Supply Chain Management

SEVENTH EDITION

SUNIL CHOPRA

Strategy, Planning, and Operation

Pearson

Seventh Edition

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Sunil Chopra
Kellogg School of Management

Pearson

New York, NY

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Dedication

I would like to thank my colleagues at Kellogg for all I have learned from them about logistics and supply chain management. I thank Peter Meindl for his collaboration during earlier editions of this book. I am grateful for the love and encouragement that 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

ABOUT THE AUTHOR

SUNIL CHOPRA

Sunil Chopra is the IBM Distinguished Professor of Operations Management and Information Systems at the Kellogg School of Management. He has served as the interim dean and senior associate dean for curriculum and teaching, and the codirector of the MMM program, a joint dual-degree program between the Kellogg School of Management and the McCormick School of Engineering at Northwestern University. He has a PhD in operations research from SUNY at Stony Brook. Prior to joining Kellogg, he taught at New York University and spent a year at IBM Research.

Professor Chopra's research and teaching interests are in supply chain and logistics management, operations management, combinatorial optimization, and the design of telecommunication networks. He has won several teaching awards at the MBA and Executive programs of Kellogg. He has authored more than 50 papers and two books.

He has been a department editor for *Management Science* and an associate editor for *Manufacturing & Service Operations Management*, *Operations Research,* and *Decision Sciences Journal*. He has also consulted for several firms in the area of supply chain and operations management.

CONTENTS

PREFACE

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

NEW TO THIS EDITION

The seventh edition has focused on changes that enhance students' ability to sharpen their critical thinking and data analytics skills as they study with the book. All concepts discussed in the book are linked to strategic decision making in a supply chain, and all quantitative ideas are illustrated using spreadsheets that can be implemented in practice. Some specific changes in the seventh edition include:

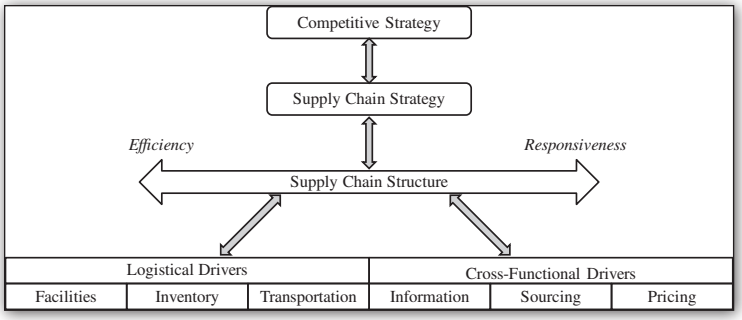
- The link between supply chain decisions and the financial performance of a firm is developed in detail in Chapter 3.
- The concepts underlying the design of distribution networks are illustrated in the context of omni-channel retailing in Chapter 4. The evolution of retailing is used throughout the book to illustrate the link between supply chain concepts and strategic decision making in a supply chain.
- Each section of each chapter in the book is associated with a clearly identified learning objective that is summarized at the end of the section.
- We have added new mini-cases in Chapters 5, 8, and 15. Information in other cases has been updated to be current.
- New exercises have been added in several chapters.
- For all numerical examples discussed in the book, we have developed spreadsheets that students can use to understand the concept at a deeper level. These spreadsheets are referred to in the book and allow the student to try different "what-if" analyses. These spreadsheets are available at *www.pearsonhighered.com/chopra* along with basic guidance on how they may be created and used.
- We have continued to add current examples throughout the book, with a particular focus on bringing in more global examples.

SOLVING TEACHING AND LEARNING CHALLENGES

To be successful, supply chain practitioners must be able to formulate effective supply chain strategy and be able to solve any resulting supply chain problems using the available analytical tools. In a supply chain class this creates the challenge of teaching students to think strategically while supporting their decisions with robust quantitative analysis. This book is designed to help faculty and students overcome this challenge through its conceptual and pedagogical structure. Conceptually, the book aims to 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

To illustrate the strategic importance of good supply chain management, we provide many current examples to show how companies have succeeded through effective supply chain management or failed because of weak supply chain management. Our strategic framework, the use of Excel-based models to explain analytic methodologies, and several mini-cases to help students internalize the link between the analytic methodologies and strategic decision making provide pedagogical support for faculty using the book.



A Consistent Strategic Framework

Within the strategic framework, we identify facilities, inventory, transportation, information, sourcing, and pricing as the key drivers of supply chain performance. The book is structured to dig deeper into each driver to understand its role in the success of a supply chain, its interaction with other drivers, analytic methodologies to support decisions related to the driver, and managerial levers related to the driver that help improve supply chain performance.

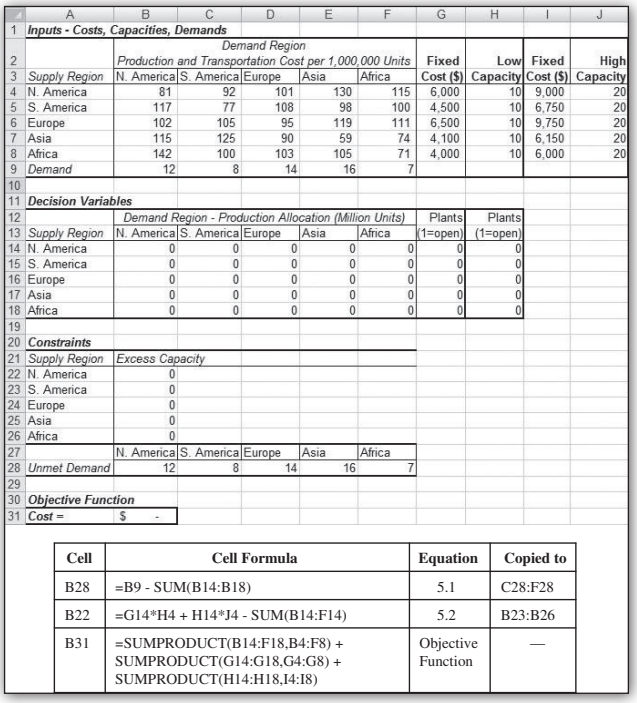
Every analytic methodology is illustrated with its application in Excel. Students have access to the associated Excel file along with instructions to construct and use the file. The Excel files help students deepen their understanding of the link between the analytic models and the strategic decisions they support.

Mini Cases

Most chapters have mini cases that can be used by faculty to ensure that students can apply the concepts and methodologies in the context of strategic decision making for a business.

DEVELOPING CAREER SKILLS

Skills learned in this book will be of great use no matter what path students choose to follow. The book is developed with the premise that good strategic decisions cannot be made without access to relevant analytics, and all analytics should be designed to support decision making. As a result, students will develop critical thinking, the ability to formulate and analyze problems, and support their recommendations with analytics that uses data literacy and computing skills.



Inputs - Costs, Capacities, Demands

Supply Region	Demand Region: Production and Transportation Cost per 1,000,000 Units: N. America	S. America	Europe	Asia	Africa	Fixed Cost ($)	Low Capacity	Fixed Cost ($)	High Capacity
N. America	81	92	101	130	115	6,000	10	9,000	20
S. America	117	77	108	98	100	4,500	10	6,750	20
Europe	102	105	95	119	111	6,500	10	9,750	20
Asia	115	125	90	59	74	4,100	10	6,150	20
Africa	142	100	103	105	71	4,000	10	6,000	20
Demand	12	8	14	16	7				

Decision Variables

Supply Region	Demand Region - Production Allocation (Million Units): N. America	S. America	Europe	Asia	Africa	Plants (1=open)	Plants (1=open)
N. America	0	0	0	0	0	0	0
S. America	0	0	0	0	0	0	0
Europe	0	0	0	0	0	0	0
Asia	0	0	0	0	0	0	0
Africa	0	0	0	0	0	0	0

Constraints

Supply Region	Excess Capacity
N. America	0
S. America	0
Europe	0
Asia	0
Africa	0

	N. America	S. America	Europe	Asia	Africa
Unmet Demand	12	8	14	16	7

Objective Function

Cost = $ -

Cell	Cell Formula	Equation	Copied to
B28	=B9 - SUM(B14:B18)	5.1	C28:F28
B22	=G14*H4 + H14*J4 - SUM(B14:F14)	5.2	B23:B26
B31	=SUMPRODUCT(B14:F18,B4:F8) + SUMPRODUCT(G14:G18,G4:G8) + SUMPRODUCT(H14:H18,I4:I8)	Objective Function	—

Excel Based Models

- Every chapter in the book pushes students to think critically in order to define and solve supply chain problems. For example, Chapter 4 develops a framework for distribution networks and then pushes students to think about how retailing may evolve in the future as consumer preferences and technology change. The first part of the chapter teaches frameworks and concepts related to the design of distribution networks. The last part of the chapter then pushes the students to analyze retailing by applying the knowledge they have gained in order to decide how retailers need to change in order to succeed in the 21st century.
- All the analytics in the book are developed through the use of Microsoft Excel. This helps students develop data literacy, computing skills, and the knowledge of how to apply information technology to support decision making. The analytics that are developed in these chapters in turn support the framework laid out in Chapter 4. Whereas Chapter 4 helps students to think conceptually about why certain retailing models have succeeded for selling jewelry while others have failed, the succeeding chapters help students quantify financial metrics for different retail networks. As a result, students learn how to use data and models to improve strategic decision making.

TABLE OF CONTENTS OVERVIEW

INSTRUCTOR TEACHING RESOURCES

At the Instructor Resource Center, *http://www.pearsonhighered.com/irc*, instructors can easily register to gain access to a variety of instructor resources available with this text in downloadable format. If assistance is needed, our dedicated technical support team is ready to help with the media supplements that accompany this text. Visit *https://support.pearson.com/getsupport* for answers to frequently asked questions and toll-free user support phone numbers.

