazon changes the form, location, and quantity of inventory it holds by the level of sales of a book to provide the right balance of responsiveness and efficiency.

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, comes an increase in carrying costs. As an example of a cycle inventory decision, consider an online book retailer. This e-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 more 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 will go unsold and may have to be discounted after the holidays. If the company has too little safety inventory, however, then Toys "R" Us will lose 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 owing to not having enough inventory.

SEASONAL INVENTORY *Seasonal inventory* is built up to counter predictable seasonal 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 has volume flexibility and can rapidly change the rate of its production system at very low cost, then it may not need seasonal inventory. 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 much 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 Inventory-related decisions affect the cost of goods sold, the C2C cycle, the assets held by the supply chain, and its responsiveness to customers. A manager should track the following inventory-related metrics that influence supply chain performance:

- ***C2C cycle time*** is a high-level metric that includes inventories, accounts payable, and receivables.
- ***Average inventory*** measures the average amount of inventory carried. Average inventory should be measured in units, days of demand, and financial value.
- ***Inventory turns*** measure the number of times inventory turns over in a year. It is the ratio of average inventory to either the cost of goods sold or sales.
- ***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 to identify reasons that justify the high inventory, such as price discounts or a product 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 by which the inflow of product exceeds its sales (beyond cycle and safety inventory). Seasonal inventory is built up solely to deal with anticipated spikes in demand.

- ***Fill rate*** (order/case) measures the fraction of orders/demand that were met on time from inventory. Fill rate should be averaged not over time but over a specified number of units of demand (say, every thousand or million).
- ***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 lost sales during the stockout period.
- ***Obsolete inventory*** measures the fraction of inventory older than a specified obsolescence date.

3.6 TRANSPORTATION

In this section, we discuss the role that transportation plays in the supply chain and 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 and affects both responsiveness and efficiency. Faster transportation is more expensive but allows a supply chain to be more responsive. As a result, the supply chain may carry lower inventories and have fewer facilities.

The appropriate choice of transportation allows a firm to adjust the location of its facilities and inventory to find the right balance between responsiveness and efficiency. A firm selling high-value items such as pacemakers may use rapid transportation to be responsive while centralizing its facilities and inventory to lower cost. In contrast, a firm selling low-value, high-demand items like light bulbs may carry a fair amount of inventory close to the customer but then use low-cost transportation such as sea, rail, and full trucks to replenish this inventory from plants located in low-cost countries.

EXAMPLE 3-3 Blue Nile

Blue Nile is an online retailer of diamonds that has used responsive transportation with FedEx to ship diamonds to customers in the United States, Canada, and several countries in Europe and Asia. Given the high value of diamonds, Blue Nile offers free shipping for overnight delivery. Responsive shipping, however, allows Blue Nile to centralize its inventory of diamonds and eliminate the need for expensive storefronts. In spite of the high transportation costs, Blue Nile has very low costs compared with those of bricks-and-mortar retailers because of the low facility and inventory expenses. Blue Nile is thus able to offer significantly lower prices than its bricks-and-mortar competition.

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 or not multiple supply or demand points will be included in a single run.

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

among 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 Inbound transportation decisions affect the cost of goods sold, whereas outbound transportation costs are part of the selling, general, and administrative expenses. Thus, transportation costs affect the profit margin. 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. Ideally, this cost should be measured per unit brought in, but it is often measured as a percentage of sales or cost of goods sold (COGS). The inbound transportation cost is generally included in COGS. It is useful to measure this cost separately for each 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 whether certain modes are overused or underused.

3.7 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

Good information can help improve the utilization of supply chain assets and the coordination of supply chain flows to increase responsiveness and reduce costs. Seven-Eleven Japan uses information to improve product availability while decreasing inventories. Walmart uses information on shipments from suppliers to facilitate cross-docking and lower inventory and transportation expense. Li & Fung, a global trading group supplying time-sensitive consumer goods such as apparel, uses information on its third-party manufacturers to source each order from the most appropriate supplier. Airlines routinely use information to offer the right number of seats at a discount price, leaving sufficient seats for business customers who make reservations at the last minute and are willing to pay a higher price. Each of these examples illustrates the importance of information as a key driver that can be used to provide higher responsiveness while simultaneously improving efficiency.

