THIRD EDITION

SUPPLY CHAIN MANAGEMENT

Strategy, Planning, and Operation

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DEDICATION

I would like to thank my colleagues at Kellogg for all that I have learned from them about logistics and supply chain management. I am grateful for the love and encouragement my parents, Krishan and Pushpa, and sisters, Sudha and Swati, have always provided during every endeavor in my life. I thank my children, Ravi and Rajiv, for the joy they have brought me. Finally, none of this would have been possible without the constant love, caring, and support of my wife, Maria Cristina.

Sunil Chopra

I would like to thank three mentors—Sunil Chopra, Hau Lee, and Gerry Lieberman—who have taught me a great deal. Thank you also to my parents and sister for their love, and to my sons, Jamie and Eric, for making me smile and teaching me what life is truly all about. Most important, I thank my wife, Sarah, who makes life wonderful and whom I love with all of my heart.

Pete Meindl

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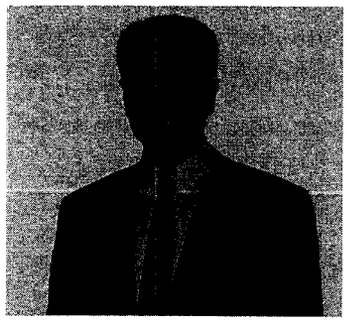

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The first edition of this book won the prestigious Book of the Year award in 2001 from the Institute of Industrial Engineers.

BRIEF CONTENTS

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PREFACE

This book is targeted toward an academic as well as a practitioner audience. On the academic side, it should be appropriate for MBA students, engineering master's students, and senior undergraduate students interested in supply chain management and logistics. It should also serve as a suitable reference for both concepts as well as methodology for practitioners in consulting and industry.

The book has grown from a course on supply chain management taught to second-year MBA students at the Kellogg School of Management at Northwestern University. The goal of this class was to cover not only high-level supply chain strategy and concepts, but also to give students a solid understanding of the analytical tools necessary to solve supply chain problems. With this class goal in mind, our objective was to create a book that would develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Analytic methodologies for supply chain analysis

Our first objective in this book is for the reader to learn the strategic importance of good supply chain design, planning, and operation for every firm. The reader will be able to understand how good supply chain management can be a competitive advantage, whereas weaknesses in the supply chain can hurt the performance of a firm. We use many examples to illustrate this idea and develop a framework for supply chain strategy.

Within the strategic framework, we identify facilities, inventory, transportation, information, sourcing, and pricing as the key drivers of supply chain performance. Our second goal in the book is to convey how these drivers may be used on a conceptual and practical level during supply chain design, planning, and operation to improve performance. We have included a case on Seven-Eleven Japan that can be used to illustrate how the company uses various drivers to improve supply chain performance. For each driver of supply chain performance, our goal is to provide readers with practical managerial levers and concepts that may be used to improve supply chain performance.

Utilizing these managerial levers requires knowledge of analytic methodologies for supply chain analysis. Our third goal is to give the reader an understanding of these methodologies. Every methodological discussion is illustrated with its application in Excel. In this discussion, we also stress the managerial context in which they are used and the managerial levers for improvement that they support.

The strategic frameworks and concepts discussed in the book are tied together through a variety of examples that show how a combination of concepts is needed to achieve significant increases in performance.

CHANGES TO THE THIRD EDITION

The third edition has several changes that we believe significantly improve the book.

- After much thought on how supply chain management has changed and expanded over the past several years, we have expanded the collection of supply chain drivers from four to six, with the new additions being the cross-functional drivers of sourcing and pricing. Both sourcing and pricing were covered in the earlier editions, but we felt that the framework was more complete with each being considered as a driver. The supply chain drivers are a structure that appears throughout the book, so making this change—and thus changing much of the structure of the book—is, we believe, a major improvement. As supply chain management has become more and more about relationships among different enterprises in the supply chain, we feel it is only natural to include these two new drivers that encompass significant processes with both upstream and downstream supply chain partners.
- Along with the expansion of the supply chain drivers comes a fuller treatment of the two new drivers, sourcing and pricing. The chapters on sourcing and pricing have increased depth, with particular emphasis on improvement and expansion of the sourcing chapter. Included in this expansion are new discussions on such important issues as how to determine whether to perform functions in-house or to outsource them as well as discussion of the services offered by various types of logistics providers. This adds a great deal of richness to the discussion of our new drivers, which we believe is necessary given their importance in the supply chain.

Supply chain metrics are crucial in monitoring a supply chain's performance and in helping to improve that performance.

- To this end, we have added a significant section to Chapter 3 on supply chain metrics. Without supply chain metrics, it is very difficult to implement supply chain changes effectively. With this new material, we hope readers will come away with an understanding of what ought to be measured and why it is important to do so. These metrics show up in the following chapters as we discuss each driver, so the reader can understand the importance of using the metric and how the metric can be improved.

In the previous editions, we combined virtually all of our discussion of the use of information technology into a chapter with that specific focus.

- We still have an IT chapter in this edition, but we have made a significant change by adding IT-focused sections within individual chapters that address IT issues specific to the realm on which the particular chapter focuses. We believe this more integrated view of IT better portrays the importance of IT and its permeation through virtually all supply chain functions.
- Similar to the IT sections within many of the chapters, we have also added sections in many chapters focused on supply chain risk. In the past, we mentioned supply chain risk in various discussions, but we believe it is such an important topic that it deserves more attention than it received. As with the IT sections, each risk section is focused on risk factors pertaining to the topic on which the chapter focuses, thus giving readers a more integrated view of all factors affecting decisions within the area of the chapter topic.
- We have also moved the content from the e-business chapter into other chapters, most notably into Chapter 4 on distribution networks. As before, we believe this presents a more integrated view of the supply chain issues one must grapple with and thus is a worthwhile change.

- Finally, we have added two cases that can be used to discuss the strategic framework as well as supply chain network design.

FOR INSTRUCTORS

For adopters of this edition we have provided the following:

- An instructor Solutions Manual in Word, with solutions spreadsheets provided in Excel. Each of the end-of-chapter problems has been carefully solved by Srinivas Talluri of Michigan State University. Where applicable, the Excel and Word solutions are both provided. These files may be downloaded from http://prenhall.com/irc.
- An Instructor Manual, containing sample syllabi and chapter lecture notes, is available in Word and may be downloaded from http://www.prenhall.com/irc.
- PowerPoint Presentation Files for each chapter of the text are available and may be downloaded from http://www.prenhall.com/irc.

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We are grateful to the students at the Kellogg School of Management who suffered through typo-ridden drafts of earlier versions of the book. Specifically, we thank Christoph Roettelle and Vikas Vats for carefully reviewing several chapters and solving problems at the end of the chapters in early editions. We thank Srinivas Talluri of Michigan State University for his tremendous help in preparing the instructor's manual, instructor's solutions manual, and PowerPoint files for the current edition. We would also like to thank our editors, Mark Pfaltzgraff and Alana Bradley, and the staff at Prentice Hall, including Melissa Feimer, Production Editor, Debbie Clare, Executive Marketing Manager, and Barbara Witmer, Editorial Assistant, for their efforts with the book. Finally, we would like to thank you, our readers, for reading and using this book. We hope it contributes to all of your efforts to improve the performance of companies and supply chains throughout the world.