This program comes with the following teaching resources.

Supplements available to instructors at *www.pearsonhighered.com/irc*	Features of the Supplement
Instructor's Solution Manual developed by the author	• Case Teaching Notes and Worksheets • Spreadsheets for all quantitative examples • Discussion questions • Example figures • Additional exercises • Solutions to all questions and problems in the book
Test Bank authored by Geoff Willis of the University of Central Oklahoma	2000 multiple-choice, true/false, short- answer, and graphing questions with these annotations: • Correct answer • Difficulty level (1 for straight recall, 2 for some analysis, 3 for complex analysis) • Learning outcome reference • Topic covered • AACSB learning standard (Analytical Thinking; Information Technology; Application of Knowledge)
TestGen® Computerized Test Bank	TestGen allows instructors to: • Customize, save, and generate classroom tests • Edit, add, or delete questions from the Test Item Files • Analyze test results • Organize a database of tests and student results.
PowerPoint Presentations authored by Jeff Heyl of the Lincoln University	Slides include all the graphs, tables, and equations in the textbook. PowerPoints meet accessibility standards for students with disabilities. Features include, but not limited to: • Keyboard and Screen Reader access • Alternative text for images • High color contrast between background and foreground colors

For Students

The following material is available to students at *http://www.pearsonhighered.com/chopra*:

- Spreadsheets for numerical examples discussed in the book. These provide the details of the example discussed, but are live and allow the student to try different what-if analyses.
- Spreadsheets that allow students to build every table shown in Chapters 5 through 16.
- Online chapter: Chapter A: Information Technology in a Supply Chain.
- Technical Note: Routing and Scheduling in Transportation. This note is also bundled with the Instructor's Manual available on *www.pearsonhighered.com/irc.*

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I would also like to thank my editor, Neeraj Bhalla, content producer, Sugandh Juneja, editorial assistant, Linda Albelli, and the people at SPi, including Nicole Suddeth, Ronel Mirano, and Raja Natesan, for their efforts with the book. Finally, I would like to thank you, the readers, for reading and using this book. I hope it contributes to all your efforts to improve the performance of companies and supply chains throughout the world. I would be pleased to hear your comments and suggestions for future editions of this text.

Sunil Chopra

Kellogg School of Management, Northwestern University

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CHAPTER

1

Understanding the Supply Chain

LEARNING OBJECTIVES

After reading this chapter, you will be able to

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

1.2 Define the three key supply chain decision phases and explain the significance of each one.

1.3 Describe the cycle and push/pull views along with the macro processes of a supply chain.

1.4 Identify important issues and decisions to be addressed in a supply chain.

1.5 Develop skills that employers have identified as critical to success in the workplace.

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

WHAT IS A SUPPLY CHAIN?

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

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 Toyota dealership to purchase a new car. The supply chain begins with the customer and his or her need for a car. The next stage of this supply chain is the dealer that the customer visits. The dealer has several cars in inventory that may have been supplied from the assembly plant using trucks from a third party. The assembly plant, in turn,

gets various modules such as electronics and powertrain from a variety of Tier 1 suppliers. Each Tier 1 supplier receives material from several Tier 2 suppliers. For example, the electronics supplier receives cameras from the camera supplier and the dashboard display from another supplier. Each of these suppliers receives raw materials from lower tier suppliers. This supply chain is illustrated in Figure 1-1, with the arrows corresponding to the direction of physical product flow.

A supply chain is dynamic and involves the constant flow of information, product, and funds among different stages. In our example, the dealer provides the product, as well as pricing and availability information, to the customer. The customer transfers funds to the dealer. The dealer conveys sales data and replenishment orders to the assembly plant, which sends cars back to the dealer on a truck. The dealer transfers funds to the auto manufacturer after the replenishment. The manufacturer also provides pricing information and sends delivery schedules to each dealer. Similar information, material, and fund flows take place across the entire supply chain.

In another example, when a customer makes a purchase online from Amazon, the supply chain includes, among others, the customer, Amazon's website, the Amazon warehouse, the carrier who delivers packages to customers, and all of Amazon's suppliers and their suppliers. The website provides the customer with information regarding pricing, product variety, and product availability. After making a product choice, the customer enters the order information and pays for the product. The product is then picked and shipped from an Amazon warehouse. As its inventory diminishes, the warehouse places replenishment orders with suppliers.

A typical supply chain may involve a variety of stages including customers, retailers, wholesalers, distributors, manufacturers, and suppliers. Even though the term supply chain may imply that only one player is involved at each stage, most supply chains are actually networks where each stage receives product from several suppliers and sends output to several customers. It may be more accurate to use the term supply network or supply web to describe the structure of most supply chains.

A critical point to keep in mind is that the customer is an integral part of any 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 functioning of a supply chain involves three key flows – information, product, and funds - as illustrated in Figure 1-2. The goal when designing a supply chain is to structure the three flows in a way that meets customer needs in a cost effective manner. For example, Apple serves its customers in a variety of ways depending upon their needs. Customers

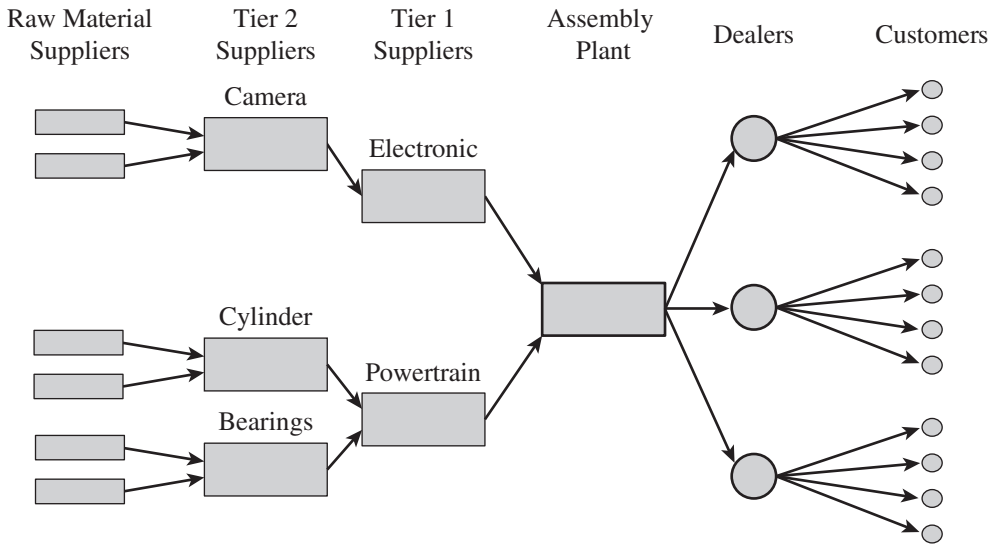

Figure 1-1 Stages of an Automotive Supply Chain

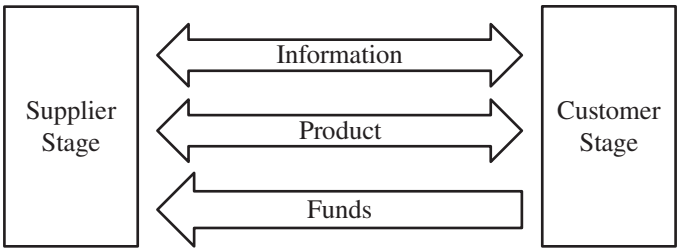

Figure 1-2 The Three Flows in a Supply Chain

can walk into an Apple store (or a third party store) or go online to purchase a product. Standard products are stocked at the stores and customers can leave the store with their phone or computer after paying the appropriate funds. Orders placed online can either be delivered at home or be picked up at an Apple store. The time taken for home delivery depends on whether the product is stocked by Apple at its warehouse or not. Personalized and custom-configured items take longer because they are not stocked at the warehouse but produced after the customer order arrives. Observe that Apple changes the flow of information, product, and funds based on the customer needs and product characteristics. The goal of this book is to develop concepts and methodologies that can be used to design supply chains that effectively meet customer needs while generating supply chain profits.

THE OBJECTIVE OF A SUPPLY CHAIN

The objective of every supply chain should be to maximize the net value generated. The net value a supply chain generates is the difference between what the value of the final product is to the customer and the costs the entire supply chain incurs in filling the customer's request. We will refer to this difference as the *supply chain surplus*.

$$\textit{Supply Chain Surplus} = \textit{Customer Value} - \textit{Supply Chain Cost}$$

The value of the final product may vary for each customer and can be estimated by the maximum amount the customer is willing to pay for it. The difference between the value of the product and its price remains with the customer as consumer surplus. The rest of the supply chain surplus becomes supply chain profitability, the difference between the revenue generated from the customer and the overall cost across the supply chain. For example, the $60 that a customer pays Best Buy for a wireless router represents the revenue the supply chain receives. Customers who purchase the router clearly value it at or above $60. Thus, part of the supply chain surplus is left with the customer as consumer surplus. The rest stays with the supply chain as profit. 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 costs incurred across all stages by the supply chain to produce and distribute the router represents the supply chain profitability: the total profit to be shared across all supply chain stages and intermediaries. The higher the supply chain profitability, the more successful the supply chain. For most profit-making supply chains, the supply chain surplus will be strongly correlated with profits. Supply chain success should be measured in terms of supply chain surplus 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 surplus.) A focus on growing the supply chain surplus pushes all members of the supply chain toward growing the size of the overall pie.

