CHAPTER 1
UNDERSTANDING THE SUPPLY CHAIN

Learning Objectives

After reading this chapter, you will be able to:

1. Discuss the goal of a supply chain and explain the impact of supply chain decisions on the success of a firm.
2. Identify the three key supply chain decision phases and explain the significance of each one.
3. Describe the cycle and push/pull views of a supply chain.
4. Classify the supply chain macro processes in a firm.

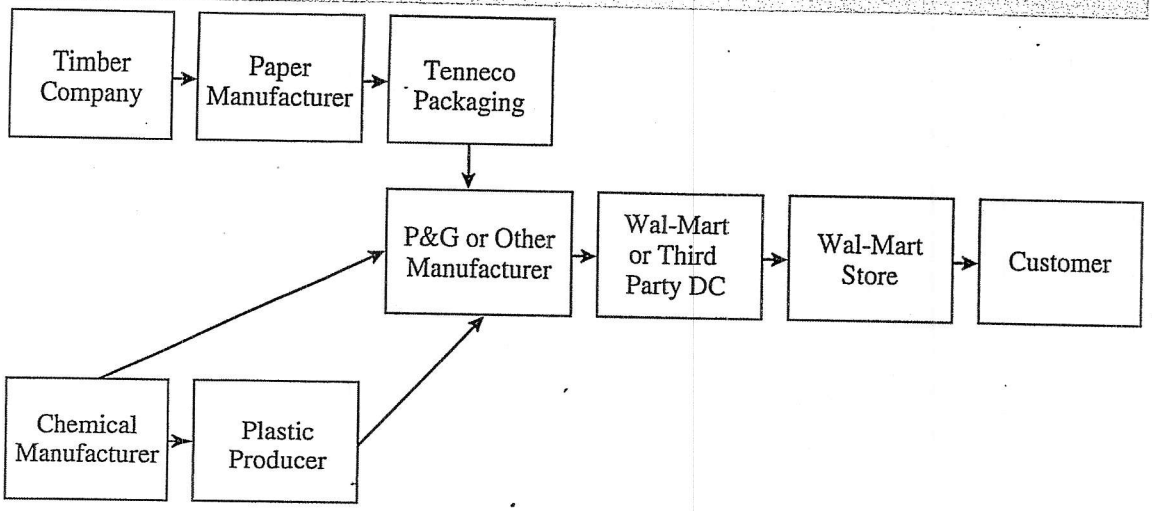
In this chapter, we provide a conceptual understanding of what a supply chain is and the various issues that need to be considered when designing, planning, or operating a supply chain. We discuss the significance of supply chain decisions and supply chain performance for the success of a firm. We also provide several examples from different industries to emphasize the variety of supply chain issues that companies need to consider at the strategic, planning, and operational levels.

1.1 WHAT IS A SUPPLY CHAIN?

A *supply chain* consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.

Consider a customer walking into a Wal-Mart store to purchase detergent. The supply chain begins with the customer and his or her need for detergent. The next stage of this supply chain is the Wal-Mart retail store that the customer visits. Wal-Mart stocks its shelves using inventory that may have been supplied from a finished-goods warehouse or a distributor using trucks supplied by a third party. The distributor in turn is stocked by the manufacturer (say, Proctor & Gamble [P&G] in this case). The P&G manufacturing plant receives raw material from a variety of suppliers, who may themselves have been supplied by lower-tier suppliers. For example, packaging material may come from Tenneco packaging, while Tenneco receives raw materials to manufacture the packaging from other suppliers. This supply chain is illustrated in Figure 1-1, with the arrows corresponding to the direction of physical product flow.

FIGURE 1-1 Stages of a Detergent Supply Chain



A supply chain is dynamic and involves the constant flow of information, product, and funds between different stages. In our example, Wal-Mart provides the product, as well as pricing and availability information, to the customer. The customer transfers funds to Wal-Mart. Wal-Mart conveys point-of-sales data as well as replenishment orders to the warehouse or distributor, who transfers the replenishment order via trucks back to the store. Wal-Mart transfers funds to the distributor after the replenishment. The distributor also provides pricing information and sends delivery schedules to Wal-Mart. Wal-Mart may send back packaging material to be recycled. Similar information, material, and fund flows take place across the entire supply chain.

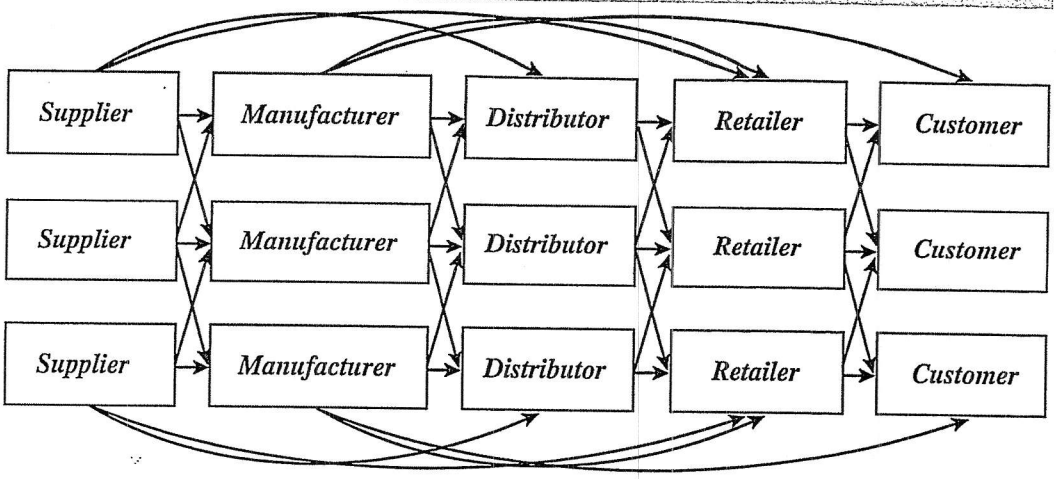
In another example, when a customer makes a purchase online from Dell Computer, the supply chain includes, among others, the customer, Dell's Web site, the Dell assembly plant, and all of Dell's suppliers and their suppliers. The Web site provides the customer with information regarding pricing, product variety, and product availability. Having made a product choice, the customer enters the order information and pays for the product. The customer may later return to the Web site to check the status of the order. Stages farther up the supply chain use customer order information to fill the request. That process involves an additional flow of information, product, and funds between various stages of the supply chain.