Even though the sharing of information can help a supply chain better meet customer needs at lower cost, there is a danger in the assumption that more information is always better. As more information is shared across a supply chain, the complexity and cost of both the required

infrastructure and the follow-up analysis grow exponentially. The marginal value provided by the information shared, however, diminishes as more and more information becomes available. It is thus important to evaluate the minimum information required to accomplish the desired objectives. For example, it may often be enough if aggregate sales, rather than detailed point-of-sale data, are shared between a retailer and a manufacturer. Aggregate information is cheaper to share and provides most of the value with regard to better production planning. The trade-off between complexity and value is important to consider when setting up the information infrastructure. The following examples illustrate how information can be used to provide customized products and improve supply chain performance.

EXAMPLE 3-4 DHL

DHL is a logistics and parcel delivery company that operates in more than 140,000 destinations with a presence in more than 200 countries, which involves working in diverse local environments with different languages, cultures, and local knowledge. For DHL, working locally means that its employees and customers have access to accurate tracking information on their packages in their local language. DHL moved from a decentralized information system involving 50 systems to a centralized integrated system to reduce risk and decrease costs while improving customer service. This resulted in a 40 percent reduction in infrastructure costs, coupled with more reliable communications throughout DHL's worldwide operation.*

EXAMPLE 3-5 Sunsweet Growers

Sunsweet Growers, a California-based dried fruit producer, implemented a supply chain sales and operations planning (S&OP) suite to replace its Excel-based planning system. The company has a highly seasonal supply, with harvest taking place primarily during September and October. Demand is also seasonal, with peak times occurring during the Christmas period. Good planning thus can be very valuable. Sunsweet's goal when implementing the suite was twofold: Each function should operate with the same data, and an early warning capability should alert planners and managers about any potential mismatches between supply and demand. After the implementation, production overruns at Sunsweet dropped from 30 percent to under 15 percent. Forecast accuracy improved by 15 to 20 percent. The early warning system alerts allowed planners to react as much as two to three weeks earlier than before the implementation.

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 discussed this distinction in Chapter 1, but we mention it again because different types of systems require different types of information. Push systems start with forecasts that are used to build 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 production and distribution of products can reflect the real demand accurately.

**Source:* Sullivan, L. "DHL Taps Several Vendors for RFID Project," *TechWeb News*, March 8, 2006; Bloch, M., and Schaper, M. "Building a Global IT Organization: An Interview with DPWN's Managing Director of IT," *The McKinsley Quarterly*, May 2006.

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 surplus. 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.

SALES AND OPERATIONS PLANNING *Sales and operations planning* (S&OP) is the process of creating an overall supply plan (production and inventories) to meet the anticipated level of demand (sales). The S&OP process starts with sales and marketing communicating their needs to the supply chain, which, in turn, communicates to sales and marketing whether the needs can be met, and at what cost. The goal of S&OP is to come up with an agreed-upon sales, production, and inventory plan that can be used to plan supply chain needs and project revenues and profits. The sales and operations 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 them into their supply chain. Some of these technologies include the following:

1. Electronic data interchange (EDI) was developed in the 1970s to facilitate the placement of instantaneous, paperless purchase orders with suppliers. Its proprietary nature, however, required significant upfront investment and often some translation between the communicating parties. It did, however, make transactions faster and more accurate than when they were paper based.

2. Relative to EDI, the Internet conveys much more information using a standard infrastructure allowing supply chains to improve both efficiency and responsiveness. The beginning of the twenty-first century has seen the Internet become the dominant medium of communication across all the macro processes (CRM, ISCM, and SRM, discussed in Chapter 1) that link the supply chain from suppliers to customers.

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 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.

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, whereas SCM systems help a company decide what it should do.

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 it. 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 bar-code scanning at the receiving dock. It can also be used to get an exact count of incoming items and items in storage.

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 be greater than or equal to 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 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 1 potentially indicates the existence of the bullwhip effect, which is discussed in Chapter 10.

3.8 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 whether each task will be performed by a responsive or efficient source and then whether the source will be internal to the company or a third party. Sourcing decisions should be made to increase the size of the total surplus to be shared across the supply chain. Outsourcing to a third party is meaningful if the third party raises the supply chain surplus more than the firm can on its own. In contrast, a firm should keep a supply chain function in-house if the third party cannot increase the supply chain surplus or if the risk associated with outsourcing is significant. For example, W.W. Grainger outsources package delivery to a third party because it is very expensive to build this capability in-house. In contrast, Grainger owns and operates its warehouses because there is sufficient scale to justify this choice. Sourcing decisions should aim to provide the appropriate level of responsiveness at the lowest cost.