Having defined the success of a supply chain in terms of supply chain surplus, the next logical step is to look for sources of value, revenue, and cost. For any supply chain, there is only

one source of revenue: the customer. The value obtained by a customer purchasing a car at a Toyota dealership depends on several factors, including the functionality and features of the car, the variety of options available, and the service offered by the dealer. The customer is the only one providing positive cash flow for the Toyota supply chain. All other cash flows are simply fund exchanges that occur within the supply chain, given that different stages have different owners. When the dealer pays Toyota, it is taking a portion of the funds the customer provides and passing that money on to Toyota. 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 grow the total supply chain surplus. A growth in supply chain surplus increases the size of the total pie, allowing contributing members of the supply chain to benefit.

In this book, we 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 that is observed in the United States and India. U.S. distributors play a much smaller role in this supply chain compared with 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 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—a retail 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 that 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 what it would cost each manufacturer to collect from retailers. 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.

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. Amazon, Seven-Eleven Japan, and Walmart 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 online businesses, such as Webvan, can be attributed to weaknesses in their supply chain design and planning. The rise and subsequent fall of the bookstore chain Borders illustrates how a failure to adapt its supply chain to a changing environment and customer expectations hurt its performance. Dell Computer is another example of a company that had to revise its supply chain design in response to changing technology and customer needs. We discuss these examples later in this section.

Seven-Eleven Japan is an example of a company that has used excellent supply chain design, planning, and operation to drive growth and profitability. It has used a very responsive

replenishment system along with an outstanding information system to ensure that products are available when and where customers need them. Its responsiveness allows the company to change the merchandise mix at each store by time of day to precisely match customer demand. As a result, the company has grown total store sales from 1 billion yen in 1974 to almost 2.7 trillion yen in 2016, with profits in 2016 totaling 304 billion yen.

Walmart has been a leader at using supply chain design, planning, and operation to achieve success with its brick-and-mortar stores. From its beginning, the company invested heavily in transportation and information infrastructure to facilitate the effective flow of goods and information. Walmart 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. Walmart has been a leader in sharing information and collaborating with suppliers to bring down costs and improve product availability. The results are impressive. In its 2016 annual report, the company reported a net income of about $14.7 billion on revenues of about $482 billion. Despite its success with large Walmart stores, the company has had some difficulty being successful with small format stores as well as the online channel where they offer an expanded assortment. Over the years the company has realized that the supply chain structure that is effective for the brick-and-mortar channel requires modification to be effective for the online channel. Similarly, the supply chain that is very effective for large format stores is not so effective for small format stores.

The failure of many online businesses, such as Webvan and Kozmo, can be attributed to their inability to design appropriate supply chains or manage information, product, and fund flows effectively. In the late 1990s, Webvan designed a supply chain with large warehouses in several major cities in the United States, from which groceries were delivered to customers' homes. This supply chain design could not compete with traditional supermarket supply chains in terms of cost. Traditional supermarket chains bring product to a store close to the consumer using full truckloads, resulting in very low transportation costs. They turn their inventory relatively quickly 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, as well as high labor costs to pick customer orders. As a result, Webvan failed in its efforts to compete with supermarkets on price. The company folded in 2001, within two years of a very successful initial public offering.

As the experience of Borders illustrates, a failure to adapt supply chains to a changing environment can significantly hurt performance. Borders, along with Barnes & Noble, dominated the selling of books and music in the 1990s by implementing the superstore concept. Compared with small local bookstores that dominated the industry prior to that, Borders was able to offer greater variety (about 100,000 titles at superstores, relative to fewer than 10,000 titles at a local bookstore) to customers at a lower cost by aggregating operations in large stores. This allowed the company to achieve higher inventory turns than local bookstores and with lower operating costs per dollar of sales. In 2004, Borders achieved sales of almost $4 billion, with profits of $132 million. Its model, however, was already under attack with the growth of Amazon, which offered much greater variety than Borders at lower cost by selling online and stocking its inventories in a few distribution centers. Borders' inability to adapt its supply chain to compete with Amazon led to a rapid decline. The company declared bankruptcy in 2010.

Dell is another example of a company that enjoyed tremendous success based on its supply chain design, planning, and operation but then had to adapt its supply chain in response to shifts in technology and customer expectations. Between 1993 and 2006, Dell experienced unprecedented growth of both revenue and profits by structuring a supply chain that provided customers with customized PCs quickly and at reasonable cost. By 2006, Dell had a net income of more than $3.5 billion on revenues of just over $56 billion. This success was based on two key supply chain features that supported rapid, low-cost customization. The first was Dell's decision to sell directly to the end customer, bypassing distributors and retailers. The second key

aspect of Dell's supply chain was the centralization of manufacturing and inventories in a few locations where final assembly was postponed until the customer order arrived. As a result, Dell was able to provide a large variety of PC configurations while keeping low levels of component inventories.

In spite of this tremendous success, the changing marketplace presented some new challenges for Dell. Whereas Dell's supply chain was well suited for highly customized PCs, the market shifted to lower levels of customization. Given the growing power of hardware, customers were satisfied with a few model types. Dell reacted by adjusting its supply chain with regard to both direct selling and building to order. The company started selling its PCs through retail chains such as Walmart in the United States and GOME in China. It also outsourced a large fraction of its assembly to low-cost locations, effectively building to stock rather than to customer order. Unlike Borders, Dell is making a significant effort to adapt its supply chain to changing times. It remains to be seen whether these changes will improve Dell's performance.

SUMMARY OF LEARNING OBJECTIVE 1

The goal of a supply chain should be to grow overall supply chain surplus. Supply chain surplus is the difference between the value generated for the customer and the total cost incurred across all stages of the supply chain. A focus on the supply chain surplus increases the size of the overall pie for all members 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.

1.2 *Define the three key supply chain decision phases and explain the significance of each one.*

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, a company decides on the structure of the supply chain for 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 used. Hyundai Motor's decision to build a second manufacturing plant in India in 2008 is a supply chain design or strategic decision. A firm must ensure that the supply chain configuration supports its strategic objectives and increases the supply chain surplus during this phase. The two Hyundai plants have allowed the firm to cost effectively serve the growing Indian market and also use its Indian plants to serve global demand for small cars. In 2015, Hyundai was the second largest automobile manufacturer and the largest automobile exporter in India. Supply chain design decisions are typically made for the long term (a matter of years) and are expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the following 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 and other factors, such as costs and prices 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. For example, Hyundai's decisions regarding markets supplied by its two Indian plants and target production quantities at each plant are classified as planning decisions. 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 in 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. 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 by which 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 such as Seven-Eleven Japan and Walmart 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.

SUMMARY OF LEARNING OBJECTIVE 2

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

1.3 *Describe the cycle and push/pull views along with the macro processes of a supply chain.*

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 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 the 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 as shown in Figure 1-3, all supply chain processes can be broken down into the following four process cycles:

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

Each cycle occurs at the interface between two successive stages of the supply chain. 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, bypasses the retailer and distributor when it sells servers directly to customers.

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

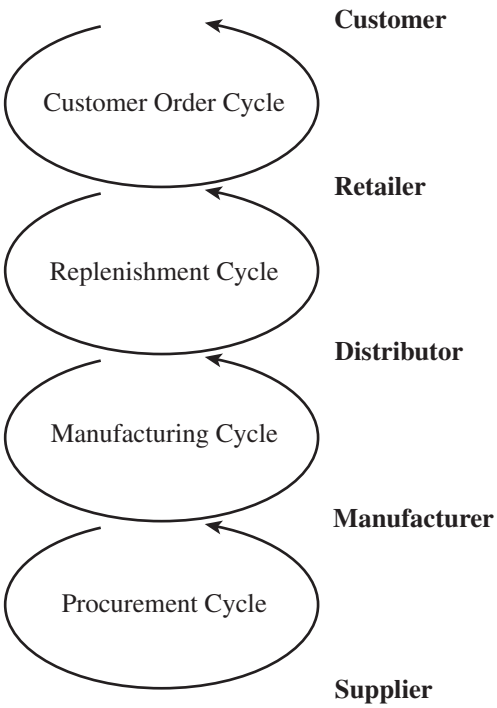

Figure 1-3 Supply Chain Process Cycles

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 again. The subprocesses in Figure 1-4 can be linked to the source, make, deliver, and return processes in the supply chain operations reference (SCOR) model. The SCOR model provides a description of supply chain processes, a framework for relationships between these processes, and a set of metrics to measure process performance. The description of the supply chain in the SCOR model is similar to the cycle view of supply chains discussed in this section.

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 publisher to replenish its inventory, it is part of the replenishment cycle—with Amazon as the buyer and the publisher as the supplier.

Within each cycle, the goal of the buyer is to ensure product availability for its customers and to achieve economies of scale in ordering. The supplier attempts to forecast buyer 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.

Even though each cycle has the same basic subprocesses, there are a few important differences among the cycles. In the customer order cycle, demand is external to the supply chain and thus is 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. A customer buys a single car, but 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 further from the end customer.

The detailed process description of a supply chain in the cycle view is useful when considering operational decisions because it clearly specifies the roles of each member of the supply chain. The cycle view is used by enterprise resource planning (ERP) systems to support supply chain operations.