These examples illustrate that the customer is an integral part of the supply chain. In fact, the primary purpose of any supply chain is to satisfy customer needs and, in the process, generate profit for itself. The term *supply chain* conjures up images of product or supply moving from suppliers to manufacturers to distributors to retailers to customers along a chain. This is certainly part of the supply chain, but it is also important to visualize information, funds, and product flows along both directions of this chain. The term *supply chain* may also imply that only one player is involved at each stage. In reality, a manufacturer may receive material from several suppliers and then supply several distributors. Thus, most supply chains are actually networks. It may be more accurate to use the term *supply network* or *supply web* to describe the structure of most supply chains, as shown in Figure 1-2.

A typical supply chain may involve a variety of stages. These supply chain stages include:

- Customers
- Retailers

FIGURE 1-2 Supply Chain Stages



- Wholesalers/distributors
- Manufacturers
- Component/raw material suppliers

Each stage in a supply chain is connected through the flow of products, information, and funds. These flows often occur in both directions and may be managed by one of the stages or an intermediary. Each stage in Figure 1-2 need not be present in a supply chain. The appropriate design of the supply chain depends on both the customer's needs and the roles played by the stages involved. In some cases, such as Dell, a manufacturer may fill customer orders directly. Dell builds-to-order; that is, a customer order initiates manufacturing at Dell. Dell does not have a retailer, wholesaler, or distributor in its supply chain. In other cases, such as the mail-order company L.L.Bean, manufacturers do not respond to customer orders directly. In this case, L.L.Bean maintains an inventory of product from which it fills customer orders. Compared to the Dell supply chain, the L.L.Bean supply chain contains an extra stage (the retailer, L.L.Bean itself) between the customer and the manufacturer. In the case of other retail stores, the supply chain may also contain a wholesaler or distributor between the store and the manufacturer.

1.2 THE OBJECTIVE OF A SUPPLY CHAIN

The objective of every supply chain should be to maximize the overall value generated. The *value* a supply chain generates is the difference between what the final product is worth to the customer and the costs the supply chain incurs in filling the customer's request. For most commercial supply chains, value will be strongly correlated with *supply chain profitability* (also known as *supply chain surplus*), the difference between the revenue generated from the customer and the overall cost across the supply chain. For example, a customer purchasing a wireless router from Best Buy pays $60, which represents the revenue the supply chain receives. Best Buy and other stages of the supply chain incur costs to convey information, produce components, store them, transport them, transfer funds, and so on. The difference between the $60 that the customer paid and the sum of all costs incurred by the supply chain to produce and distribute the router represents the supply chain profitability or surplus. Supply chain profitability or

surplus is the total profit to be shared across all supply chain stages and intermediaries. The higher the supply chain profitability, the more successful is the supply chain. Supply chain success should be measured in terms of supply chain profitability and not in terms of the profits at an individual stage. (In subsequent chapters we see that a focus on profitability at individual stages may lead to a reduction in overall supply chain profits.)

Having defined the success of a supply chain in terms of supply chain profitability, the next logical step is to look for sources of revenue and cost. For any supply chain, there is only one source of revenue: the customer. At Wal-Mart, a customer purchasing detergent is the only one providing positive cash flow for the supply chain. All other cash flows are simply fund exchanges that occur within the supply chain, given that different stages have different owners. When Wal-Mart pays its supplier, it is taking a portion of the funds the customer provides and passing that money on to the supplier. All flows of information, product, or funds generate costs within the supply chain. Thus, the appropriate management of these flows is a key to supply chain success. Effective *supply chain management* involves the management of supply chain assets and product, information, and fund flows to maximize total supply chain profitability.

In this book we will have a strong focus on analyzing all supply chain decisions in terms of their impact on the supply chain surplus. These decisions and their impact can vary for a wide variety of reasons. For instance, consider the difference in the supply chain structure for fast-moving consumer goods observed in the United States and India. U.S. distributors play a much smaller role in this supply chain compared to their Indian counterparts. We argue that the difference in supply chain structure can be explained by the impact a distributor has on the supply chain surplus in the two countries.

Retailing in the United States is largely consolidated, with large chains buying consumer goods from most manufacturers. This consolidation gives retailers sufficient scale that the introduction of an intermediary such as a distributor does little to reduce costs and may actually increase costs because of an additional transaction. In contrast, India has millions of small retail outlets. The small size of Indian retail outlets limits the amount of inventory they can hold, thus requiring frequent replenishment—an order can be compared with the weekly grocery shopping for a family in the United States. The only way for a manufacturer to keep transportation costs low is to bring full truckloads of product close to the market and then distribute locally using "milk runs" with smaller vehicles. The presence of an intermediary who can receive a full truckload shipment, break bulk, and then make smaller deliveries to the retailers is crucial if transportation costs are to be kept low. Most Indian distributors are one-stop shops, stocking everything from cooking oil to soaps and detergents made by a variety of manufacturers. Besides the convenience provided by one-stop shopping, distributors in India are also able to reduce transportation costs for outbound delivery to the retailer by aggregating products across multiple manufacturers during the delivery runs. Distributors in India also handle collections, because their cost of collection is significantly lower than each manufacturer collecting from retailers on its own. Thus, the important role of distributors in India can be explained by the growth in supply chain surplus that results from their presence. The supply chain surplus argument implies that as retailing in India begins to consolidate, the role of distributors will diminish.

1.3 THE IMPORTANCE OF SUPPLY CHAIN DECISIONS

There is a close connection between the design and management of supply chain flows (product, information, and funds) and the success of a supply chain. Wal-Mart, Dell Computer, and Seven-Eleven Japan are examples of companies that have built

their success on superior design, planning, and operation of their supply chain. In contrast, the failure of many e-businesses such as Webvan can be attributed to weaknesses in their supply chain design and planning. Similarly, Quaker Oats's acquisition of Snapple in 1994 is an example of how the inability to design and manage supply chain flows effectively led to failure. We discuss these examples later in this section.

Wal-Mart has been a leader at using supply chain design, planning, and operation to achieve success. From its beginning, the company invested heavily in transportation and information infrastructure to facilitate the effective flow of goods and information. Wal-Mart designed its supply chain with clusters of stores around distribution centers to facilitate frequent replenishment at its retail stores in a cost-effective manner. Frequent replenishment allows stores to match supply and demand more effectively than the competition. Wal-Mart has been a leader in sharing information and collaborating with suppliers to bring down costs and improve product availability. The results are impressive. In their 2004 annual report, the company reported a net income of more than $9 billion on revenues of about $250 billion. These are dramatic results for a company that reached annual sales of only $1 billion in 1980. The growth in sales represents an annual compounded growth rate of 26 percent.

Dell has, over a relatively short period of time, become the world's largest personal computer (PC) manufacturer. In 2004 Dell had a net income of over $2.6 billion on revenues of just over $41 billion. The company has attributed a significant part of its success to the way it manages flows—product, information, and funds—within its supply chain.