The following example illustrates how Zara has sourced appropriately to be efficient for basic products and responsive for trendy products.

EXAMPLE 3-6 Zara

Zara has a sourcing strategy that varies by product type. For basic products such as white T-shirts, Zara aims for efficiency because demand is predictable. These products are sourced from suppliers in low cost countries. For trendy products for which demand is unpredictable, in contrast, Zara sources from company-owned factories in Europe. These factories are not low cost, but they are flexible and responsive to the rapidly evolving needs of the trendy 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. 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. This decision should be driven in part by its impact on the total supply chain surplus. It is best to outsource if the growth in total supply chain surplus is significant with little additional risk.

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.

PROCUREMENT *Procurement* is the process of obtaining goods and services within a supply chain. Managers must structure procurement with a goal of increasing supply chain surplus. 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 Sourcing decisions have a direct impact on the cost of goods sold and accounts payable. The performance of the source also affects quality, inventories, and inbound transportation costs. 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 for.
- ***Average purchase price*** measures the average price at which a good or service was purchased during the year. The average should be obtained by weighting each price by the quantity purchased at that 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.
- ***Supply quality*** measures the quality of product supplied.
- ***Supply lead time*** measures the average time between when an order is placed and when the product arrives. Long lead times reduce responsiveness and add to the inventory the supply chain must carry.
- ***Percentage of on-time deliveries*** measures the fraction of deliveries from the supplier that were on time.
- ***Supplier reliability*** measures the variability of the supplier's lead time as well as the delivered quantity relative to plan. Poor supplier reliability hurts responsiveness and adds to the amount of inventory the supply chain must carry.

3.9 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 influencing 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, especially when the supply chain is not very flexible. Short-term discounts can be used to eliminate supply surpluses or decrease seasonal demand spikes by moving some of the demand forward. 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 EDLP may foster stable demand that allows for efficiency in the supply chain. For example, Costco, a membership-based wholesaler in the United States, has a policy that prices are kept steady but low. The steady prices ensure that demand stays relatively stable. The Costco supply chain exploits the relative stability of demand to be efficient. 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. Amazon uses a menu of shipping options and prices to identify customers who value responsiveness and those who value low cost. This identification allows the company to serve both effectively, as shown in the following example.

EXAMPLE 3-7 Amazon.com

Amazon offers its customers a large menu of prices for products that are purchased from the company. For example, in January 2014, a person purchasing two books worth $40 could use standard shipping (3 to 5 business days) at a cost of $4.98, two-day shipping at a cost of $14.97, one-day shipping at a cost of $24.97, or free shipping (5 to 8 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 customers who want a low price to help it improve its efficiency.

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 to 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 EDLP 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 EDLP 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 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 of when the pricing menu is somewhat inconsistent is seen at many MRO suppliers, which 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 with home delivery. The pricing policy thus can lead to customer behavior that has a negative impact on profits.

PRICING-RELATED METRICS Pricing directly affects revenues but can also affect production costs and inventories, depending on its impact on consumer demand. 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, and so on), 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.

3.10 SUMMARY OF LEARNING OBJECTIVES

1. ***Describe key financial measures of firm performance.*** The key financial measures of firm performance include return on equity; return on assets; accounts payable turnover; profit margin; asset turnover and accounts receivable turnover; inventory turns; property, plant, and equipment turns; and cash-to-cash cycle.

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

3. ***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, whereas having fewer, central facilities creates higher efficiency. Holding higher levels of inventory increases the responsiveness of a supply chain, whereas keeping inventory low increases the chain's efficiency. Using faster modes of transportation increases a chain's responsiveness, whereas 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, which 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.

4. ***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. Each of these metrics directly or indirectly affects the financial metrics and the responsiveness to customers.

Discussion Questions

1. It is said that sourcing decisions are always an important factor affecting the supply chain performance for all industries. Is there any exception to this?
2. The flow of information has become more and more important in supply chain management. Describe the key impacts of information on supply chain performance in terms of responsiveness and efficiency with reference to the logistics industry.
3. Discuss the following proposition with reference to an automobile garage handling maintenance and repair: "Modal choice decisions could improve the responsiveness of the supply chain performance."
4. "Price decisions only affect the buyers' behavior and not the responsiveness of the supply chain." Comment on this proposition with reference to shipping logistics.
5. Marks & Spencer (M&S) has currently outsourced parts of its delivery services to a logistics provider. You have been asked to advise when the company should choose to operate its own account operation to provide delivery services.
6. What are the impacts of the high-low pricing adopted by major supermarkets on supply chain performance?
7. What are some industries in which products have proliferated and life cycles have shortened? How have the supply chains in these industries adapted?
8. How can the full set of logistical and cross-functional drivers be used to create strategic fit for a cell phone manufacturer targeting both time-sensitive and price-conscious customers?
9. On which supply chain drivers should a firm trying to shrink its cash-to-cash cycle focus?
10. Would you expect a brick-and-mortar retailer or an online retailer to have a higher asset turnover? Which supply chain drivers impact asset turnover?