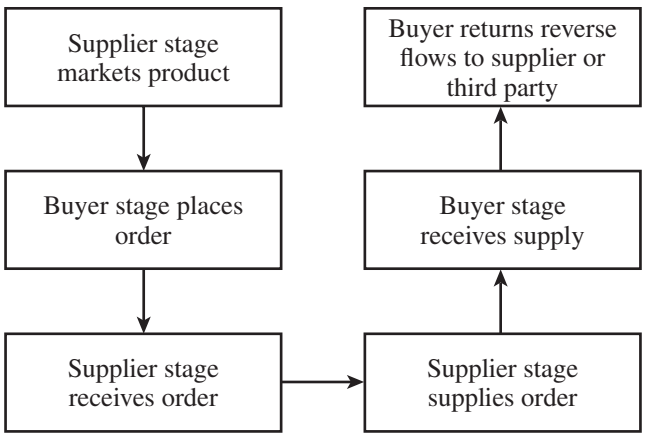

Figure 1-4 Subprocesses in Each Supply Chain Process Cycle

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 based on a 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 a predictable environment where 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 Ethan Allen to compare the push/pull view and the cycle view.

L. L. Bean executes all processes in the customer order cycle *after* the customer order 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 cycles. In fact, raw material such as 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.

Ethan Allen makes customized furniture, such as sofas and chairs, for which customers select the fabric and finish. In this case, the arrival of a customer order triggers production of the product. The manufacturing cycle is thus part of the customer order fulfillment process in the customer order cycle. There are effectively only two cycles in the Ethan Allen supply chain for customized furniture: (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 Ethan Allen are classified as pull processes because they are initiated by customer order arrival. The company, however, does not place raw material orders in response to a customer order. Raw material inventory is

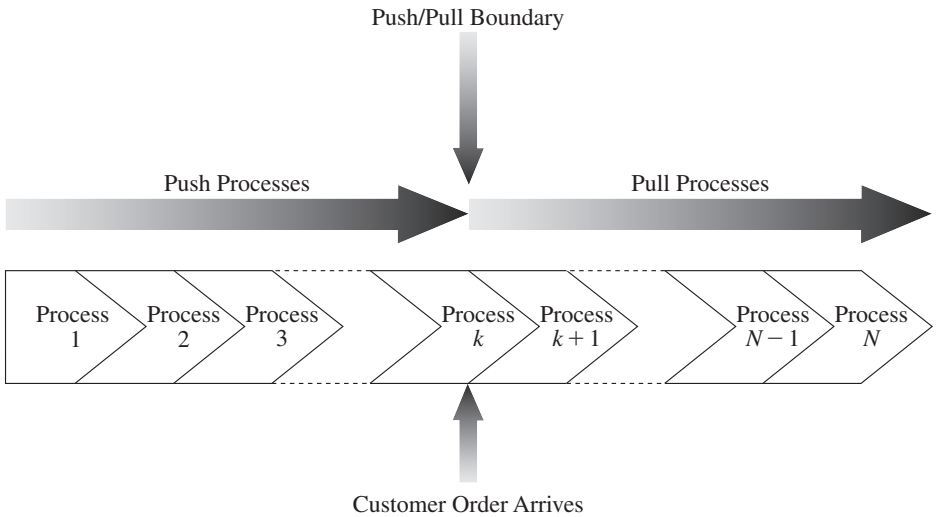

Figure 1-5 Push/Pull View of the Supply Chain

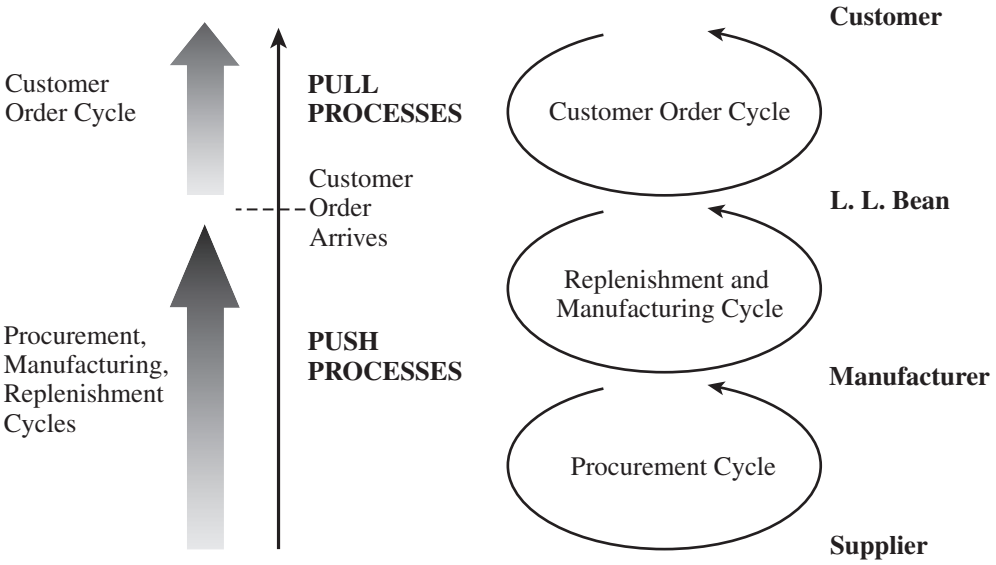

Figure 1-6 Push/Pull Processes for the L. L. Bean Supply Chain

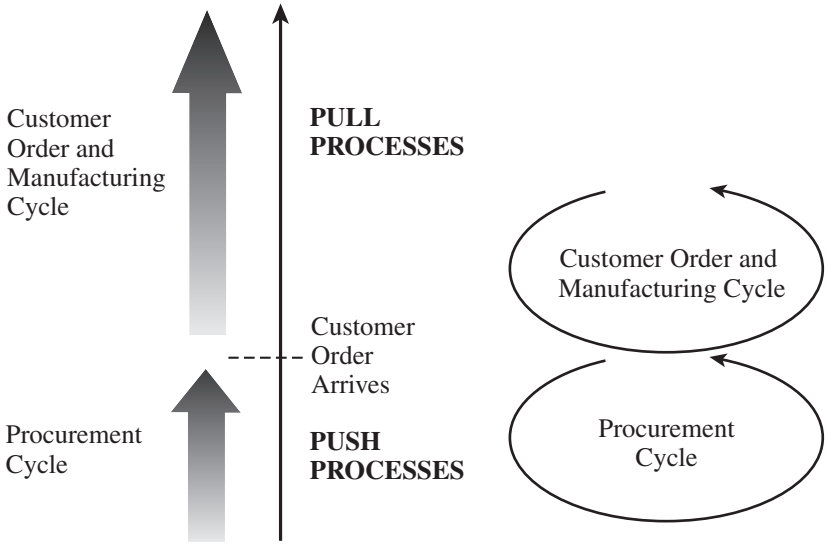

Figure 1-7 Push/Pull Processes for Ethan Allen Supply Chain for Customized Furniture

replenished in anticipation of customer demand. All processes in the procurement cycle for Ethan Allen are thus classified as push processes, because they are in response to a forecast.

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 an 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, though, the paint

supply chain had great difficulty matching supply and demand. In the 1990s, paint supply chains were restructured so 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 were still performed in the push phase. The result is that customers are always able to get the color of their choice, whereas total paint inventories across the supply chain have declined.

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 at 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 at the interface between the firm and its suppliers

These 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 website, 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 and receipt of replenishment orders.

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 9 and 10. 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

Figure 1-8 Supply Chain Macro Processes

process, and purchasing oversees the SRM macro process—with little communication among them. It is not unusual for marketing and manufacturing to have 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 one another.

SUMMARY OF LEARNING OBJECTIVE 3

The cycle view 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. All supply chain processes within a firm can be classified into three macro processes: CRM, ISCM, and SRM. 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. Integration among the three macro processes is crucial for successful supply chain management.

EXAMPLES OF SUPPLY CHAINS

1.4 *Identify important issues and decisions to be addressed in a supply chain.*

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

Gateway and Apple: Two Different Journeys into Retailing

Gateway was founded in 1985 as a direct sales manufacturer of PCs with no retail footprint. In 1996, Gateway was one of the first PC manufacturers to start selling PCs online. After many years of selling its PCs without a retail infrastructure, however, Gateway introduced an aggressive strategy of opening Gateway retail stores throughout the United States in the late 1990s. Its stores carried no finished-goods inventory and were showrooms focused on helping customers select the right configuration to purchase. All PCs were manufactured to order and shipped to the customer 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. By April 2004, Gateway had closed all its retail outlets and reduced the number of configurations offered to customers. In August 2007, Gateway was purchased by Taiwan's Acer for $710 million. By 2010, Gateway computers were sold through more than 20 different retail outlets, including Best Buy and Costco. As one can imagine, this was quite a transition for the company to experience.

In contrast, Apple has enjoyed tremendous success since it opened its first retail store in 2001. By 2016, Apple had more than 460 stores worldwide, with sales of over $20 billion. Unlike Gateway, Apple has always carried product inventory at its stores. Given its product designs, Apple carries relatively little variety in its stores. In 2014, Apple retail stores had an average revenue per square foot of $4,799, the highest among all retailers.

The following questions highlight supply chain decisions that have a bearing on the difference between Apple's and Gateway's performance:

1. Why did Gateway choose not to carry any finished-product inventory at its retail stores? Why did Apple choose to carry inventory at its stores?
2. What are the characteristics of products that are most suitable to be carried in finished-goods inventory at a retail store? What characterizes products that are best manufactured to order?
3. How does product variety affect the level of inventory a retail store must carry?
4. Is a direct selling supply chain without retail stores always less expensive than a supply chain with retail stores?
5. What factors explain the success of Apple retail and the failure of Gateway Country stores?

Zara: Apparel Manufacturing and Retail

Zara is a chain of fashion stores owned by Inditex, Spain's largest apparel manufacturer and retailer. In 2015, Inditex reported sales of about 21 billion euros from more than 7,000 retail outlets in about 88 countries. In an industry where 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 four 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 do those of 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 with 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, along with 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.