Dell bypasses distributors and retailers and sells directly to customers. Close contact with its customers and an understanding of customers' needs allow Dell to develop better forecasts. To further improve the match between supply and demand, Dell makes an active effort to steer customers in real time, on the phone or via the Internet, toward PC configurations that can be built given the components available.

On the operational side, Dell centralizes manufacturing and inventories in a few locations and postpones final assembly until orders arrive. As a result, Dell is able to provide a large variety of PC configurations while keeping very low levels of inventory. In 2004, Dell carried less than five days' worth of inventory; in contrast, the competition, selling through retailers, carries several weeks' worth of inventory. If Intel introduces a new chip, the low level of inventory allows Dell to go to market with a PC containing the chip faster than the competition. If prices drop suddenly, as they often do, Dell has less inventory that loses value relative to its competitors. For some products, such as monitors manufactured by Sony, Dell maintains no inventory. The transportation company simply picks up the appropriate number of computers from Dell's Austin, Texas, plant and monitors from Sony's factory in Mexico, matches them by customer order, and delivers them to the customers. This procedure allows Dell to save time and money associated with the extra handling of monitors.

The success of the Dell supply chain is facilitated by sophisticated information exchange. Dell provides real-time data to suppliers on the current state of demand. Suppliers are able to access their components' inventory levels at the factories along with daily production requirements. Dell has created customized Web pages for its major suppliers to view demand forecasts and other customer-sensitive information, thus helping suppliers to get a better idea of customer demand and better match their production schedules to that of Dell.

Dell's low levels of inventory also help ensure that defects are not introduced into a large quantity of products. When a new product is launched, supplier engineers are stationed right in the plant. If a customer calls in with a problem, production can be

stopped and flaws fixed in real time. As there is no finished product in inventory, the amount of defective merchandise produced is minimized.

Dell also manages its cash flows very effectively. By managing inventories, receivables, and payables very closely, it managed a cash conversion cycle of negative 36 days in 2004. In other words, Dell ran its business on other people's money!

Clearly, Dell's supply chain design and its management of product, information, and cash flows play a key role in the company's success. In the changing marketplace, however, the company's supply chain design presents some new challenges for Dell. Whereas it has a supply chain that is very well suited to provide a high degree of customization at a low cost, it is not clear that hardware customization will stay significant for PCs and other products that Dell sells. In the future, Dell may have to rethink its supply chain design to maintain success.

The failure of many e-businesses such as Webvan and Kozmo can be attributed to their inability to design appropriate supply chains or manage supply chain flows effectively. Webvan designed a supply chain with large warehouses in several major cities in the United States, from which groceries were delivered to customer homes. This supply chain design could not compete with traditional supermarket supply chains in terms of cost. Traditional supermarket chains bring product to a supermarket close to the consumer using full truckloads, resulting in very low transportation costs. They turn their inventory relatively fast and let the customer perform most of the picking activity in the store. In contrast, Webvan turned its inventory marginally faster than supermarkets but incurred much higher transportation costs for home delivery and high labor costs to pick customer orders. The result was a company that folded in 2001 within two years of a very successful initial public offering.

Quaker Oats, with its acquisition of Snapple, provides another example in which failure to design and manage supply chain flows led to financial failure. In December 1994, Quaker Oats purchased Snapple, a producer of bottled natural drinks such as teas, at a cost of $1.7 billion. Gatorade, the top-selling brand in the sports drink segment, was Quaker Oats's most successful beverage. Gatorade was very strong in the South and Southwest of the United States, whereas Snapple was strong in the Northeast and on the West Coast.

Quaker Oats announced that a major motivation of the merger was the potential synergies between the two distribution systems of Snapple and Gatorade. The company, however, was unable to take advantage of these synergies. Problems stemmed from causes such as disparate manufacturing facilities and different customer types. Gatorade was manufactured in plants owned by Quaker Oats, whereas Snapple was produced under contract by outside plants. Gatorade sold significant amounts through supermarkets and grocery stores, whereas Snapple sold primarily through restaurants and independent retailers. Over the two years following its acquisition of Snapple, Quaker Oats was unable to gain much synergy between the two distribution systems in its attempts to merge them. Just 28 months later, Quaker Oats sold Snapple to Triarc Companies for about $300 million, about 20 percent of the purchase price. The inability to achieve synergies between the two supply chains was a significant reason for the failure of Snapple for Quaker Oats.

KEY POINT Supply chain design, planning, and operation decisions play a significant role in the success or failure of a firm.

In the next section, we categorize supply chain decision phases based on the frequency with which they are made and the time frame they take into account.

1.4 DECISION PHASES IN A SUPPLY CHAIN

Successful supply chain management requires many decisions relating to the flow of information, product, and funds. Each decision should be made to raise the supply chain surplus. These decisions fall into three categories or phases, depending on the frequency of each decision and the time frame during which a decision phase has an impact. As a result, each category of decisions must consider uncertainty over the decision horizon.

1. ***Supply Chain Strategy or Design:*** During this phase, given the marketing and pricing plans for a product, a company decides how to structure the supply chain over the next several years. It decides what the chain's configuration will be, how resources will be allocated, and what processes each stage will perform. Strategic decisions made by companies include whether to outsource or perform a supply chain function in-house, the location and capacities of production and warehousing facilities, the products to be manufactured or stored at various locations, the modes of transportation to be made available along different shipping legs, and the type of information system to be utilized. A firm must ensure that the supply chain configuration supports its strategic objectives and increases the supply chain surplus during this phase. Cisco's decisions regarding its choice of supply sources for components, contract manufacturers for manufacturing, and the location and capacity of its warehouses, are all supply chain design or strategic decisions. Supply chain design decisions are typically made for the long term (a matter of years) and are very expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years.

2. ***Supply Chain Planning:*** For decisions made during this phase, the time frame considered is a quarter to a year. Therefore, the supply chain's configuration determined in the strategic phase is fixed. This configuration establishes constraints within which planning must be done. The goal of planning is to maximize the supply chain surplus that can be generated over the planning horizon given the constraints established during the strategic or design phase. Companies start the planning phase with a forecast for the coming year (or a comparable time frame) of demand in different markets. Planning includes making decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies to be followed, and the timing and size of marketing and price promotions. Dell's decisions regarding markets supplied by a production facility and target production quantities at each location are classified as planning decisions. Planning establishes parameters within which a supply chain will function over a specified period of time. In the planning phase, companies must include uncertainty in demand, exchange rates, and competition over this time horizon in their decisions. Given a shorter time frame and better forecasts than the design phase, companies in the planning phase try to incorporate any flexibility built into the supply chain in the design phase and exploit it to optimize performance. As a result of the planning phase, companies define a set of operating policies that govern short-term operations.