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CASE STUDY

Seven-Eleven Japan Co.

Established by Ito Yokado 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. On September 1, 2005, Seven & i Holdings Co. Ltd., was established as the holding company for Seven-Eleven Japan, Ito-Yokado, and Denny's Japan. As a result, detailed financial results for Seven-Eleven Japan have not been available since then and are reported only as the convenience store portion of Seven & i Holdings. Seven-Eleven Japan realized a phenomenal growth between 1985 and 2013. During that period, the number of stores in Japan increased from 2,299 to more than 16,000. Globally, the firm had more than 53,000 convenience stores by June 2014 and was the world's largest chain in terms of retail outlets. Global revenues for Seven & i from convenience store operations were 1,899 billion yen in 2013 with an operating income of 221.7 billion yen. The firm was present in 42 of Japan's 47 prefectures and planned to open 1,500 stores in Japan in 2014. Customer visits to Seven-Eleven outlets averaged more than 1,000 per store per day in 2013.

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 (Table 3-3), resulting in 16,086 stores by 2014.

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 2005, Seven & i Holdings was established through a stock transfer combining Seven-Eleven Japan, Ito-Yokado, and Denny's Japan. In 2013, convenience store operations from Seven-Eleven Japan and other subsidiaries in North America and China contributed

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

Year	Number of Stores	Annual Sales (billion yen)
1974	15	0.7
1979	801	109.8
1984	2,299	386.7
1989	3,954	780.3
1994	5,905	1,392.3
1999	8,153	1,963.9
2004	10,826	2,440.8
2005	11,310	2,498.7
2006	11,735	2,533.5
2007	12,034	2,574.3
2008	12,298	2,762.5
2009	12,753	2,784.9
2010	13,232	2,947.6
2011	14,005	3,280.5
2012	15,072	3,508.4
2013	16,086	3,781.2

Source: John C. Stevenson, "Downtown Fixture," *Business*, November 6, 2006, pp. 1, 8–9.

37.4 percent of total revenues from operations and 76.1 percent of operating income for the Seven & i Holdings Company (see Table 3-4 for details). The relative performance of convenience stores within Japanese operations was even more dominant. The discrepancy between Tables 3-3 and 3-4 results because Table 3-3 reports sales at both company-owned and franchised stores, whereas Table 3-4 reports revenues for only Seven & i.

The Convenience Store Industry and Seven-Eleven in Japan

The convenience store sector was one of the few business areas that continued to grow during the prolonged slowdown in Japan toward the end of the twentieth century and the start of the twenty-first century. From 1991 to 2013, annual sales at convenience stores more than tripled, from just over 3 trillion to almost 10 trillion yen. As a point of comparison over this period, supermarket sales stayed stable, at about 13 trillion yen.

Japan's convenience store sector gradually consolidated, with larger players growing and smaller operators shutting down. In 2004, the top ten convenience store chains accounted for approximately 90 percent of Japan's convenience stores. By 2013, consolidation had resulted in the top five chains accounting for more than 90 percent of convenience store sales in Japan.

Seven-Eleven Japan had increased its share of the convenience store market since it opened. In 2012, Seven-Eleven was Japan's leading convenience store operator, accounting for a 38.8 percent market share in the convenience store segment. This share had increased relative to the 34.3 market share in 2008. 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 combined competition. By 2013, average daily sales per store at Seven-Eleven Japan stores had increased to 668,000 yen. In 2013, Seven-Eleven's operating income of 224.9 billion yen positioned it as a leader not only of the convenience store sector but also of Japan's retail industry as a whole. Seven-Eleven intended to continue its growth by opening 1,500 new stores in the year ending February 2014. This growth was 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

TABLE 3-4 Financial Figures for Seven & i (2011–2013)

For Fiscal Years Ending February 28/29	2011	2012	2013
Total revenues (billion yen)	5,119.7	4,786.3	4,991.6
Total operating income (billion yen)	243.3	292.1	295.7
Convenience store revenues (billion yen)		1,662.7	1,899.5
Convenience store operating income (billion yen)		215.9	221.7

Source: Data obtained from Seven Eleven Japan Annual Report 2013.

included both company-owned stores and third-party–owned franchises. To ensure efficiency, Seven-Eleven Japan based its fundamental network expansion policy on a market-concentration 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 felt that its market-concentration strategy improved distribution efficiency, brand awareness, efficiency of franchise support services, and advertising effectiveness. It also served as an effective deterrent to competition.