In 2012, Inditex distributed to stores all over the world from eight distribution centers located in Spain. The group claimed an average delivery time of 24 to 36 hours for European stores and up to a maximum of 48 hours for stores in America or Asia from the time the order was received in the distribution center (DC) to the time it was delivered to the stores. Shipments from the DCs to stores were made several times a week. This allowed store inventory to closely match customer demand.

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. What advantage does Zara gain from replenishing its stores multiple times a week compared with a less frequent schedule?
5. Do you think Zara's responsive replenishment infrastructure is better suited for online sales or retail sales?

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 and 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 website. 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 (although 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 five DCs from which all orders are filled. Neither McMaster nor W.W. Grainger manufactures any product. They both 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 from inventory along with many other products that are drop shipped from suppliers. 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 to be shipped directly in response to a customer order?
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?

Toyota: A Global Auto Manufacturer

Toyota Motor Corporation is Japan's top auto manufacturer and has experienced significant growth in global sales over the past 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. Before 1996, Toyota used specialized local factories for each market. After the Asian financial crisis in 1996–97, Toyota redesigned its plants so it could 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 and product design. Should parts plants be built for local production or should there be a few parts plants globally that supply multiple assembly plants? Toyota has worked hard to increase commonality in parts used around the globe. Although this has helped the company lower costs and improve parts availability, common parts caused significant difficulty when one of the parts had to be recalled. In 2009, Toyota had to recall about 12 million cars using common parts across North America, Europe, and Asia, causing significant damage to the brand as well as to the finances.

Any global manufacturer like Toyota 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 for specific contingency markets?

3. How should markets be allocated to plants and how frequently should this allocation be revised?
4. How should the investment in flexibility be valued?

Amazon: Online Sales

Amazon sells books, music, and many other items over the Internet and is one of the pioneers of online consumer sales. Amazon, based in Seattle, started by filling all orders using books purchased from a distributor in response to customer orders. As it grew, the company added warehouses, allowing it to react more quickly to customer orders. By 2015, Amazon had over 100 locations in the United States and another 100 in the rest of the world. It used the U.S. Postal Service and other package carriers, such as UPS and FedEx, to send products to customers. Outbound shipping-related costs at Amazon in 2015 were over $10 billion.

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, industrial supplies, grocery items, and shoes. In 2009, one of its largest acquisitions was Zappos, a leader in online shoe sales. This acquisition added a great deal of product variety: According to the Amazon annual report, this required creating 121,000 product descriptions and uploading more than 2.2 million images to the website. In 2010, another interesting acquisition by Amazon was diapers.com. Unlike Zappos, this acquisition added little variety but considerable shipping volumes.

In 2016, Amazon opened its first physical bookstore with plans to open more. By the end of 2016 there were reports that Amazon planned to open small brick-and-mortar stores that would sell produce, milk, meats and other perishable items. Several questions arise concerning how Amazon is structured and the product categories it continues to add:

1. Why is Amazon building more warehouses as it grows? How many warehouses should it have, and where should they be located?
2. Should Amazon stock every product it sells?
3. What advantage can online players derive from setting up a brick-and-mortar location? How should they use the two channels to gain maximum advantage?
4. What advantages and disadvantages does the online channel enjoy in the sale of shoes and diapers relative to a retail store?
5. For what products does the online channel offer the greater advantage relative to retail stores? What characterizes these products?

Macy's and W.W. Grainger: Omni-Channel Retailing

After selling for decades from its department stores, Macy's made a big push into omni-channel retailing, allowing customers to have a seamless experience between shopping online or at a store. Customers could browse online and then experience the product at a store or order online after seeing a product at the store. Omni-channel is not just about ordering, however; it is also about fulfillment. Orders placed on any channel could access Macy's entire assortment. By 2012, Macy's had equipped 292 Macy's stores to fulfill online orders or orders from other stores that were sold out of a particular item. If customers desired, orders placed online could be picked up at select stores and items purchased online could be returned to stores. By 2015, this approach was presenting some challenges.

Macy's approach of using stores to fulfill online orders is similar to what W. W. Grainger practiced until about 2001. At that time, about 50 percent of the units and 30 percent of sales dollars were shipped to customers from Grainger stores. In 2001, Grainger embarked on a network redesign where the fulfillment of online orders was shifted from stores to DCs. The goal was to take advantage of picking and transportation efficiencies by aggregating online order fulfillment from DCs.

Any omni-channel retailer must address the following questions:

1. Should online orders be filled from stores or fulfillment centers? What role(s) should each facility play?
2. How should store inventories be managed in an omni-channel setting?
3. Should returns be kept at a store or sent to a fulfillment center?

SUMMARY OF LEARNING OBJECTIVE 4

At a strategic level, a supply chain designer must decide whether to build a responsive supply chain like Zara or focus on lower costs. A decision must be made on the location and capacity of each facility and whether it will be dedicated or flexible in terms of the products it produces and markets it serves. The designer must decide whether products will be sold directly to customers, through distributors like Grainger, or through brick-and-mortar retailers like Macy's. If opting for omni-channel retail, the designer must decide which facilities will fulfill different customer orders. The planner must then decide on the production levels at each production site and inventory levels at each DC and retail store. As customer orders arrive, the operations manager must decide how each order will be fulfilled given the available inventory and production schedule. The goal when making all these decisions is to maximize the supply chain surplus.

DEVELOPING SKILLS FOR YOUR CAREER

1.5 *Develop skills that employers have identified as critical to success in the workplace.*

If you are not an operations or supply chain major, you may think that this book is not relevant to you. Let me assure you it is. Whether or not you plan on a career in operations or supply chain management, the lessons you will learn in this book will help you develop career skills that are useful no matter what path you take. Employers have identified communication, critical thinking, collaboration, knowledge application and analysis, business ethics and social responsibility, data literacy, and information technology application and computing skills as being important for success in the 21st century. This book helps you develop several of these skills.

A key theme that permeates this book is the link between strategic decision making and analytics. Good strategic decisions cannot be made without access to relevant analytics, and all analytics should be designed to support decision making. Thus, every chapter in the book pushes students to think critically in order to define and solve supply chain problems. For example, Chapter 4 develops a framework for distribution networks and then pushes students to think about how retailing may evolve in the future as consumer preferences and technology change. The first part of the chapter teaches frameworks and concepts related to the design of distribution networks. The last part of the chapter then pushes the students to analyze retailing by applying the knowledge they have gained in order to decide how retailers need to change in order to succeed in the 21st century.

Analytics that supports these frameworks is then discussed in detail in the following chapters. For example, Chapter 11, 12, and 13 help students learn the analytics related to inventory management in a supply chain. All the analytics in the book are developed through the use of Microsoft Excel. This helps students develop data literacy, computing skills, and the knowledge of how to apply information technology to support decision making. The analytics that are developed in these chapters in turn support the framework laid out in Chapter 4. Whereas Chapter 4 helps students to think conceptually about why certain retailing models have succeeded for selling jewelry while others have failed, the succeeding chapters help students quantify financial metrics for different retail networks. As a result, students learn how to use data and models to improve strategic decision making. This is a skill that will be of great importance in the 21st century where decision makers will face rapidly changing environments and a surplus of data that must be reconciled when making decisions.

SUMMARY OF LEARNING OBJECTIVE 5

Skills learned in this book will be of great use no matter what path students choose to follow. The book is developed with the premise that good strategic decisions cannot be made without access to relevant analytics, and all analytics should be designed to support decision making. As a result, students will develop critical thinking, the ability to formulate and analyze problems, and support their recommendations with analytics that uses data literacy and computing skills.

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 such as 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 such as 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 such as Amazon? List two supply chain decisions that have a significant impact on supply chain profitability.
7. List some of the strategic, planning, and operational decisions that an automotive manufacturer must make with regards to its supply chain.

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CHAPTER

2

Achieving Strategic Fit in a Supply Chain

LEARNING OBJECTIVES

After reading this chapter, you will be able to

2.1 Explain why achieving strategic fit is critical to a company's overall success.

2.2 Describe how a company achieves strategic fit between its supply chain strategy and its competitive strategy.

2.3 Identify the main levers to deal with uncertainty in a supply chain.

2.4 Discuss the importance of expanding the scope of strategic fit across the supply chain.

In Chapter 1, we discussed 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 identify key levers that can be used to deal with uncertainty in a supply chain. 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.

COMPETITIVE AND SUPPLY CHAIN STRATEGIES

2.1 *Explain why achieving strategic fit is critical to a company's overall success.*

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

We can also contrast Blue Nile, with its online retailing model for diamonds, with Zales, which sells diamond jewelry through retail outlets. Blue Nile has emphasized the variety of

diamonds available from its website and the fact that its prices are significantly lower than its bricks-and-mortar competition. Customers, however, have to wait to get their jewelry and do not have any opportunity to touch and see it before purchase (Blue Nile does provide a 30-day return period, though). At Zales, in contrast, a customer can walk into the retail store, be helped by a salesperson, and leave immediately with a diamond ring. The variety available at a Zales store, however, is limited. Whereas Blue Nile offers more than 190,000 stones on its site, a typical Zales store carries fewer than a thousand.