3. ***Supply Chain Operation:*** The time horizon here is weekly or daily, and during this phase companies make decisions regarding individual customer orders. At the operational level, supply chain configuration is considered fixed, and planning policies are already defined. The goal of supply chain operations is to handle incoming customer orders in the best possible manner. During this phase, firms allocate inventory or production to individual orders, set a date that an order is to be filled, generate pick lists at a warehouse, allocate an order to a particular shipping mode and shipment, set delivery

schedules of trucks, and place replenishment orders. Because operational decisions are being made in the short term (minutes, hours, or days), there is less uncertainty about demand information. Given the constraints established by the configuration and planning policies, the goal during the operation phase is to exploit the reduction of uncertainty and optimize performance.

The design, planning, and operation of a supply chain have a strong impact on overall profitability and success. It is fair to state that a large part of the success of firms like Wal-Mart and Dell can be attributed to their effective supply chain design, planning, and operation.

In later chapters, we develop concepts and present methodologies that can be used at each of the three decision phases described earlier. Most of our discussion addresses the supply chain design and planning phases.

KEY POINT Supply chain decision phases may be categorized as design, planning, or operational, depending on the time frame during which the decisions made apply.

1.5 PROCESS VIEWS OF A SUPPLY CHAIN

A supply chain is a sequence of processes and flows that take place within and between different stages and combine to fill a customer need for a product. There are two different ways to view the processes performed in a supply chain.

1. ***Cycle View:*** The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of a supply chain.
2. ***Push/Pull View:*** The processes in a supply chain are divided into two categories depending on whether they are executed in response to a customer order or in anticipation of customer orders. *Pull* processes are initiated by a customer order, whereas *push* processes are initiated and performed in anticipation of customer orders.

CYCLE VIEW OF SUPPLY CHAIN PROCESSES

Given the five stages of a supply chain shown in Figure 1-2, all supply chain processes can be broken down into the following four process cycles, as shown in Figure 1-3:

- Customer order cycle
- Replenishment cycle
- Manufacturing cycle
- Procurement cycle

Each cycle occurs at the interface between two successive stages of the supply chain. The five stages thus result in four supply chain process cycles. Not every supply chain will have all four cycles clearly separated. For example, a grocery supply chain in which a retailer stocks finished-goods inventories and places replenishment orders with a distributor is likely to have all four cycles separated. Dell, in contrast, sells directly to customers, thus bypassing the retailer and distributor.

Each cycle consists of six subprocesses as shown in Figure 1-4. Each cycle starts with the supplier marketing the product to customers. A buyer then places an order that is received by the supplier. The supplier supplies the order, which is received by the buyer. The buyer may return some of the product or other recycled material to the supplier or a third party. The cycle of activities then begins all over again.

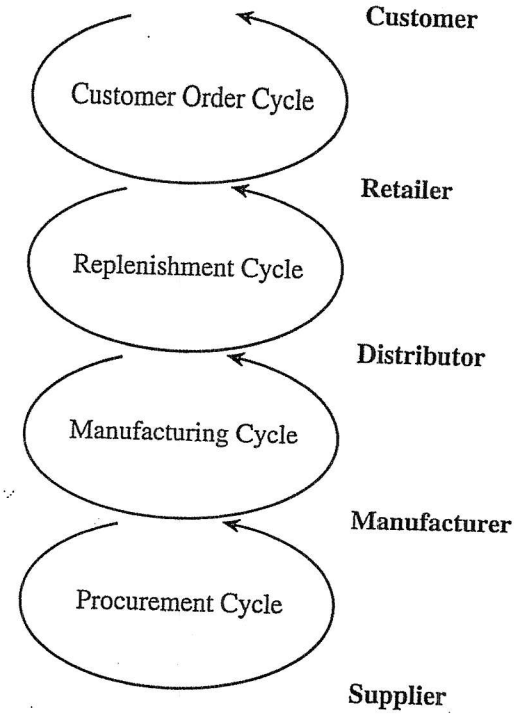


FIGURE 1-3 Supply Chain Process Cycles

Depending on the transaction in question, the subprocesses in Figure 1-4 can be applied to the appropriate cycle. When customers shop online at Amazon, they are part of the customer order cycle—with the customer as the buyer and Amazon as the supplier. In contrast, when Amazon orders books from a distributor to replenish its inventory, it is part of the replenishment cycle—with Amazon as the buyer and the distributor as the supplier.

Within each cycle, the goal of the buyer is to ensure product availability and to achieve economies of scale in ordering. The supplier attempts to forecast customer orders and reduce the cost of receiving the order. The supplier then works to fill the order on time and improve efficiency and accuracy of the order fulfillment process. The buyer then works to reduce the cost of the receiving process. Reverse flows are managed to reduce cost and meet environmental objectives.

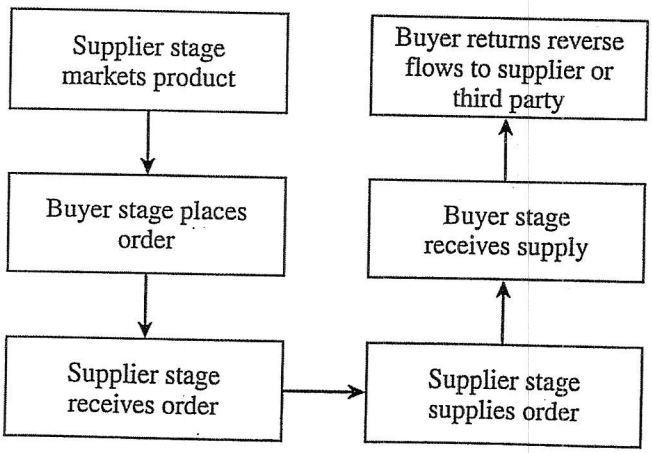


FIGURE 1-4 Subprocesses in Each Supply Chain Process Cycle

Even though each cycle has the same basic subprocesses, there are a few important differences between cycles. In the customer order cycle, demand is external to the supply chain and thus uncertain. In all other cycles, order placement is uncertain but can be projected based on policies followed by the particular supply chain stage. For example, in the procurement cycle, a tire supplier to an automotive manufacturer can predict tire demand precisely once the production schedule at the manufacturer is known. The second difference across cycles relates to the scale of an order. Whereas a customer buys a single car, the dealer orders multiple cars at a time from the manufacturer, and the manufacturer, in turn, orders an even larger quantity of tires from the supplier. As we move from the customer to the supplier, the number of individual orders declines and the size of each order increases. Thus, sharing of information and operating policies across supply chain stages becomes more important as we move farther from the end customer.