We would be pleased to hear your comments and suggestions for future editions of this text.

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PART I

BUILDING A STRATEGIC FRAMEWORK TO ANALYZE SUPPLY CHAINS

The goal of the three chapters in Part I is to provide a strategic framework to analyze the design, planning, and operational decisions within supply chains. Such a framework helps clarify supply chain goals and identify managerial actions that improve supply chain performance in terms of the desired goals.

Chapter 1 defines a supply chain and establishes the impact that supply chain decisions have on a firm's performance. A variety of examples are used to illustrate supply chain decisions, their influence on performance, and their role in a firm's competitive strategy. Chapter 2 describes the relationship between supply chain strategy and the competitive strategy of a firm and emphasizes the importance of ensuring that strategic fit exists between the two strategies. The chapter also discusses how expanding the scope of strategic fit across all functions and stages within the supply chain improves performance. Chapter 3 describes the major drivers of supply chain performance: facilities, inventory, transportation, information, sourcing, and pricing. Key decisions and metrics related to each driver are identified and linked to a company's ability to support its competitive strategy.

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.

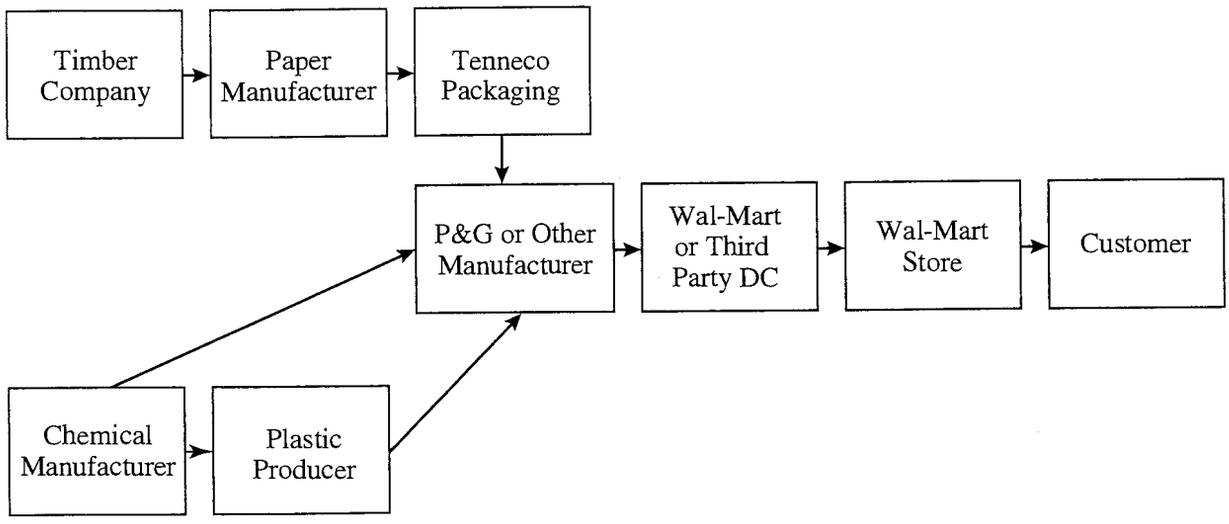
In this chapter, we provide a conceptual understanding of what a supply chain is and the various issues that need to be considered when designing, planning, or operating a supply chain. We discuss the significance of supply chain decisions and supply chain performance for the success of a firm. We also 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.

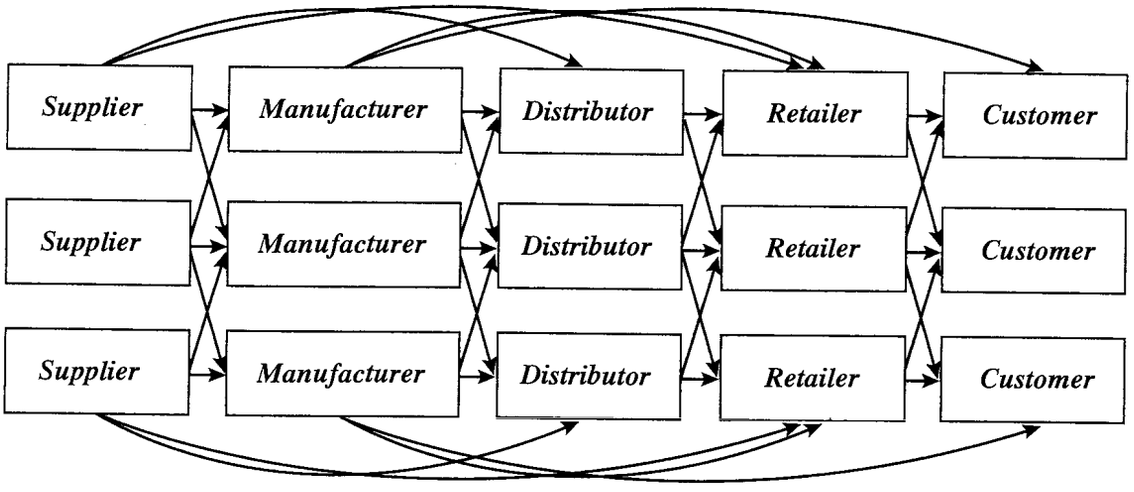
In another example, when a customer makes a purchase online from Dell Computer, the supply chain includes, among others, the customer, Dell's Web site, the Dell assembly plant, and all of Dell's suppliers and their suppliers. The Web site provides the customer with information regarding pricing, product 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.

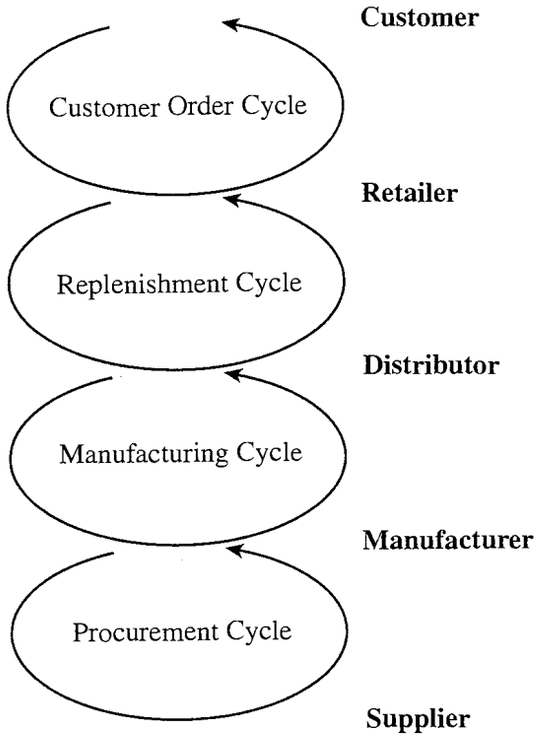


FIGURE 1-3 Supply Chain Process Cycles

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.