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.

By 2014, Seven-Eleven had stores in 42 of 47 of the prefectures within Japan. With an increased demand for "close-by, convenient stores" when there were fewer small- and medium-size retailers in a given area, Seven-Eleven felt that besides bringing stores to new areas, it could also continue to open stores in densely populated urban areas such as Tokyo, Nagoya, and Osaka.

With Seven-Eleven franchises being highly sought after, fewer than one of 100 applicants was awarded a franchise (a testament to store profitability). The franchise owner was required to put a significant amount of money up front. Half 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

Store Information and Contents

Seven-Eleven had more than 16,000 stores in Japan by January 2014 (see Table 3-3). 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. In 2013, daily sales at a store averaged 668,000 yen (about $6,528 in March 2014 at an exchange rate of about 102 yen to a U.S. dollar), which was almost twice the average at a U.S. store.

Seven-Eleven Japan offered its stores a choice from a set of 5,000 SKUs. Each store carried about 3,000 SKUs on average, depending on local customer demand. Seven-Eleven Japan emphasized regional merchandising to cater precisely to local preferences. Each store carried food items, beverages, magazines, and consumer items such as soaps and detergents. The relative sales across product categories in 2012 for Seven-Eleven Japan are given in Table 3-5.

The food items were classified into 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 2012, processed and fast foods contributed about 53 percent of the total sales at each store. More than 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. By 2013, Seven-Eleven Japan had 171 daily production facilities and 158 distribution centers across Japan.

TABLE 3-5 Sales by Product Category in 2012

	Percentage of Total Sales
Processed foods	26.6
Fast foods	26.0
Fresh/daily foods	12.3
Nonfoods	35.1

Source: Data obtained from Seven Eleven Japan Annual Report 2012.

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.

Seven-Eleven was focused on increasing the number of original items that were available only at their stores. In 2004, original items accounted for roughly 52 percent of total store sales. In 2007, Seven & i launched Seven Premium private brand products for sale at its stores. By February 2010, Seven Premium offered 1,035 SKUs; this number was expected to grow in the future. Private brand products were sold across all store formats and were viewed by the company as an important part of the expansion of synergies across its various retail formats.

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, 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. Seven Bank was set up as the core operating company for Seven & i in financial services. By 2013, virtually every Seven-Eleven Japan store had an ATM installed, with Seven Bank having almost 18,000 ATMs. The company averaged 111 transactions per ATM per day.

Other services offered at stores include photocopying, ticket sales (including baseball games, express buses, and music concerts), using multifunctional copiers, and being a pick-up location for parcel delivery companies that typically did not leave the parcel outside if the customer was not at home. In 2010, the convenience stores also started offering some government services, such as providing certificates of residence. The major thrust for offering these services was to take advantage of the convenient locations of Seven-Eleven stores in Japan. Besides providing additional revenue, the services also got customers to visit the stores more frequently. Several of these services exploited the existing Total Information System (described later) 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 preference along with the synergies from the existing distribution system.

In March 2007, Seven-Eleven Japan introduced "Otoriyose-bin," or Internet shopping. The service enabled customers to buy products that were typically not available at the retail stores. Customers were allowed to order on the Internet with both pick-up and payment at Seven-Eleven stores. No shipping fee was charged for this service. The company built Seven Net Shopping, its Internet site, aimed at combining the group's stores and Internet services. In April 2007, "nanaco" electronic money was offered in Seven-Eleven stores. The service allowed customers to prepay and use a card or cell phone to make payments. The service was offered as a convenience to customers making small purchases and was also a reward system offering one yen's worth of points for every 100 yen spent by the customer. By 2013, 21.45 million nanaco accounts had been issued.

Given Japan's aging population and an increase in the number of women working outside the home (Seven-Eleven estimated that in 2009, more than 70 percent of women in their 40s worked outside the home), Seven-Eleven wanted to exploit its "close-by convenient stores" to better serve its customers. The company attempted to do this by increasing the number of high daily consumption rate products from 500 to 900 and by bolstering its Seven-Meal service for home delivery.