A cycle view of the supply chain is very useful when considering operational decisions because it clearly specifies the roles of each member of the supply chain. The detailed process description of a supply chain in the cycle view forces a supply chain designer to consider the infrastructure required to support these processes. The cycle view is useful, for example, when setting up information systems to support supply chain operations.

KEY POINT A cycle view of the supply chain clearly defines the processes involved and the owners of each process. This view is very useful when considering operational decisions because it specifies the roles and responsibilities of each member of the supply chain and the desired outcome for each process.

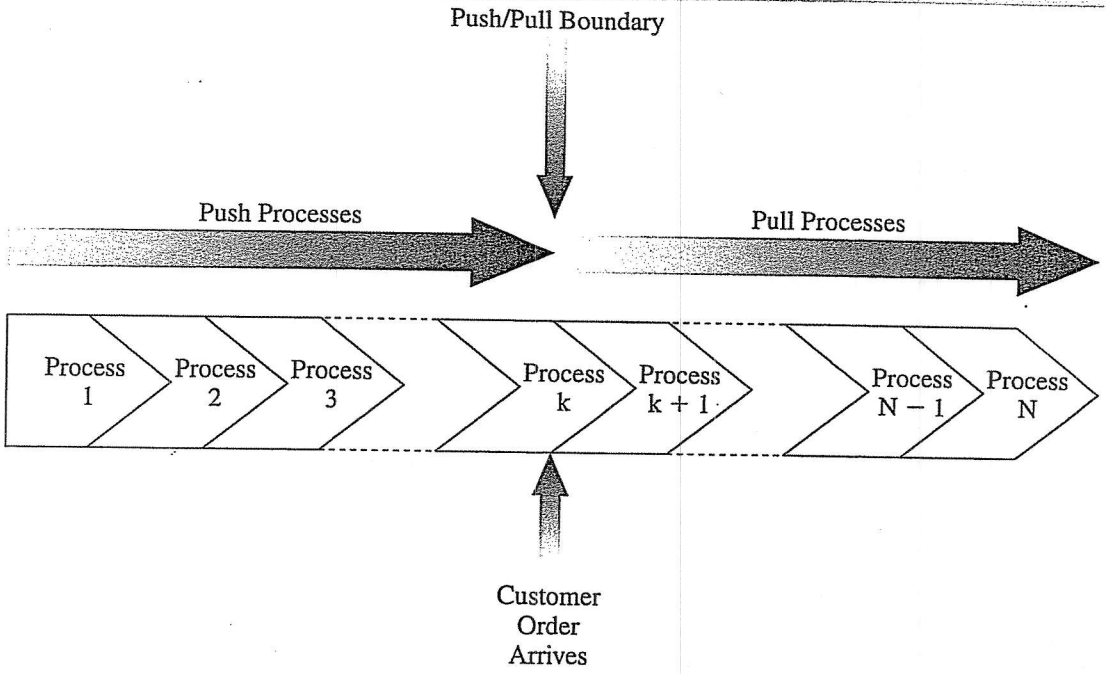
PUSH/PULL VIEW OF SUPPLY CHAIN PROCESSES

All processes in a supply chain fall into one of two categories depending on the timing of their execution relative to end customer demand. With pull processes, execution is initiated in response to a customer order. With push processes, execution is initiated in anticipation of customer orders. Therefore, at the time of execution of a pull process, customer demand is known with certainty, whereas at the time of execution of a push process, demand is not known and must be forecast. Pull processes may also be referred to as *reactive processes* because they react to customer demand. Push processes may also be referred to as *speculative processes* because they respond to speculated (or forecasted) rather than actual demand. The *push/pull boundary* in a supply chain separates push processes from pull processes as shown in Figure 1-5. Push processes operate in an uncertain environment because customer demand is not yet known. Pull processes operate in an environment in which customer demand is known. They are, however, often constrained by inventory and capacity decisions that were made in the push phase.

Let us compare a make-to-stock environment like that of L.L.Bean and a build-to-order environment like that of Dell to compare the push/pull view and the cycle view.

L.L.Bean executes all processes in the customer order cycle *after* the customer arrives. All processes that are part of the customer order cycle are thus pull processes. Order fulfillment takes place from product in inventory that is built up in anticipation of customer orders. The goal of the replenishment cycle is to ensure product availability when a customer order arrives. All processes in the replenishment cycle are performed in anticipation of demand and are thus push processes. The same holds true for processes in the manufacturing and procurement cycle. In fact, raw material such as

FIGURE 1-5 Push/Pull View of the Supply Chain



fabric is often purchased six to nine months before customer demand is expected. Manufacturing itself begins three to six months before the point of sale. The processes in the L.L.Bean supply chain break up into pull and push processes, as shown in Figure 1-6.

The situation is different for a build-to-order computer manufacturer like Dell. Dell does not sell through a reseller or distributor but directly to the consumer. Demand is not filled from finished-product inventory, but from production. The arrival of a customer order triggers production of the product. The manufacturing cycle is thus