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

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

The value chain begins with new product development, which creates specifications for the product. Marketing and sales generate demand by publicizing the customer priorities that the products and services will satisfy. Marketing also brings customer input back to new product development. Operations transforms inputs to outputs according to specifications 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. 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

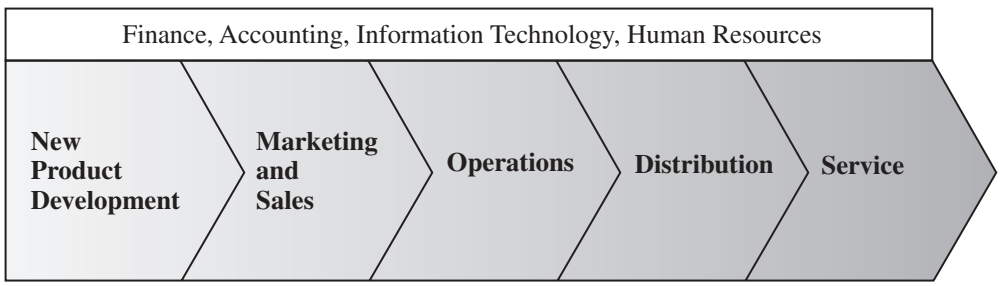

Figure 2-1 The Value Chain in a Company

strategy." For example, Dell's initial decision to sell direct, its 2007 decision to start selling PCs through resellers, and Cisco's decision to use contract manufacturers define the broad structure of their supply chains and are all part of their supply chain strategies. Amazon's decision in 2016 to open bookstores and announce the opening of "convenience" stores is a part of its supply chain strategy. Supply chain strategy also includes design decisions regarding inventory, transportation, operating facilities, and information flows. For example, Amazon's decisions to build warehouses to stock some products and to continue using distributors as a source of other products are part of its supply chain strategy. Similarly, Toyota's decision to have production facilities in each of its major markets is part of its supply chain strategy.

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

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

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

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

To elaborate on strategic fit, let us consider the evolution of Dell and its supply chain between 1993 and the present. Between 1993 and 2006, Dell's competitive strategy was to provide a large variety of customizable products at a reasonable price. Given the focus on customization, Dell's supply chain was designed to be very responsive. Assembly facilities owned by Dell were designed to be flexible and to easily handle the wide variety of configurations requested by customers. A facility that focused on low cost and efficiency by producing large volumes of the same configuration would not have been appropriate in this setting.

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

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

SUMMARY OF LEARNING OBJECTIVE 1

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. A lack of strategic fit between the competitive and supply chain strategies can result in the supply chain taking actions that are not consistent with customer needs, leading to a reduction in supply chain surplus and a decrease in supply chain profitability.

2.2 *Describe how a company achieves strategic fit between its supply chain strategy and its competitive strategy.*

HOW IS STRATEGIC FIT ACHIEVED?

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

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

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

Understanding the Customer and Supply Chain Uncertainty

To understand the customer, a company must identify the needs of the customer segment being served. Each customer in a particular segment will tend to have similar needs, whereas customers

in a different segment can have very different needs. Let us compare Seven-Eleven Japan and a discounter such as Sam's Club (a part of Walmart). When customers go to Seven-Eleven to purchase detergent, they go there for the convenience of a nearby store and are not necessarily looking for the lowest price. In contrast, low price is very important to a Sam's Club customer. This customer may be willing to tolerate less variety and even purchase large package sizes as long as the price is low. Even though customers purchase detergent at both places, the demand varies along certain attributes. In the case of Seven-Eleven, customers are in a hurry and want convenience. In the case of Sam's Club, they want a low price and are willing to spend time getting it. In general, customer demand from different segments varies along several attributes, as follows:

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

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

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

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

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

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

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

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

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.

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

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

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

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

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: Based on Marshall L. Fisher, "What Is the Right Supply Chain for Your Product?" Harvard Business.

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: Based on Hau L. Lee, "Aligning Supply Chain Strategies with Product Uncertainties." California.

Lee (2002) pointed out that along with demand uncertainty, it is important to consider uncertainty resulting from the capability of the supply chain. For example, when a new component is introduced in the consumer electronics industry, the quality yields of the production process tend to be low and breakdowns are frequent. As a result, companies have difficulty delivering according to a well-defined schedule, resulting in high supply uncertainty for electronics manufacturers. As the production technology matures and yields improve, companies are able to follow a fixed delivery schedule, resulting in low supply uncertainty. Table 2-3 illustrates how various characteristics of supply sources affect the supply uncertainty.

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

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

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

Understanding the Supply Chain Capabilities

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

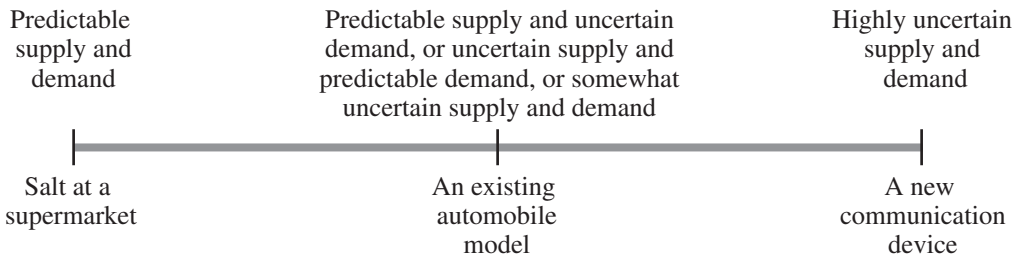

Figure 2-2 The Implied Uncertainty (Demand and Supply) Spectrum

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

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

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

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

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

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

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

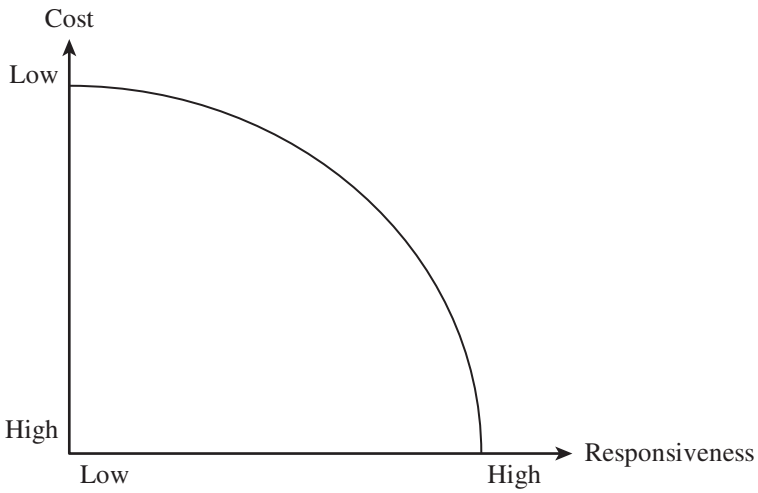

Figure 2-3 Cost-Responsiveness Efficient Frontier

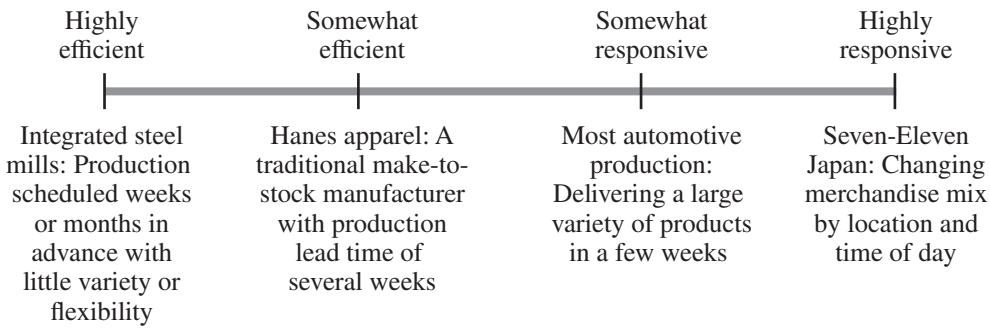

Figure 2-4 The Responsiveness Spectrum

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

Achieving Strategic Fit

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

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

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

From the preceding discussion, it follows that increasing implied uncertainty from customers and supply sources is best served by increasing responsiveness from the supply chain. This

relationship is represented by the "zone of strategic fit" illustrated in Figure 2-5. For a high level of performance, companies should move their competitive strategy (and resulting implied uncertainty) and supply chain strategy (and resulting responsiveness) toward the zone of strategic fit.

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

IKEA is a Swedish furniture retailer with large stores in about fifty countries. IKEA has targeted customers who want stylish furniture at a reasonable cost. The company limits the variety it needs to stock by selling unassembled furniture and designing modular components that are used in multiple finished products. The large scale of each store and the limited variety of components sold decrease the implied uncertainty faced by the supply chain. IKEA stocks all components in inventory and serves customers from stock. Thus, it uses store inventory to absorb all the uncertainty faced by the supply chain. The presence of inventory at large IKEA stores allows replenishment orders to its manufacturers to be more stable and predictable. As a result, IKEA passes along little uncertainty to its manufacturers, who tend to be located in low-cost countries and focus on efficiency. IKEA provides responsiveness (in the form of immediate availability) in the supply chain, with the stores absorbing most of the uncertainty and being responsive, and the suppliers absorbing little uncertainty and being efficient.