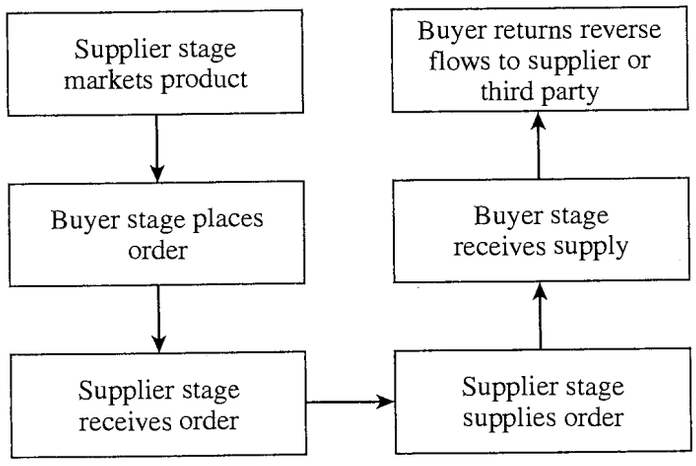


FIGURE 1-4 Subprocesses in Each Supply Chain Process Cycle

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.

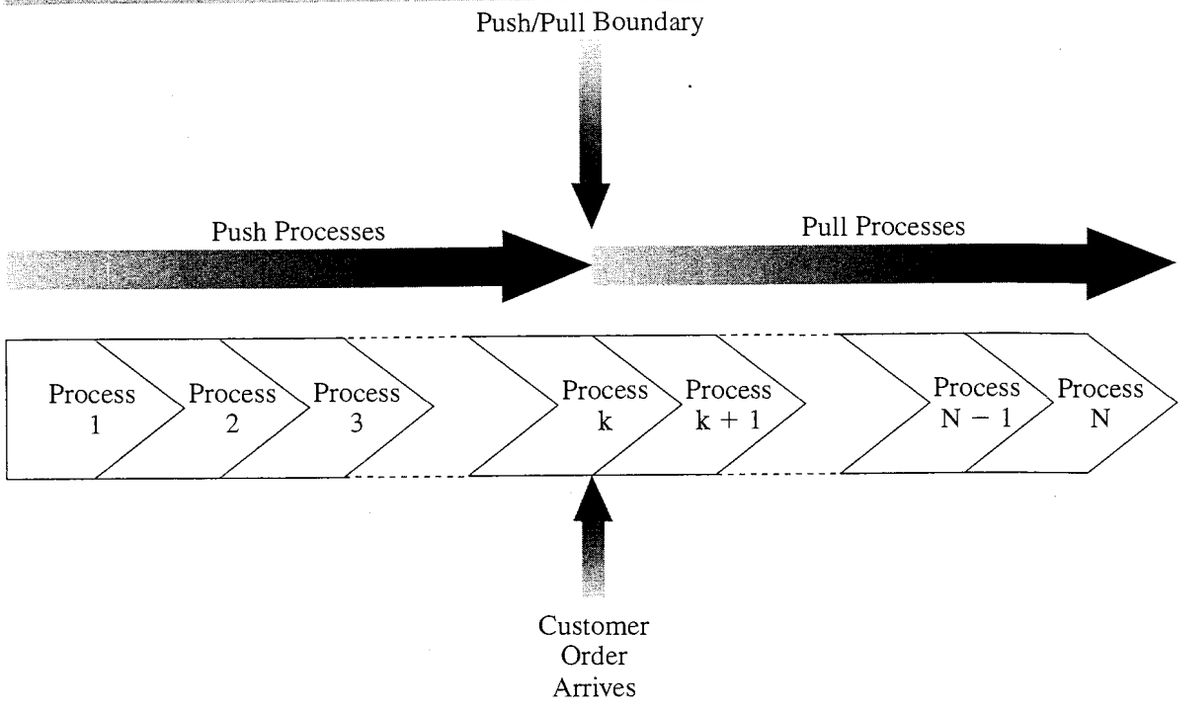
PUSH/PULL VIEW OF SUPPLY CHAIN PROCESSES

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

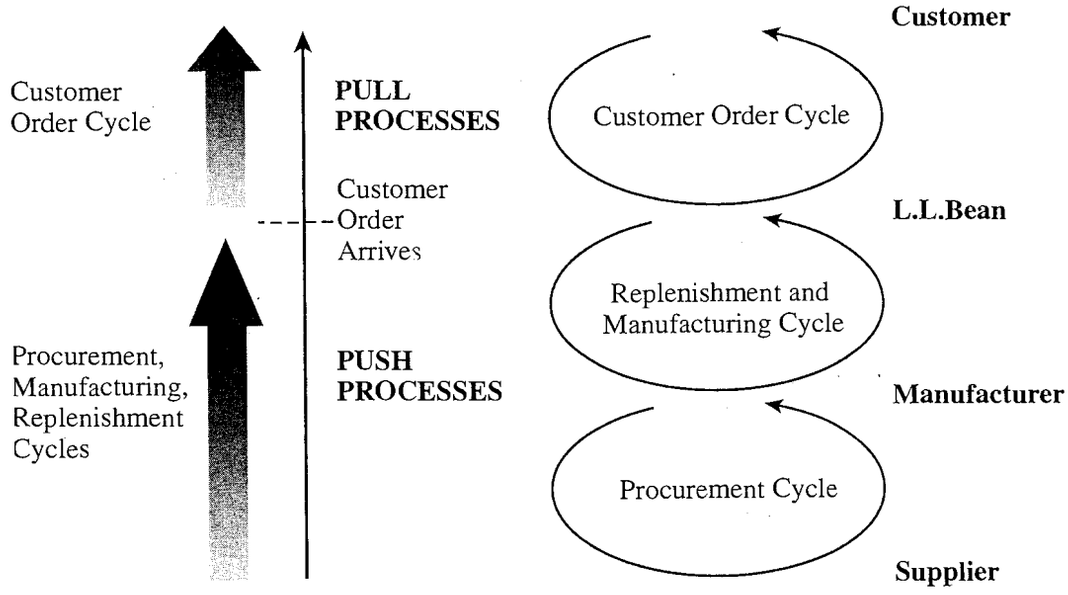
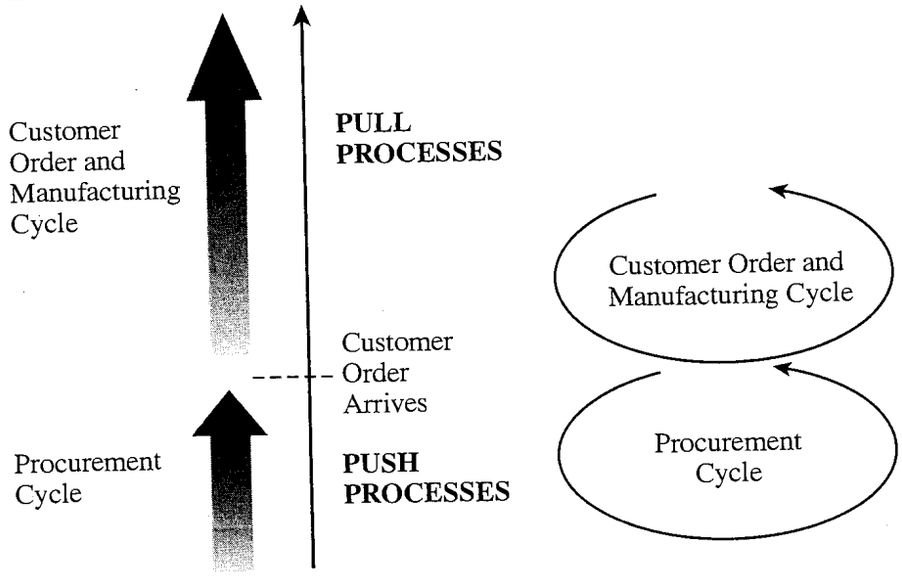


FIGURE 1-7 Push/Pull Processes for Dell Supply Chain



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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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.