FIGURE 1-6 Push/Pull Processes for the L.L.Bean Supply Chain

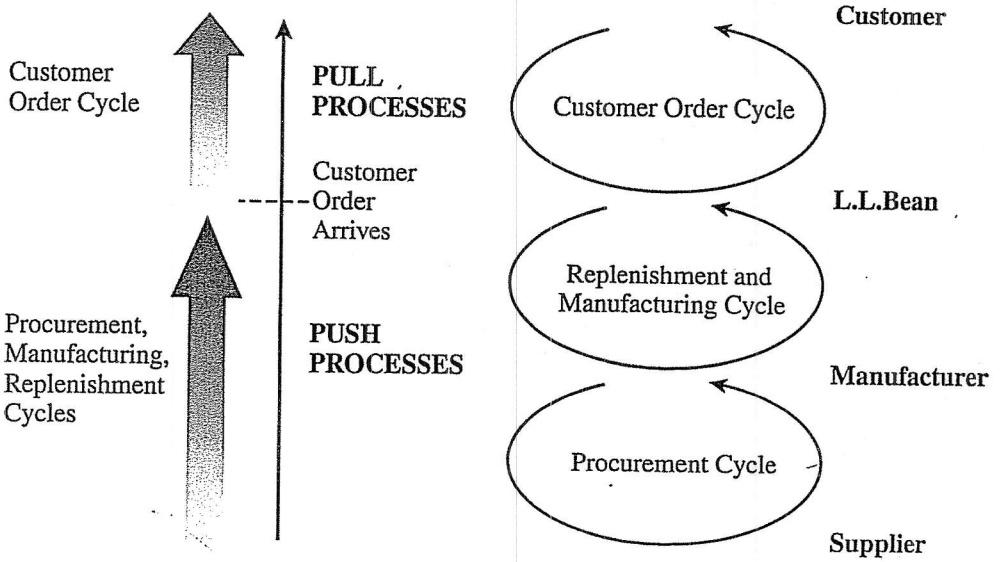
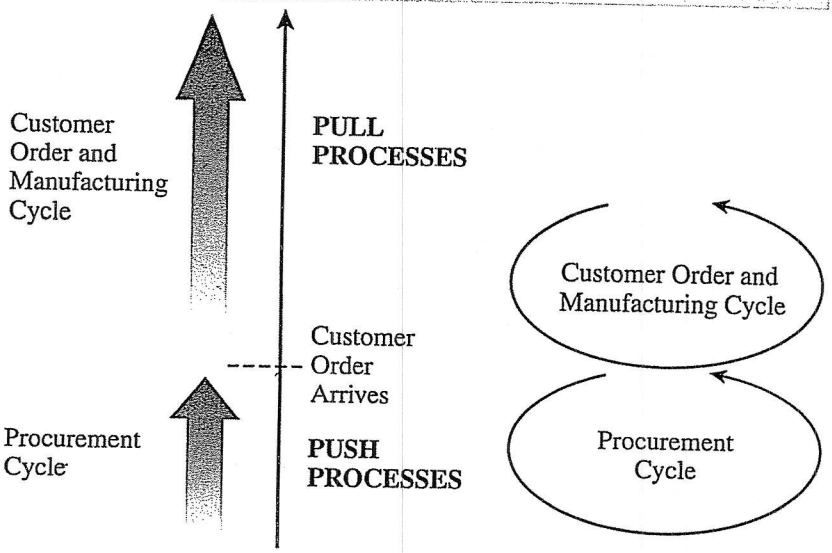


FIGURE 1-7 Push/Pull Processes for Dell Supply Chain



part of the customer order fulfillment process in the customer order cycle. There are effectively only two cycles in the Dell supply chain: (1) a customer order and manufacturing cycle and (2) a procurement cycle, as shown in Figure 1-7.

All processes in the customer order and manufacturing cycle at Dell are thus classified as pull processes because they are initiated by customer arrival. Dell, however, does not place component orders in response to a customer order. Inventory is replenished in anticipation of customer demand. All processes in the procurement cycle for Dell are thus classified as push processes, because they are in response to a forecast. The processes in the Dell supply chain break up into pull and push processes as shown in Figure 1-7.

A push/pull view of the supply chain is very useful when considering strategic decisions relating to supply chain design. The goal is to identify an appropriate push/pull boundary such that the supply chain can match supply and demand effectively.

The paint industry provides another excellent example of the gains from suitably adjusting the push/pull boundary. The manufacture of paint requires production of the base, mixing of suitable colors, and packing. Until the 1980s, all these processes were performed in large factories and paint cans were shipped to stores. These qualified as push processes, as they were performed to a forecast in anticipation of customer demand. Given the uncertainty of demand, the paint supply chain had great difficulty matching supply and demand. In the 1990s, paint supply chains were restructured such that mixing of colors was done at retail stores after customers placed their orders. In other words, color mixing was shifted from the push to the pull phase of the supply chain even though base preparation and packing of cans was still performed in the push phase. The result is that customers are always able to get the color of their choice, while total paint inventories across the supply chain have declined.

KEY POINT A push/pull view of the supply chain categorizes processes based on whether they are initiated in response to a customer order (pull) or in anticipation of a customer order (push). This view is very useful when considering strategic decisions relating to supply chain design.

SUPPLY CHAIN MACRO PROCESSES IN A FIRM

All supply chain processes discussed in the two process views and throughout this book can be classified into the following three macro processes as shown in Figure 1-8.

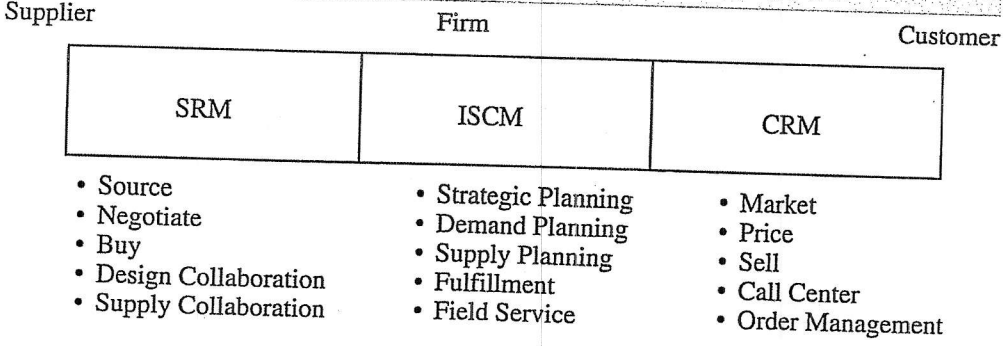
1. ***Customer Relationship Management (CRM):*** All processes that focus on the interface between the firm and its customers
2. ***Internal supply chain management (ISCM):*** All processes that are internal to the firm
3. ***Supplier Relationship Management (SRM):*** All processes that focus on the interface between the firm and its suppliers

The three macro processes manage the flow of information, product, and funds required to generate, receive, and fulfill a customer request. The CRM macro process aims to generate customer demand and facilitate the placement and tracking of orders. It includes processes such as marketing, pricing, sales, order management, and call center management. At an industrial distributor such as W.W. Grainger, CRM processes include the preparation of catalogs and other marketing materials, management of the Web site, and management of the call center that takes orders and provides service. The ISCM macro process aims to fulfill demand generated by the CRM process in a timely manner and at the lowest possible cost. ISCM processes include the planning of internal production and storage capacity, preparation of demand and supply plans, and fulfillment of actual orders. At W.W. Grainger, ISCM processes include planning for the location and size of warehouses; deciding which products to carry at each warehouse; preparing inventory management policies; and picking, packing, and shipping actual orders. The SRM macro process aims to arrange for and manage supply sources for various goods and services. SRM processes include the evaluation and selection of suppliers, negotiation of supply terms, and communication regarding new products and orders with suppliers. At W.W. Grainger, SRM processes include the selection of suppliers for various products, negotiation of pricing and delivery terms with suppliers, sharing of demand and supply plans with suppliers, and the placement of replenishment orders.

All three supply chain macro processes and their component processes are shown in Figure 1-8.