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, jointly with NEC, developed 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, the 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. Sales data gathered in each store by 11:00 p.m. were processed and ready for analysis the next morning.

The hardware system at a 2012 Seven-Eleven store included the following:

- ***Graphic order terminal:*** This was a handheld device with a wide-screen graphic display, used by the store owner or manager to place orders. 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 an 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 Seven-Eleven 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:*** As soon as a customer purchased an item and paid at the POS register, sales and other data (such as the age and sex of the customer) were stored and transmitted to headquarters through the store computer.

The analyzed and updated data were then sent back to the Seven-Eleven Japan stores via the network each morning. All this information was available on the graphic order terminal with the objective of improving 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, and 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. About 70 percent of the items sold at a Seven-Eleven store changed in the course of a year. About 100 new products were introduced each week. 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. 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 DC. Each store order was separated so the DC 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 DC, deliveries of like products from different suppliers (e.g., milk and sandwiches) were 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. Warm and chilled foods were delivered three times daily, whereas room-temperature products were delivered once a day. Frozen products were delivered three to seven times a week, depending on the weather. 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, seventy vehicles visited each store every day. By 2006, only nine were necessary. This dramatically reduced delivery costs and enabled rapid delivery of a variety of fresh foods.

As of May 2013, Seven-Eleven Japan had a total of 171 daily production facilities throughout the country that produced items were distributed through 158 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 (Table 3-6). The major growth was in Asia, although 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 in Japan. Stores in the United States were replenished using direct store delivery (DSD) by some manufacturers, with the remaining products delivered by wholesalers. DSD accounted for about half the total volume, with the rest coming from wholesalers.

TABLE 3-6 Global Store Distribution for Seven-Eleven in December 2013

Country	Stores
Japan	16,020
United States	8,155
Taiwan	4,919
Thailand	7,429
South Korea	7,085
China	2,001
Malaysia	1,557
Mexico	1,690
Canada	486
Australia	595
Singapore	537
Philippines	1,009
Norway	157
Sweden	190
Denmark	196
Indonesia	149
Total	52,175

Source: Data obtained from Seven Eleven Japan website http://www.sej.co.jp/company/en/g_stores.html.

With the goal of introducing "fresh" products in the United States, 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. Relative to Japan, a greater fraction of the food sold, especially hot food such as wings and pizza, was prepared in the store. 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 more than 63 percent of its sales from non-gasoline products compared with 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 with a special focus on hot foods.

In 2009, revenue in the United States and Canada totaled $16.0 billion, with about 63 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 more than 50 in Japan. This, 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 with 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 and 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?

CASE STUDY

Financial Statements for Walmart Stores Inc. and Macy's Inc.

Table 3-7 contains the financial results for Walmart and Macy's for 2012. Evaluate the financial performance of each company based on the various metrics discussed in Section 3.1, such as ROE, ROA, profit margin, asset turns, APT, C2C, ART, INVT, and PPET. Can you explain the differences you see in their performance based on their supply chain strategy and structure? Compare the metrics for each company with similar metrics for Amazon and Nordstrom from Table 3-1. Which metrics does each company perform better on? What supply chain drivers and metrics might explain this difference in performance?

TABLE 3-7 Selected Financial Data for Walmart Stores Inc. and Macy's Inc.

Year ended January 31, 2013 ($ millions)	Walmart	Macy's
Net operating revenues	469,162	27,686
Cost of goods sold	352,488	16,538
Gross profit	116,674	11,148
Selling, general, and administrative expense	88,873	8,482
Operating income	27,801	2,661
Interest expense	2,251	425
Other income (loss)—net	187	(134)
Income before income taxes	25,737	2,102
Income taxes	7,981	767
Net income	17,756	1,198
Assets		
Cash and cash equivalents	7,781	1,836
Net receivables	6,768	371
Inventories	43,803	5,308
Total current assets	59,940	7,876
Property, plant, and equipment	116,681	8,196
Goodwill	20,497	3,743
Other assets	5,987	615
Total assets	203,105	20,991
Liabilities and Stockholder Equity		
Accounts payable	59,099	4,951
Short-term debt	12,719	124
Total current liability	71,818	5,075
Long-term debt	41,417	6,806
Total liabilities	126,243	14,940
Stockholder equity	76,343	6,051