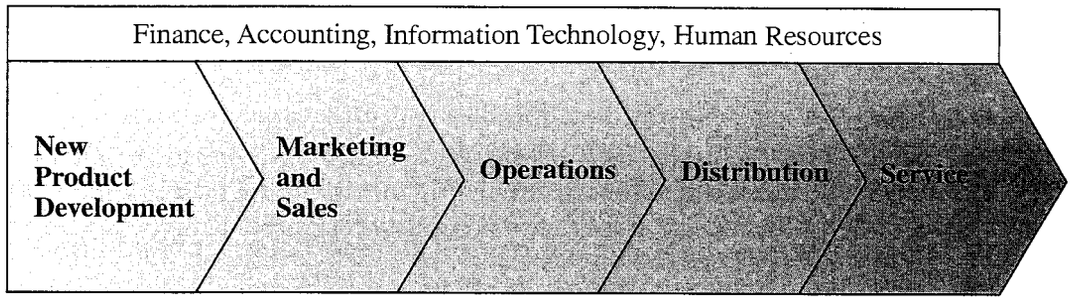
In Chapter 1, we discuss what a supply chain is and the importance of supply chain design, planning, and operation to a firm's success. In this chapter, we define supply chain strategy and explain how creating a strategic fit between a company's competitive strategy and its supply chain strategy affects 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, Wal-Mart aims to provide high availability of a variety of products of reasonable quality at low prices. Most products sold at Wal-Mart are commonplace (everything from home appliances to clothing) and can be purchased elsewhere. What Wal-Mart provides is a low price and product availability. McMaster-Carr sells maintenance, repair, and operations (MRO) products. It offers more than 400,000 different products through both a catalog and a Web site. 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 Wal-Mart is different from that at McMaster.

We can also contrast Dell, with its build-to-order model, with a firm like Gateway selling eMachines PCs through retailers. Dell has stressed customization and variety at a reasonable cost, with customers having to wait approximately one week to get their product. In contrast, a customer can walk into a computer retailer, be helped by a salesperson, and leave the same day with an eMachines computer. The amount of variety and customization available at the retailer, however, is limited. 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 Wal-Mart customer, in contrast,

FIGURE 2-1 The Value Chain in a Company



places greater emphasis on cost. A Dell customer, purchasing online, places great emphasis on product variety and customization. A customer purchasing an eMachines PC at a retailer is most concerned with price, 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. Using new product specifications, operations transforms inputs to outputs to create the product. 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. Given that firms are rarely completely vertically integrated, it is important to recognize that the supply chain strategy defines not only what processes within the firm should do well but also what the role played by each supply chain entity is. For example, Cisco's supply chain strategy calls for most component manufacturing and assembly to be outsourced. In this case, Cisco's supply chain strategy identifies not just what Cisco should do well but also the role of each third party to which supply chain tasks are 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 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 decision to sell direct, Gateway's 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.

The value chain emphasizes the close relationship between the functional strategies within a company. Each function is crucial if a company is to satisfy customer needs profitably. Thus, the various functional strategies cannot be formulated in isolation. They are closely intertwined and must fit and support each other if a company is to succeed.

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 service 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

This chapter is built on the idea that for any company to be successful, its supply chain strategy and competitive strategy must fit together. *Strategic fit* means that both the competitive and supply chain strategies 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. The issue of achieving strategic fit is a key consideration during the supply chain strategy or design phase discussed in Chapter 1.

All processes and functions that are part of a company's value chain contribute to its success or failure. These processes and functions do not operate in isolation; no one process or function can ensure the chain's success. Failure at any one process or function, however, may lead to failure of the overall chain. A company's success or failure is thus closely linked to the following keys:

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. In thinking of the major tasks of a chief executive officer (CEO), there are few greater than the job of aligning the supply chain design and all of the core functional strategies with the overall competitive strategy to achieve strategic fit. If this alignment is not achieved, conflicts arise between different functional goals within the firm, or between the goals of different supply chain stages. Such conflicts result in different functions within the firm and stages across the supply chain targeting different customer priorities. This conflict within the firm or across the supply chain leads to conflicts during supply chain operation.

Consider, for example, a situation in which marketing is publicizing a company's ability to provide a large variety of products very quickly; simultaneously, distribution is targeting the lowest cost means of transportation. In this situation, it is very 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 where 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 return to the example of Dell Computer from Chapter 1. Dell's competitive strategy is to provide a large variety of customizable products at a reasonable price. Its customers can select from among thousands of possible PC configurations. In terms of supply chain strategy, a PC manufacturer has a range of options. At one extreme, a company can have an efficient supply chain with a focus on the ability to produce low-cost PCs by limiting variety and exploiting economies of scale. At the other extreme, a company can have a highly flexible and responsive supply chain that is very good at producing a large variety of products. In this second case, costs will be higher than in an efficient supply chain. Both supply chain strategies are viable by themselves, but do not necessarily fit with Dell's competitive strategy. A supply chain strategy that emphasizes flexibility and responsiveness has a better strategic fit with Dell's competitive strategy of providing a large variety of customizable products.

This notion of fit also extends to Dell's other functional strategies. For instance, its new product development strategy should emphasize designing products that are easily customizable, which may include designing common platforms across several products and the use of common components. Dell products use common components and are designed to be assembled quickly. This feature allows Dell to assemble customized PCs quickly in response to a customer order. The design of new products at Dell supports the supply chain's ability to assemble customized PCs in response to customer orders. This capability, in turn, supports Dell's strategic goal of offering customization to its customers. Dell has clearly achieved strong strategic fit among its different functional strategies and its competitive strategy. The notion of fit also extends to other stages in the Dell supply chain. Given that Dell provides a high degree of customization while operating with low levels of inventory, it is crucial that its suppliers and carriers be responsive. For example, the ability of carriers to merge a PC from Dell with a

monitor from Sony allows Dell not to carry any Sony monitors in inventory. Dell has tried to achieve this alignment of capabilities across the supply chain.

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 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 the supply chain faces in satisfying these needs. 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, disruption, and delay that the supply chain must be prepared for.
2. ***Understanding the Supply Chain Capabilities:*** There are many types of supply chains, each of which 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 Wal-Mart). 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 very 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.

- ***The 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.
- ***The 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.
- ***The 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.
- ***The 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.

- ***The 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.
- ***The 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 Wal-Mart 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 the many 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 very fundamental sense, each customer need can be translated into the metric of implied demand uncertainty. *Implied demand uncertainty* is demand uncertainty due to the portion of demand that the supply chain is targeting, not the entire demand.

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 and 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 more disaggregate
Number of channels through which product may be acquired increases	Increase because the total customer demand is now disaggregated over more channels
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

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

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 high 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 very 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 palmtop computer has high implied demand uncertainty. It will likely have a high margin, very 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.