Observe that all three macro processes are aimed at serving the same customer. For a supply chain to be successful, it is crucial that the three macro processes are well integrated. The importance of this integration is discussed in Chapters 16 and 17. The organizational structure of the firm has a strong influence on the success or failure of the integration effort. In many firms, marketing is in charge of the CRM macro process, manufacturing handles the ISCM macro process, and purchasing oversees the SRM macro process—with very little communication among them. It is not unusual for

FIGURE 1-8 Supply Chain Macro Processes



marketing and manufacturing to have two different forecasts when making their plans. This lack of integration hurts the supply chain's ability to match supply and demand effectively, leading to dissatisfied customers and high costs. Thus, firms should structure a supply chain organization that mirrors the macro processes and ensures good communication and coordination among the owners of processes that interact with each other.

KEY POINT Within a firm, all supply chain activities belong to one of three macro processes: CRM, ISCM, and SRM. Integration among the three macro processes is crucial for successful supply chain management.

1.6 EXAMPLES OF SUPPLY CHAINS

In this section, we consider several supply chains and raise questions that must be answered during the design, planning, and operation phases of these supply chains. In later chapters, we discuss concepts and present methodologies that can be used to answer these questions.

GATEWAY: A DIRECT SALES MANUFACTURER

Gateway is a manufacturer of PCs that was founded in 1985 and started as a direct sales manufacturer with no retail footprint. In 1996, Gateway was one of the first PC manufacturers to start selling PCs online. Over the years Gateway expanded its operations worldwide, with sales and manufacturing presence in Europe and Asia Pacific. In 1999, the company had three plants in the United States, a plant in Ireland, and one in Malaysia.

In the late 1990s, Gateway introduced an aggressive strategy of opening Gateway retail stores throughout the United States. By January 2002, Gateway had approximately 280 retail stores in the United States. Gateway's strategy was to avoid carrying any finished-goods inventory at the retail stores and simply use these stores for customers to try the PCs and obtain help in deciding on the right configuration to purchase. When customers placed their order, PCs were manufactured to order and shipped from one of the assembly plants.

Initially, investors rewarded Gateway for this strategy and raised the stock price to more than $80 per share in late 1999. However, this success did not last. By November 2002, Gateway shares had dropped to less than $4 and Gateway was losing a significant amount of money. Plants in Salt Lake City, Ireland, and Malaysia were shut. By April 2004, Gateway had closed all its retail outlets and reduced the number of configurations offered to customers. The company was looking to sell its PCs through electronics retailers such as Best Buy and Circuit City. As you can imagine, this was quite a transition for the company to experience.

The following questions highlight supply chain decisions that have a bearing on Gateway's performance:

1. Why did Gateway have multiple production facilities in the United States? In the last few years Dell has also increased the number of facilities in the United States to four. What advantages or disadvantages does increasing the number of production facilities offer? How does Gateway decide which production facility will produce and ship a customer order?
2. What factors did Gateway consider when deciding which plants to close?

3. Why did Gateway choose not to carry any finished-product inventory at its retail stores?
4. Should a firm with an investment in retail stores carry any finished-goods inventory? What are the characteristics of products that are most suitable to be carried in finished-goods inventory? What characterizes products that are best manufactured to order?
5. Is the Dell model of selling directly without retail stores always less expensive than a supply chain with retail stores?
6. What are the supply chain implications of Gateway's decision to offer fewer configurations?

ZARA: APPAREL MANUFACTURING AND RETAIL

Zara is a chain of fashion stores owned by Inditex, Spain's largest apparel manufacturer and retailer. In 2004, Inditex reported sales of 13 billion euros from more than 2,200 retail outlets in 56 countries. The company opened a new store for each day in 2004. In an industry in which customer demand is fickle, Zara has grown rapidly with a strategy to be highly responsive to changing trends with affordable prices. Whereas design-to-sales cycle times in the apparel industry have traditionally averaged more than six months, Zara has achieved cycle times of five to six weeks. This speed allows Zara to introduce new designs every week and to change 75 percent of its merchandise display every three to four weeks. Thus, Zara's products on display match customer preferences much more closely than the competition. The result is that Zara sells most of its products at full price and has about half the markdowns in its stores compared to the competition.

Zara manufactures its apparel using a combination of flexible and quick sources in Europe (mostly Portugal and Spain) and low-cost sources in Asia. This contrasts with most apparel manufacturers, who have moved most of their manufacturing to Asia. About 40 percent of the manufacturing capacity is owned by Inditex, with the rest outsourced. Products with highly uncertain demand are sourced out of Europe, whereas products that are more predictable are sourced from its Asian locations. More than 40 percent of its finished-goods purchases and most of its in-house production occur after the sales season starts. This compares with less than 20 percent production after the start of a sales season for a typical retailer. This responsiveness and the postponement of decisions until after trends are known allow Zara to reduce inventories and forecast error. Zara has also invested heavily in information technology to ensure that the latest sales data are available to drive replenishment and production decisions.

Until 2002, Zara centralized all its European distribution and some of its global distribution through a single distribution center (DC) in Spain. It also had some smaller satellite DCs in Latin American countries. Shipments from the DCs to stores were made twice a week. This allowed store inventory to closely match customer demand. As Zara has grown, it has built another distribution center in Spain.

The following questions raise supply chain issues that are central to Zara's strategy and success:

1. What advantage does Zara gain against the competition by having a very responsive supply chain?
2. Why has Inditex chosen to have both in-house manufacturing and outsourced manufacturing? Why has Inditex maintained manufacturing capacity in Europe even though manufacturing in Asia is much cheaper?
3. Why does Zara source products with uncertain demand from local manufacturers and products with predictable demand from Asian manufacturers?

4. Why is Zara building a new distribution center as its sales grow? Is it better to have the new distribution center near the existing one, or at a completely different location?
5. What advantage does Zara gain from replenishing its stores twice a week compared to a less frequent schedule? How does the frequency of replenishment affect the design of its distribution system?
6. What information infrastructure does Zara need in order to operate its production, distribution, and retail network effectively?

W.W. GRAINGER AND McMASTER-CARR: MRO SUPPLIERS

W.W. Grainger and McMaster-Carr sell maintenance, repair, and operations (MRO) products. Both companies have catalogs, as well as Web pages through which orders can be placed. W.W. Grainger also has several hundred stores throughout the United States. Customers can walk into a store, call in an order, or place it via the Web. W.W. Grainger orders are either shipped to the customer or picked up by the customer at one of its stores. McMaster-Carr, on the other hand, ships almost all its orders (though a few customers near its DCs do pick up their own orders). W.W. Grainger has nine DCs that both replenish stores and fill customer orders. McMaster has DCs from which all orders are filled. Neither McMaster nor W.W. Grainger manufactures any product. They primarily serve the role of a distributor or retailer. Their success is largely linked to their supply chain management ability.