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

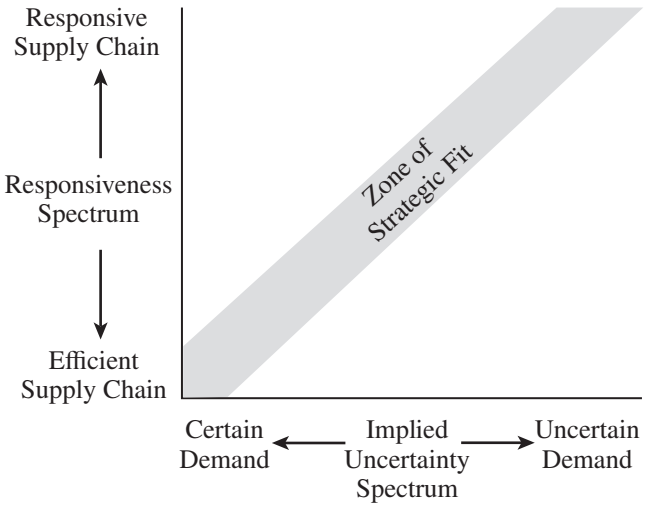

Figure 2-5 Finding the Zone of Strategic Fit

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

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

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

Tailoring the Supply Chain for Strategic Fit

Our previous discussion focused on achieving strategic fit when a firm serves a single market segment and the result is a well-defined and narrow strategic position. Although such a scenario holds for firms like IKEA, many firms are required to achieve strategic fit while serving many customer segments with a variety of products across multiple channels. In such a scenario, a

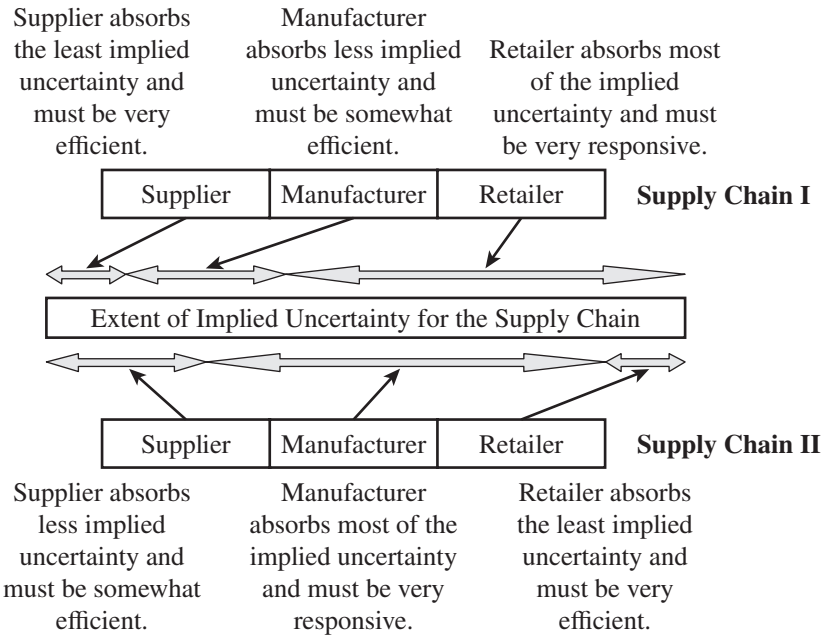

Figure 2-6 Different Roles and Allocations of Implied Uncertainty for a Given Level of Supply Chain Responsiveness

TABLE 2-4 Comparison of Efficient and Responsive Supply Chains

	Efficient Supply Chains	Responsive Supply Chains
Primary goal	Supply demand at the lowest cost	Respond quickly to demand
Product design strategy	Maximize performance at a minimum product cost	Create *modularity* to allow postponement of product differentiation
Pricing strategy	Lower margins because price is prime customer driver	Higher margins because price 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: Based on Marshall L. Fisher, "What Is the Right Supply Chain for Your Product?" Harvard Business.

"one size fits all" supply chain cannot provide strategic fit, and a tailored supply chain strategy is required. For example, Zara sells trendy items with unpredictable demand along with basics, such as white T-shirts, with a more predictable demand. Whereas Zara uses a responsive supply chain with production in Europe for trendy items, it uses a more efficient supply chain with production in Asia for the basics. This tailored supply chain strategy provides a better strategic fit for Zara compared with using a single supply chain. Another example is Levi Strauss, which sells both customized and standard-sized jeans. Demand for standard-sized jeans has a much lower demand uncertainty than demand for customized jeans. As a result, Levi Strauss must tailor its supply chain to meet both sets of needs.

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

Tailoring the supply chain requires sharing operations for some links in the supply chain, while having separate operations for other links. The links are shared to achieve maximum possible efficiency while providing the appropriate level of responsiveness to each segment. For instance, all products may be made on the same line in a plant, but products requiring a high level of responsiveness may be shipped using a fast mode of transportation, such as FedEx. Products that do not have high responsiveness needs may be sent by slower and less expensive means such as truck, rail, or even ship. In other instances, products requiring high responsiveness may be manufactured using a flexible process, whereas products requiring less responsiveness may be manufactured using a less responsive but more efficient process. The mode of transportation used in both cases, however, may be the same. In other cases, some products may be held at regional warehouses close to the customer, whereas others may be held in a centralized warehouse far from the customer. W.W. Grainger holds fast-moving items with low implied uncertainty in its decentralized locations close to the customer. It holds slow-moving items with higher implied demand uncertainty in a centralized warehouse. Appropriate tailoring of the supply chain

helps a firm achieve varying levels of responsiveness for a low overall cost. The level of responsiveness is tailored to each product, channel, or customer segment. Tailoring of the supply chain is an important concept that we develop further in subsequent chapters.

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

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

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

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

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

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

SUMMARY OF LEARNING OBJECTIVE 2

To achieve strategic fit, a company must first understand the needs of the customers being served and the capabilities of all supply sources. Both the needs and the capabilities should be used to identify the implied uncertainty that the supply chain must absorb. The second step is to understand the supply chain's capabilities in terms of efficiency and responsiveness. The key to strategic fit is ensuring that supply chain responsiveness is consistent with customer needs, supply capabilities, and the resulting implied uncertainty. Tailoring the supply chain is essential to achieving strategic fit when supplying a wide variety of customers with many products through different channels.

SUPPLY CHAIN LEVERS TO DEAL WITH UNCERTAINTY

2.3 *Identify the main levers to deal with uncertainty in a supply chain.*

There are five basic levers that can be used to deal with uncertainty in a supply chain – capacity, inventory, time, information, and price. Let us start with an example where all five levers are commonly used. Consider a fashion retailer preparing for the fall season. The retailer starts by looking at historical sales and any other information available relating to consumer preferences.

The better the available information, the less uncertainty the retailer faces with regards to anticipated customer demand. Given the uncertainty of demand and the level of service planned for its customers, the retailer must decide on the level of inventory to start the season with. This will depend on the available supply capacity and the time taken by the supplier to fulfill a replenishment order. The more the available supply capacity and the quicker that a replenishment order arrives, the less the starting inventory required by the retailer. As the season progresses, the retailer may decrease prices to spur demand if the available inventory seems to be too high. Finding the right combination of actions in each of the five levers is critical for the retailer's success. As shown in Figure 2-7, a supply chain achieves strategic fit by finding the right balance between these levers to respond to the implied uncertainty it faces.

We now discuss each of the levers and the role they play in dealing with uncertainty.

CAPACITY A combination of excess capacity and flexible capacity can help a supply chain deal with uncertainty. An example of both is the paint mixer found in paint stores in most parts of the world. The mixers are flexible and can mix paint in a large variety of colors. This allows the paint store to deal with the uncertainty of which color a particular customer may want to buy. The capacity of a mixer is large enough that it helps the paint store deal with the uncertainty of the number of customers who will arrive at any time looking for paint. A supply chain must consider the cost of excess capacity and flexibility when using capacity as a lever to deal with uncertainty.

INVENTORY Holding inventory is one of the most common levers used in practice to deal with uncertainty. Most of the inventory sitting at a Chanel store is held because there is uncertainty about the product that customers walking into the store may purchase. A dealer holds a variety of cars in inventory because demand is uncertain. A supply chain must consider the cost of holding inventory when using this lever to deal with uncertainty.

TIME A combination of speedy supply and the willingness of customers to wait can help a supply chain deal with uncertainty. Zara uses its ability to replenish its stores quickly to reduce the underlying uncertainty of demand. Its ability to replenish its stores within 48 hours leaves it vulnerable to uncertainty of demand only over that 48-hour period. In contrast, customers at an integrated steel mill often wait weeks for their product to be delivered. The long promised lead times allow the steel mill to aggregate demand over a long period of time, thus reducing its uncertainty. A supply chain must consider the cost of speedy supply and the potential loss of customers by making them wait when using time as a lever to deal with uncertainty.

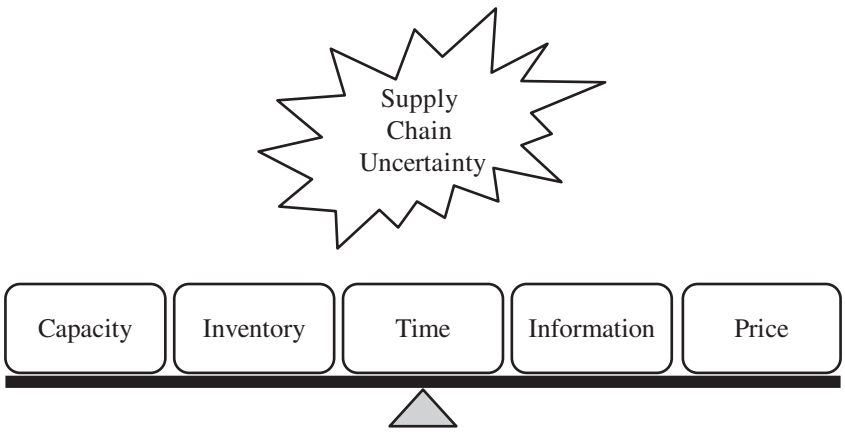

Figure 2-7 Five Key Levers to Deal with Supply Chain Uncertainty

INFORMATION Uncertainty is nothing but an absence of the right information. Thus, investing in the appropriate information can help a supply chain reduce the uncertainty it faces. A well-publicized example is that of Target trying to identify pregnant women so they could send them specially designed ads in their second trimester, which is when expectant mothers start buying new things for themselves and the baby[1]. Statisticians at Target identified about 25 products whose purchasing patterns for shoppers allowed Target to assign each shopper a "pregnancy prediction" score. This information was used by the company to send coupons to each shopper that were timed to match with her needs during specific stages of the pregnancy. Investment in the appropriate information (as opposed to data) allowed Target to significantly reduce its uncertainty when targeting shoppers.