Another example is a circuit board supplier whose customers include two different types of PC manufacturers. One of its customers is a build-to-order PC manufacturer such as Dell that requires same-day lead times. In this case, the supplier might need to build up inventory or have very flexible manufacturing to be prepared for whatever demand Dell has that day. Forecast error and supplier inventories would be high; because of these factors, margins would likely be higher. The supplier's other customer builds a small variety of PCs and specifies in advance the number and type of PCs to be built. This information gives the supplier a longer lead time and reduces the forecasting errors and inventories. Thus, the supplier would likely get smaller margins from the latter PC manufacturer. These examples demonstrate that even with the same product, different customer segments can have different implied demand uncertainty given disparate service requirements.

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 PC industry, the quality yields of the production process tend to be low and breakdowns are frequent. As a result, companies have difficulty delivering according to a well-defined schedule, resulting in high supply uncertainty for PC manufacturers. As the production technology matures and yields improve, companies are able to follow a fixed delivery schedule, resulting in low

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 "Aligning Supply Chain Strategies with Product Uncertainties." Hau L. Lee, *California Management Review* (Spring 2002), 105–19.

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.

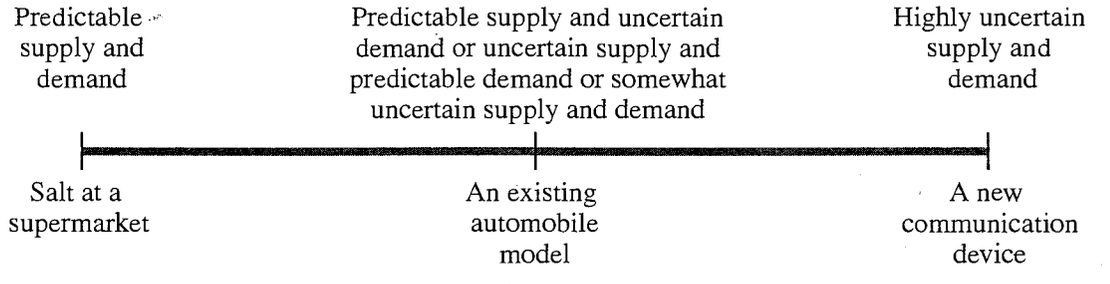
We can create a spectrum of uncertainty by combining the demand and supply uncertainty. This implied uncertainty spectrum is shown in Figure 2-2.

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 very 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 where supply chains face low levels of implied demand uncertainty but significant supply uncertainty based on weather. The supply chain thus has to face an intermediate level of implied uncertainty.

Several factors contribute risk to various portions of the supply chain and thus increase uncertainty. Throughout the book we will note the particular risks and discuss some ways that these risks can be mitigated.

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.

FIGURE 2-2 The Implied Uncertainty (Demand and Supply) 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 creating a supply chain strategy that best meets the demand a company has targeted given the uncertainty it faces.

We now consider the characteristics of supply chains and categorize them. Similar to the way we placed demand on a one-dimensional spectrum (the implied uncertainty spectrum), we will also place each supply chain on a spectrum. Like customer needs, supply chains have many 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. The efficient frontier represents the cost-responsiveness performance of the best supply chains. A

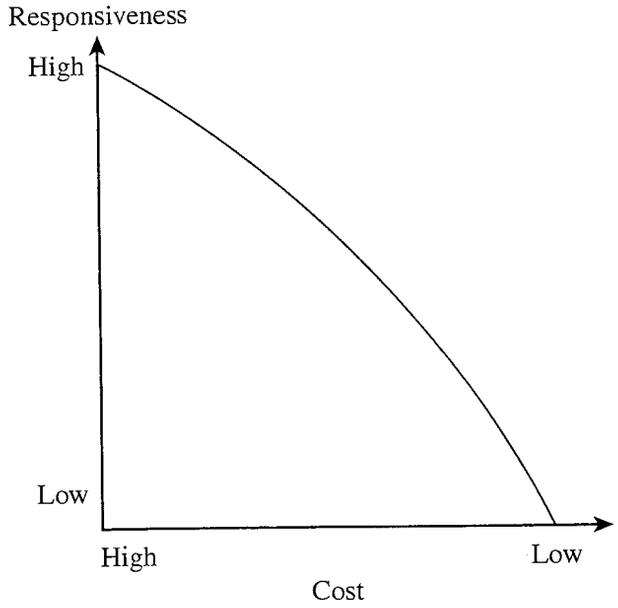
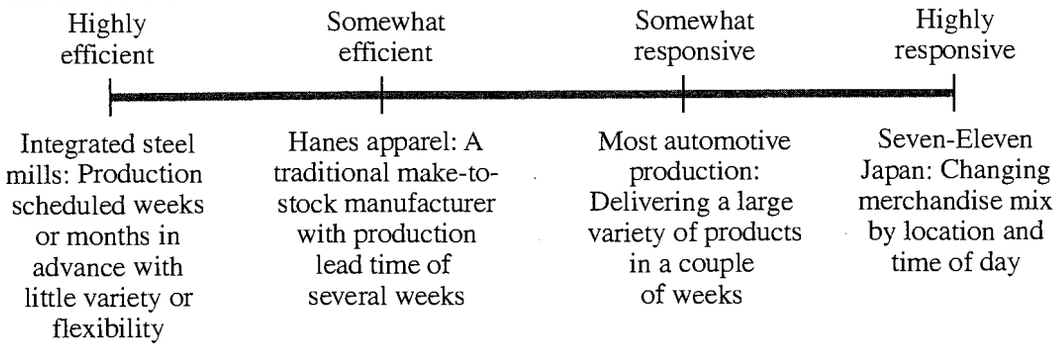


FIGURE 2-3
Cost-Responsiveness Efficient Frontier

FIGURE 2-4 The Responsiveness Spectrum



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.

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 very 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. The Dell supply chain allows a customer to customize any of several thousand PC configurations. Dell then delivers the appropriate PC to the customer within days. The Dell supply chain is also considered 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. 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 Dell targets customers who value having customized PCs delivered within days. Given the vast variety of PCs, the high level of innovation, and rapid delivery, demand from Dell customers can be characterized as having high demand uncertainty. Some supply uncertainty also exists, especially for newly introduced components. Dell has the option of designing an efficient or responsive supply chain. An efficient supply chain may use slow, inexpensive modes of transportation and economies of scale in production. If Dell made these choices, it would have difficulty supporting the customer's desire for rapid delivery and a wide variety of customizable products. Building a responsive supply chain, however, will allow Dell to meet its customers' needs. Therefore, a responsive supply chain strategy is best suited to meet the needs of Dell's targeted customers.

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 very 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.

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 first 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 20 countries. IKEA has targeted customers who want stylish furniture at a reasonable cost. The company limits the variety of styles that it sells. The large scale of each store and the limited variety of furniture 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 IKEA

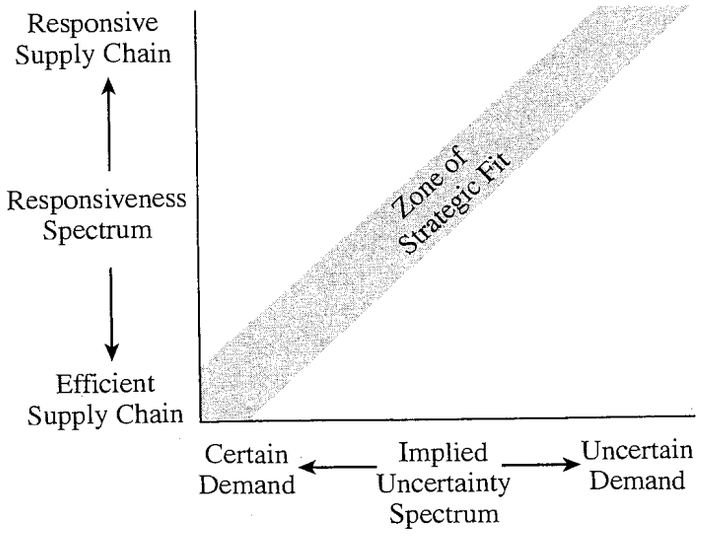


FIGURE 2-5
Finding the Zone of Strategic Fit

stores allows replenishment orders to its manufacturers to be more stable and predictable. As a result, IKEA passes along very 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 very little uncertainty and being efficient.