Both firms offer several hundred thousand products to their customers. Each firm stocks more than 100,000 products, with the rest being obtained from the supplier as needed. Both firms face the following strategic and operational issues:

1. How many DCs should be built and where should they be located?
2. How should product stocking be managed at the DCs? Should all DCs carry all products?
3. What products should be carried in inventory and what products should be left with the supplier?
4. What products should W.W. Grainger carry at a store?
5. How should markets be allocated to DCs in terms of order fulfillment? What should be done if an order cannot be completely filled from a DC? Should there be specified backup locations? How should they be selected?
6. How should replenishment of inventory be managed at the various stocking locations?
7. How should Web orders be handled relative to the existing business? Is it better to integrate the Web business with the existing business or to set up separate distribution?
8. What transportation modes should be used for order fulfillment and stock replenishment?

TOYOTA: A GLOBAL AUTO MANUFACTURER

Toyota Motor Corporation is Japan's top auto manufacturer and has experienced significant growth in global sales over the last two decades. A key issue facing Toyota is the design of its global production and distribution network. Part of Toyota's global strategy is to open factories in every market it serves. Toyota must decide what the production capability of each of the factories will be, as this has a significant impact on the desired distribution system. At one extreme, each plant can be equipped only for local production. At the other extreme, each plant is capable of supplying every market.

Prior to 1996, Toyota used specialized local factories for each market. After the Asian financial crisis in 1996/1997, Toyota redesigned its plants so that it can also export to markets that remain strong when the local market weakens. Toyota calls this strategy "global complementation."

Whether to be global or local is also an issue for Toyota's parts plants. Should they be designed for local consumption or should there be few parts plants globally that supply multiple assembly plants? For any global manufacturer like Toyota, one must address the following questions regarding the configuration and capability of the supply chain:

1. Where should the plants be located and what degree of flexibility should be built into each? What capacity should each plant have?
2. Should plants be able to produce for all markets or only specific contingency markets?
3. How should markets be allocated to plants and how frequently should this allocation be revised?
4. What kind of flexibility should be built into the distribution system?
5. How should this flexible investment be valued?
6. What actions may be taken during product design to facilitate this flexibility?

AMAZON.COM: AN E-BUSINESS

Amazon.com sells books, music, and other items over the Internet and is one of the pioneers of consumer e-business. Amazon, based in Seattle, started by filling all orders using books purchased from a distributor in response to customer orders. This practice differs from that of a traditional bookstore, which usually purchases directly from publishers and stocks books in anticipation of customer orders. Today, Amazon has six warehouses where it holds inventory. Amazon stocks best-selling books, though it still gets other titles from distributors or publishers. It uses the U.S. Postal Service and other package carriers such as UPS and FedEx to send books to customers.

Amazon has continued to expand the set of products that it sells online. Besides books and music, Amazon has added many product categories such as toys, apparel, electronics, jewelry, and shoes. After several years of losses, Amazon has been profitable since 2003.

Several brick-and-mortar players including traditional booksellers such as Borders and Barnes & Noble have also started selling using the Internet channel. Barnes & Noble has set up Barnes&Noble.com as a separate company, whereas Borders uses Amazon to fulfill its online orders, after initially trying to operate an online business. In the case of Barnes & Noble, the retail store and the online supply chains share warehousing and transportation to some extent. This is a departure from the company's original strategy, when Barnes&Noble.com was not visible in any Barnes & Noble bookstore.

Several questions arise concerning how Amazon is structured and how traditional booksellers have responded:

1. Why is Amazon building more warehouses as it grows? How many warehouses should it have and where should they be located?
2. What advantages does selling books via the Internet provide over a traditional bookstore? Are there any disadvantages to selling via the Internet?
3. Should Amazon stock every book it sells?
4. What advantage can brick-and-mortar players derive from setting up an online channel? How should they use the two channels to gain maximum advantage?

5. Should traditional booksellers like Barnes and Noble integrate e-commerce into their current supply chain or manage it as a separate supply chain?
6. For what products does the e-commerce channel offer the greatest advantage? What characterizes these products?

1.7 SUMMARY OF LEARNING OBJECTIVES

1. Discuss the goal of a supply chain and explain the impact of supply chain decisions on the success of a firm.

   The goal of a supply chain should be to maximize overall supply chain profitability. Supply chain profitability is the difference between the revenue generated from the customer and the total cost incurred across all stages of the supply chain. Supply chain decisions have a large impact on the success or failure of each firm because they significantly influence both the revenue generated and the cost incurred. Successful supply chains manage flows of product, information, and funds to provide a high level of product availability to the customer while keeping costs low.
2. Identify the three key supply chain decision phases and explain the significance of each one.

   Supply chain decisions may be characterized as strategic (design), planning, or operational, depending on the time period during which they apply. Strategic decisions relate to supply chain configuration. These decisions have a long-term impact lasting several years. Planning decisions cover a period of a few months to a year and include decisions such as production plans, subcontracting, and promotions over that period. Operational decisions span from minutes to days and include sequencing production and filling specific orders. Strategic decisions define the constraints for planning decisions, and planning decisions define the constraints for operational decisions.
3. Describe the cycle and push/pull views of a supply chain.

   A cycle view of a supply chain divides processes into cycles, each performed at the interface between two successive stages of a supply chain. Each cycle starts with an order placed by one stage of the supply chain and ends when the order is received from the supplier stage. A push/pull view of a supply chain characterizes processes based on their timing relative to that of a customer order. Pull processes are performed in response to a customer order, whereas push processes are performed in anticipation of customer orders.
4. Classify the supply chain macro processes in a firm.

   All supply chain processes can be classified into three macro processes based on whether they are at the customer or supplier interface or are internal to the firm. The CRM macro process consists of all processes at the interface between the firm and the customer that work to generate, receive, and track customer orders. The ISCM macro process consists of all supply chain processes that are internal to the firm and work to plan for and fulfill customer orders. The SRM macro process consists of all supply chain processes at the interface between the firm and its suppliers that work to evaluate and select suppliers and then source goods and services from them.

Discussion Questions

1. Consider the purchase of a can of soda at a convenience store. Describe the various stages in the supply chain and the different flows involved.
2. Why should a firm like Dell take into account total supply chain profitability when making decisions?
3. What are some strategic, planning, and operational decisions that must be made by an apparel retailer like The Gap?

4. Consider the supply chain involved when a customer purchases a book at a bookstore. Identify the cycles in this supply chain and the location of the push/pull boundary.
5. Consider the supply chain involved when a customer orders a book from Amazon. Identify the push/pull boundary and two processes each in the push and pull phases.
6. In what way do supply chain flows affect the success or failure of a firm like Amazon? List two supply chain decisions that have a significant impact on supply chain profitability.

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