PRICE Prices of products and services that vary over time can help a supply chain deal with uncertainty. Prices of baseball games and even Disney theme parks are higher on busy days. This is similar to what airlines and hotels have done for years by dynamically changing the price they charge based on unused seats or hotel rooms. Close to the scheduled time, prices of seats and rooms go up or down based on whether demand has been high or low up to that point. Apparel retailers constantly vary the discount they offer based on unsold inventory. In each instance, lower prices are used to spur demand if unsold inventory is high relative to demand or higher prices are charged if unsold inventory is low relative to demand. A supply chain needs a lot of real time information about inventory, demand, and customer response to effectively implement dynamic pricing.

As shown in Figure 2-7, a supply chain must find the right balance of these levers to deal with uncertainty. When capacity is cheap, a supply chain may over invest in capacity to save on the other levers. Department stores in India stock almost all men's pants based only on waist size and not length. Tailors on site customize the length in a short period of time as customers finish shopping. The investment in low cost capacity at each store significantly reduces the inventory held at the store. In contrast, a retailer like The Gap in the United States stocks pants based on both waist size and length. While this solution increases the amount of inventory held, it decreases the investment in centralized production capacity. In any supply chain, finding the right balance among the levers is the key to strategic fit.

SUMMARY OF LEARNING OBJECTIVE 3

The implied uncertainty that a supply chain needs to absorb depends on the needs of the customer segment(s) targeted. Capacity, inventory, time, information, and price are the five levers that a supply chain can use to deal with this uncertainty. Investing more in one lever generally allows the supply chain to invest less in one or more of the other levers. To achieve strategic fit, a supply chain must find the right balance between investments in the five levers to effectively serve the target customer segment(s).

EXPANDING STRATEGIC SCOPE

2.4 *Discuss the importance of expanding the scope of strategic fit across the supply chain.*

A key issue relating to strategic fit is the scope, in terms of supply chain stages, across which the strategic fit applies. *Scope of strategic fit* refers to the functions within the firm and stages across the supply chain that devise an integrated strategy with an aligned objective. At one extreme, every operation within each functional area devises its own independent strategy, with the objective of optimizing its local performance. In this case, the scope of strategic fit is restricted to an operation in a functional area within a stage of the supply chain. At the opposite extreme,

[1] Charles Duhigg. "How Companies Learn Your Secrets," *New York Times*, February 16, 2012, http://www.nytimes.com/2012/02/19/magazine/shopping-habits.html.

all functional areas across all stages of the supply chain devise aligned strategies that maximize supply chain surplus. In this case, the scope of strategic fit extends to the entire supply chain.

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

Intraoperation Scope: Minimizing Local Cost

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

Intrafunctional Scope: Minimizing Functional Cost

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

Interfunctional Scope: Maximizing Company Profit

The key weakness of the intrafunctional view is that different functions within a firm may have conflicting objectives. For example, marketing and sales may focus on revenue generation, whereas manufacturing and distribution focus on cost reduction. In this case, the actions taken by the two functions are often in conflict and hurt the firm's overall performance. Over time, companies have realized the importance of expanding the scope of strategic fit and aligning strategy across all functions within the firm. With the interfunctional scope, the goal is to maximize company profit. To achieve this goal, all functional strategies are developed to align with one another and with the competitive strategy.

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

inventory and warehouse expense. The company enjoys high profits because all functions align their strategy around the common objective of reliable next-day delivery of a wide variety of MRO products.

Intercompany Scope: Maximizing Supply Chain Surplus

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

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

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

Agile Intercompany Scope

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

Agile intercompany scope refers to a firm's ability to achieve strategic fit when partnering with supply chain stages that change over time. For example, a company may select both a responsive as well as an efficient supplier for a product. An agile intercompany scope would allow the firm to use the low cost supplier to supply the predictable portion of demand for the product with the responsive supplier being the backup who comes through when demand exceeds supply available from the low cost supplier. The agility to shift demand between the efficient and responsive supplier increases the overall supply chain surplus in an unpredictable environment.

SUMMARY OF LEARNING OBJECTIVE 4

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 Walmart.
6. Give arguments to support the statement that Walmart has achieved good strategic fit between its competitive and supply chain strategies. What challenges does it face as it works to open smaller format stores?
7. What are some factors that influence implied uncertainty? How does the implied uncertainty differ between an integrated steel mill that measures lead times in months and requires large orders and a steel service center that promises 24-hour lead times and sells orders of any size?
8. What is the difference in implied uncertainty faced by a convenience store chain such as 7-Eleven, a supermarket chain, and a discount retailer such as Costco?
9. What are some problems that can arise when each stage of a supply chain focuses solely on its own profits when making decisions? Identify some actions that can help a retailer and a manufacturer work together to expand the scope of strategic fit.
10. For each of the five levers – capacity, inventory, time, information, and price – identify an example where a supply chain has focused on this lever to deal with uncertainty. In each case, identify reasons why you think it is or is not an appropriate choice.

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CASE STUDY

The Demise of Blockbuster

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

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

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

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

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

Netflix

Netflix was founded in 1997 by Reed Hastings as a pay-per-rental mail-order video rental company. After experimenting with both pay-per-rental and subscription, the company settled on a subscription-based strategy by the end of 1999. By 2010, Netflix had 13 million members and was the world's largest subscription service, sending DVDs by mail and streaming movies and television episodes over the Internet. For $8.99 a month, Netflix members could have any of more than 100,000 DVD titles delivered to their homes and could instantly watch a smaller set of television episodes and movies streamed to their televisions and computers. Netflix shipped some 2 million discs daily in the United States.

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

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

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

	Blockbuster	Netflix	Coinstar
Revenue	4,062	1,670	1,145
Cost of revenue	1,884	1,079	793
Gross profit	2,178	591	352
Operating expenses			
Sales, general, and administrative	2,020	289	150
Total operating expenses	2,533	399	267
Operating income	(355)	192	85
Net income from continuing operations	(518)	116	29
Net income	(558)	116	54
ASSETS			
Receivables	79	—	61
Inventories	639	37	104
Total current assets	1,060	411	391
Property and equipment at cost	2,374	266	759
Accumulated depreciation	(2,125)	(134)	(358)
Net property, plant, and equipment	249	132	400
Total assets	1,538	680	1,223

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

Between 2005 and 2009, Netflix delivered excellent financial results and grew revenues by 150 percent and profits by about 175 percent. Despite the strong performance of its DVD rental business, however, the company was focused on increasing the fraction of digital content it delivered. Its streaming service, launched in 2007, allowed customers to watch select movies and content on the Netflix website via their PCs. By 2009, the Netflix service offered more than 17,000 titles (although most new releases were not included in the selection) streamed through a variety of devices. By 2013, the streaming service contributed majority of Netflix's revenue, although most of the profits still came from the DVD mailing business.

Redbox

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

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

By early 2010, Redbox had approximately 23,000 kiosks nationwide, including in select McDonald's restaurants, leading grocery stores, and Walmart, Walgreens, and 7-Eleven stores. Redbox had expanded to over 40,000 kiosks by 2012. Retailers, who were struggling to keep people shopping, realized that having a DVD kiosk in a store created foot traffic. In some cases, retailers even offered discounts that essentially made it free for Redbox to install a kiosk.

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

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

Study Questions

1. In what ways did Blockbuster achieve better strategic fit than local stores?
2. How much implied uncertainty do Netflix and Redbox face? What levers do they use to deal with this uncertainty?
3. How did Netflix and Redbox achieve better strategic fit than Blockbuster?

CHAPTER

3

Supply Chain Drivers and Metrics

LEARNING OBJECTIVES

After reading this chapter, you will be able to

3.1 Describe key financial measures of firm performance.

3.2 Identify the major drivers of supply chain performance.

3.3 Define the key performance metrics for facilities and discuss their role in creating strategic fit between the supply chain strategy and the competitive strategy.

3.4 Define the key performance metrics for inventory and discuss its role in creating strategic fit between the supply chain strategy and the competitive strategy.

3.5 Define the key performance metrics for transportation and discuss its role in creating strategic fit between the supply chain strategy and the competitive strategy.

3.6 Define the key performance metrics for information and discuss its role in creating strategic fit between the supply chain strategy and the competitive strategy.

3.7 Define the key performance metrics for sourcing and discuss its role in creating strategic fit between the supply chain strategy and the competitive strategy.

3.8 Define the key performance metrics for pricing and discuss its role in creating strategic fit between the supply chain strategy and the competitive strategy.

In this chapter, our goal is to link key financial measures of firm performance to supply chain performance. We introduce the three logistical drivers—facilities, inventory, and transportation—and the three cross-functional drivers—information, sourcing, and pricing—that determine the performance of any supply chain. We discuss how these drivers are used in the design, planning, and operation of the supply chain. We define several metrics that can be used to gauge the performance of each driver and its impact on strategic fit and financial performance.

3.1 *Describe key financial measures of firm performance.*

FINANCIAL MEASURES OF PERFORMANCE

In Chapter 1, we discussed how growing the supply chain surplus is the ultimate goal of a supply chain. Our premise was that increasing the surplus allows for a growth of supply chain profitability, which facilitates an improvement in the financial performance of each member of the