In contrast, another approach for responsiveness may involve the retailer holding very 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's retailers allow customers to select from a very 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 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 roles of each stage of the supply chain. 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 level 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

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

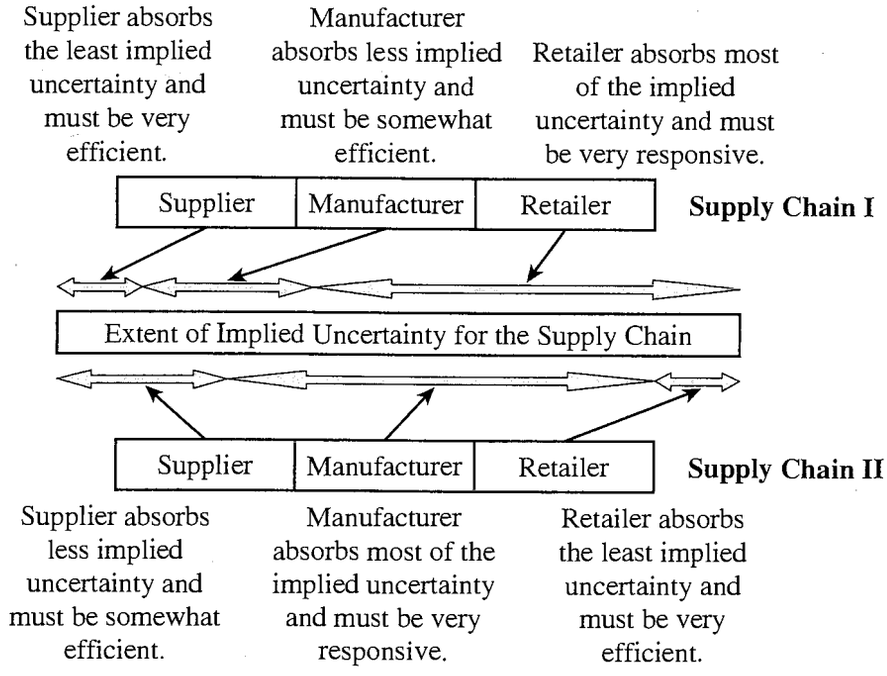
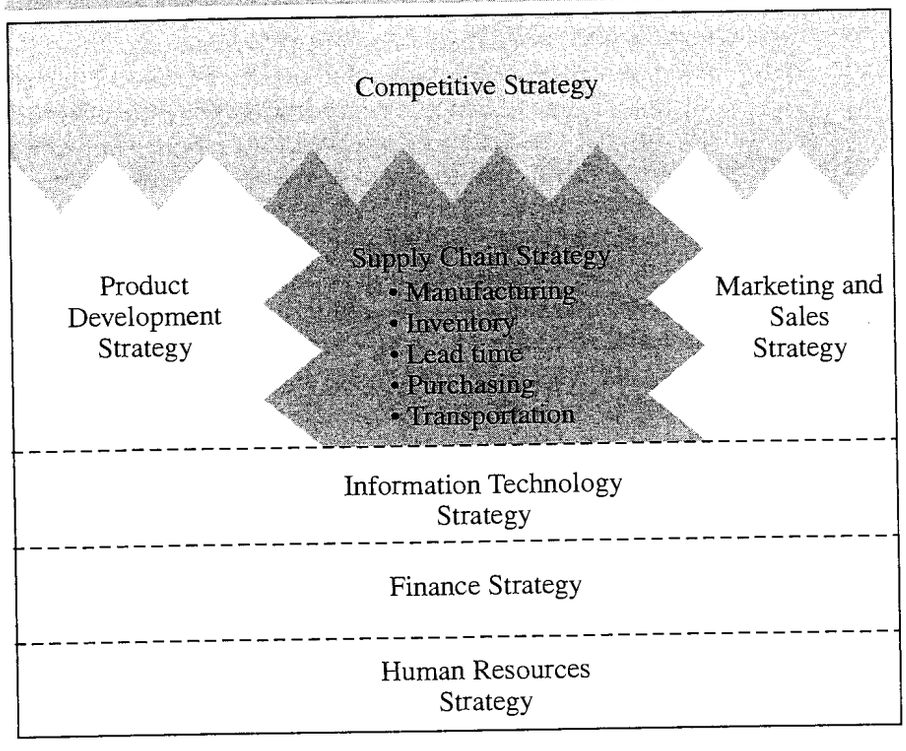


FIGURE 2-7 Fit Between Competitive and Functional Strategies



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 who 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 who 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, as shown in Figure 2-7. 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.

Thus, firms with different locations along the responsiveness spectrum must have different supply chain designs and different functional strategies that support their responsiveness. We discuss the impact of supply chain design on the level of responsiveness in Chapter 4. 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.

Changing the strategies to achieve strategic fit may sound easy enough to do, but in reality it can be quite difficult. In later chapters, we will discuss many of the obstacles

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

to achieving this fit. Right now, the important points to remember from this discussion are the following.

1. There *is no* supply chain strategy that is always right.
2. There *is* a right supply chain strategy for a given competitive strategy.

The drive for strategic fit should come from the highest levels of the organization. In many companies, different groups devise competitive and functional strategies. Without proper communication between the groups and coordination by high-level management such as the CEO, these strategies are not likely to achieve strategic fit. For many firms, the failure to achieve strategic fit is a key reason for their inability to succeed.

OTHER ISSUES AFFECTING 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 strategic position. We now consider how multiple products, multiple customer segments, and product life cycle affect strategic fit.

Multiple Products and Customer Segments

Most companies produce and sell multiple products to multiple customer segments, each with different characteristics. A department store may sell seasonal products with high implied demand uncertainty, such as ski jackets, along with products with low implied demand uncertainty, such as black socks. The demand in each case maps to a different part of the uncertainty spectrum. W.W. Grainger sells MRO products to both large firms, such as Ford and Boeing, and small manufacturers and contractors. The customer needs in the two cases are very different. A large firm is much more likely to be concerned with price, given the large volumes they generate from W.W. Grainger, whereas a smaller company is apt to go to W.W. Grainger because it is responsive. The two segments that are served map to different positions along the implied uncertainty spectrum. 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.

In each of the aforementioned 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 supply chain that balances efficiency and responsiveness given its portfolio of products, customer segments, and supply sources.

There are several possible routes a company can take to achieve this balance. One is to set up independent supply chains for each different product or customer segment. This strategy is feasible if each segment is large enough to support a dedicated supply chain. It fails, however, to take advantage of any economies of scope that often exist among a company's different products. Therefore, a preferable strategy is to tailor the supply chain to best meet the needs of each product's demand.

Tailoring the supply chain requires sharing some links in the supply chain with some products, 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. Those products that do not have high responsiveness needs may be shipped 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 very 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 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 or customer segment. Tailoring of the supply chain is an important concept that we develop further in subsequent chapters.

Product Life Cycle

As products go through their life cycle, the demand characteristics and the needs of the customer segments being served change. Supply characteristics also change as the product and production technologies mature. High-tech products are particularly prone to these life-cycle swings over a very short time span. A product goes through its life cycle from the introductory phase, when only the leading edge of customers is interested and supply is uncertain, all the way to the point at which the product becomes a commodity, the market is saturated, and supply is predictable. Thus, if a company is to maintain strategic fit, its supply chain strategy must evolve as its products enter different phases.

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 very 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 due to 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 a drug's patent expires and generic drugs are introduced. At this stage, demand for the drug stabilizes and margins shrink. Customers make their selections from the various choices based on price. 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 needs to change. In such a situation, efficiency is the most important characteristic of the supply chain.

This discussion illustrates that as products mature, the corresponding supply chain strategy should, in general, move from being responsive to being efficient, as illustrated in Figure 2-8.

To illustrate these ideas, consider the example of Intel Corporation. Each time Intel introduces a new computer processor, there is great uncertainty with respect to demand for this new product, as it depends on the sales of new high-end PCs. Typically there is high uncertainty regarding how the market will receive these PCs and what the demand will be. Supply is unpredictable because yield is low and variable. At this stage, the Intel supply chain must be very responsive so it can react if demand is very high.

As the Intel processor becomes more mainstream, demand begins to stabilize, and yield from the production process is higher and more predictable. At this point demand and supply normally display lower implied uncertainty and price becomes a greater determinant of sales. Now it is important for Intel to have an efficient supply chain in place for producing processors.

All PC manufacturers are subject to the cycle described earlier. When a new model is introduced, margins are high, but demand is highly uncertain. In such a situation, a

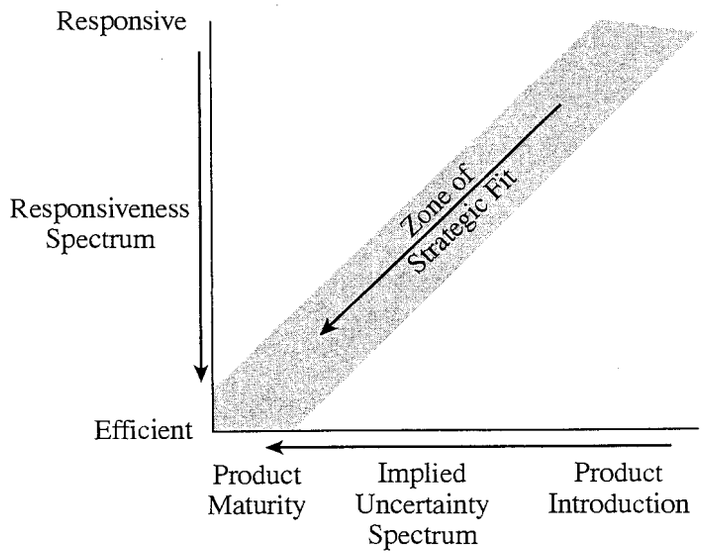


FIGURE 2-8 Changes in Supply Chain Strategy over a Product Life Cycle

responsive supply chain best serves the PC manufacturer. As the model matures, demand stabilizes and margins shrink. At this stage it is important that the manufacturer have an efficient supply chain. Apple Computer is an example of a firm that has had difficulty during product introduction. When it introduced the G4 in 1999, demand for the machine far exceeded the available supply of processors, resulting in significant lost sales. The supply chain in this case did not display sufficient responsiveness during the product's introductory phase.

The key point here is that demand and supply characteristics change over a product's life cycle. Because demand and supply characteristics change, the supply chain strategy must also change over the product life cycle if a company is to continue achieving strategic fit.

Globalization and Competitive Changes over Time

A final dimension to consider when matching supply chain and competitive strategy is the change in competitor behavior resulting from changes in the marketplace or increased globalization. Like product life cycles, competitors can change the landscape, thereby requiring a change in the firm's competitive strategy. An example is the growth of mass customization in various industries since the last decade of the twentieth century. As competitors flood the marketplace with product variety, customers are becoming accustomed to having their individual needs satisfied. Thus, the competitive focus today is on producing sufficient variety at a reasonable price. As more firms increase the level of variety offered, supply chains have been forced to develop the ability to support a wider range of products. Another big change is the increase in global sourcing of products. The availability of a Chinese-made leather recliner at Wal-Mart for $199 has put pressure on U.S. manufacturers to become much more responsive than they were in the past. Successful furniture manufacturers in the United States have responded by offering enough variety to make choice an advantage, while bringing down response time and keeping prices in check. Similar pressures of globalization are being felt in the apparel sector with the end of quotas, and local firms in developed countries are forced to respond. As the competitive landscape changes, a firm is forced to alter its competitive strategy. With the change in competitive strategy, a firm must also change its supply chain strategy to maintain strategic fit.

KEY POINT To achieve strategic fit, a firm must tailor its supply chain to best meet the needs of different customer segments. To retain strategic fit, supply chain strategy must be adjusted over the life cycle of a product and as the competitive landscape changes.

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.

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 a shared objective. At one extreme, every operation within each functional area devises its own independent strategy with the objective of optimizing its individual performance. In

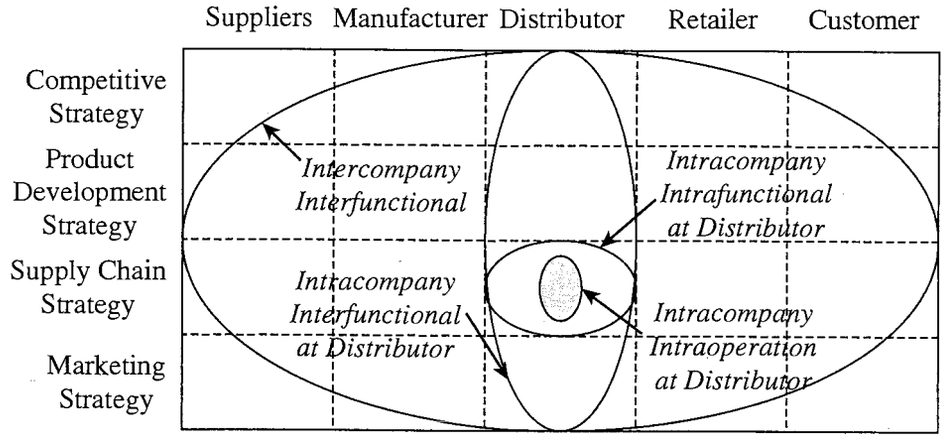
this case the scope of strategic fit is restricted to an operation in a functional area within a stage of the supply chain. At the opposite extreme, all functional areas across all stages of the supply chain devise strategy jointly with a common objective of maximizing supply chain profit. In this case 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. We represent the scope of strategic fit on a two-dimensional grid. Horizontally, the scope of strategic fit is considered across different supply chain stages, starting from suppliers and moving all the way along the chain to the customer. Vertically, the scope is applied to the fit achieved across different functional strategies—competitive, product development, supply chain, and marketing.

INTRACOMPANY INTRAOPERATION SCOPE: THE MINIMIZE LOCAL COST VIEW

The most limited scope over which strategic fit is considered is one operation within a functional area within a company. This is referred to as *intracompany intraoperation scope.* Here, each operation within each stage of the supply chain devises strategy independently. In such a setting, the resulting collection of strategies will most likely not come close to maximizing supply chain profit, because different functions and operations have conflicting local objectives. 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. Consider an example of a distribution company in which a transportation operation is evaluated based on average shipping cost per unit. Shipping the product individually costs $5/item, whereas shipping by truckload costs only $1/item. To minimize cost, the transportation group ships the product in full truckloads because this practice results in the lowest shipping cost per unit. This decision, while minimizing transportation cost per unit, increases response time and may undermine a competitive strategy based on responsiveness. The key point here is that the transportation decision was made independent of other functions within the firm and the rest of the supply chain. In this case, the scope of strategic fit is restricted to a portion (transportation) of the distributor stage within the supply chain. The smallest ellipse in Figure 2-9 represents the scope of strategic fit at the distributor in this instance.

FIGURE 2-9 The Different Scopes of Strategic Fit Across a Supply Chain



INTRACOMPANY INTRAFUNCTIONAL SCOPE: THE MINIMIZE FUNCTIONAL COST VIEW

Given that many operations together form each function within a firm, managers recognized the weakness of the intracompany intraoperation scope. Supply chain operations include manufacturing, warehousing, and transportation, among others. With the intracompany intrafunctional scope, the strategic fit is expanded to include all operations within a function. In this case, the warehousing manager no longer minimizes warehousing costs while the transportation manager independently minimizes transportation costs. By working together and developing a joint strategy, the two minimize the total functional cost.

Applying the intracompany intrafunctional scope and continuing with the distribution example, managers now look not only at transportation costs, but also at warehousing and other supply chain–related costs. Although truckload transportation saves the company $4/item, it costs an additional $8/item because of increased inventory and warehousing costs. Therefore, it costs less for the company to ship each item individually because the extra $4 transportation charge saves the company $8 in inventory-related costs.

In this case the scope of strategic fit expands to an entire function within a stage of the supply chain. Figure 2-9 shows the intracompany intrafunctional scope as it applies to the supply chain strategy at the distributor.

INTRACOMPANY INTERFUNCTIONAL SCOPE: THE MAXIMIZE COMPANY PROFIT VIEW

The key weakness of the intracompany intrafunctional view is that different functions 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 across all functions within the firm. With the intracompany interfunctional scope, the goal is to maximize company profit. To achieve this goal, all functional strategies are developed to support both each other and the competitive strategy.

How does this change manifest itself? To return to our example, instead of looking only at the supply chain costs, the company will now look at revenue as well. Although the company had already decided to ship individual units to bring down inventory costs, marketing wanted to increase inventory so the company could take advantage of increased sales as a result of higher service levels. If the revenues and margins gained from holding more inventory outweigh the additional costs, the company should go ahead and increase inventory. The basic point is that both operational and marketing decisions have revenue and cost impact. They must thus be coordinated. The intracompany interfunctional scope of strategic fit as it applies to the distributor is shown in Figure 2-9.

INTERCOMPANY INTERFUNCTIONAL SCOPE: THE MAXIMIZE SUPPLY CHAIN SURPLUS VIEW

The intracompany interfunctional scope of strategic fit has two major weaknesses. First, it leads to each stage of the supply chain trying to maximize its own profits, which does not necessarily result in the maximization of supply chain surplus. Supply chain surplus is maximized only when all supply chain stages coordinate strategy together. This occurs with the intercompany interfunctional scope, in which all stages of the

supply chain coordinate strategy across all functions, ensuring that together they best meet the customer's needs and maximize supply chain surplus.

The second major weakness of the intracompany scope was noted in the 1990s when speed became a key driver of supply chain success. Today, more and more companies are succeeding not because they have the lowest priced product and not because they have the highest-quality or best-performing product, but because they are able to respond quickly to market needs and get the right product to the right customer at the right time. Companies like Zara, the Spanish apparel retailer, have used speed as their primary competitive advantage to succeed in the marketplace.

This shift toward speed has forced companies to ask what creates the level of speed that customers are demanding. When this question is examined, the answer for most companies lies to a large extent outside their own boundaries. The most significant delays are created at the interface between the boundaries of different stages of a supply chain. Thus, managing these interfaces becomes key to providing quick response to customers. The intracompany scope restricts strategic attention within each stage of the supply chain, leading to the interfaces being neglected. The intercompany scope forces every stage of the supply chain to look across the supply chain and evaluate the impact of its actions on other stages as well as on the interfaces. The intercompany scope allows the supply chain to raise the supply chain surplus and increase the size of the pie that all stages have to share among themselves.

The intercompany interfunctional scope of strategic fit is shown in Figure 2-9.

KEY POINT 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.

Taking this view requires each company to evaluate its actions in the context of the entire supply chain. This means treating stages in the supply chain that a company does not own as belonging to the company. For example, a supply chain theme that has received a great deal of press in recent years is the reduction of inventory. Many companies strive to reduce their own inventories because they assume that the less inventory they have, the better. This assumption has led to a rash of changes in ownership of inventory from stage to stage in the supply chain without necessarily achieving any real reduction in overall inventory. Manufacturers feel that if they force their suppliers to own the parts inventory, they will not have to finance this inventory and therefore their costs will go down. In many cases, however, the suppliers simply take ownership of the parts inventory without making any changes in the way this inventory is managed. Because holding this inventory increases the suppliers' costs, they are forced to raise their prices to the manufacturer or lower their margins. In the end, there is no real increase in supply chain surplus because the supply chain merely shifts costs back and forth between its links.

The intercompany interfunctional scope proposes a different approach. Instead of just forcing the inventory on the supplier, who then increases price, the manufacturer and the supplier need to work together to actually reduce the amount of inventory that is required. For example, by sharing demand information with the supplier, the manufacturer can lower the amount of inventory needed in the chain, thus reducing overall cost, increasing the supply chain surplus, and making firms in that supply chain more competitive.

This result will allow the supply chain to either increase profits by sharing the extra surplus or reduce price by passing along some of the surplus to the customer. Overall,

the supply chain will be more competitive if it can achieve the intercompany scope of strategic fit.

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.

AGILE INTERCOMPANY INTERFUNCTIONAL SCOPE

Up to this point, we have discussed strategic fit in a static context; that is, the players in a supply chain and the customer 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 different firms, depending on the product being produced and the customer being served. The strategy and operations at firms 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 customer 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 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 strategy 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.
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.

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. Where would you place the demand faced by Nordstrom on the implied demand uncertainty spectrum? Why?
3. What level of responsiveness would be most appropriate for Nordstrom's supply chain? What should the supply chain be able to do particularly well?
4. How can Nordstrom expand the scope of strategic fit across its supply chain?
5. Reconsider the previous four questions for other companies such as Amazon, a supermarket chain, an auto manufacturer, and a discount retailer such as Wal-Mart.
6. Give arguments to support the statement that Wal-Mart has achieved very good strategic fit between its competitive and supply chain strategies.

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