Chapter 1

Context of Supply Chain Management

Learning Objectives

After reading this chapter, you should be able to:

- Discuss the evolution of the supply chain.
- Define what a supply chain is.
- Identify the three main flows in a typical supply chain.
- Define what supply chain management is.
- Discuss the difference between logistics management and supply chain management (SCM).
- Classify the supply chain decisions in a firm.

1.1 Evolution of Supply Chain

The supply chain isn't a new concept. Actually, it evolved over time. The supply chain was coined to cope with the challenges that existed at different times in history.

In the first half of the twentieth century, vertical integration was a popular form of business structure. Vertical integration normally implies ownership of upstream suppliers and downstream customers, which was once viewed as a desirable strategy for many organizations. This strategy means that a business attempts to be mostly self-sufficient. For example, a firm's primary business is the assembly of finished products, and it also has an in-house fabrication department to manufacture components. On the downstream side, the firm may have its own distribution centers and, in some cases, its own retail stores. One classic example of this arrangement is the River Rouge plant of Ford Motors. This company brought in iron ore from company-owned mines, processed it through the foundries and metal working shops, and moved on to the final assembly line, all within the span of 2-3 days.

The advantage of vertical integration is obvious. Firms own direct control of all operations, reduce work-in-process inventories, and reduce cycle time from the raw material stage to the finished goods stage. However, as the market expanded geographically and customers became more diverse, products became more complex or custom to satisfy the

greater diversity in the marketplace. It was increasingly difficult for one organization to do everything for itself. Consequently, many businesses began to shift from a pattern of making everything by themselves to buying arrangements, which led to what is now known as outsourcing, where an activity that used to be done in-house is transferred to outsiders who can provide an advantage in terms of cost or value. In other words, organizations are now focusing on their core business, which are the things that they do really well and where they have a distinguished advantage. Everything else is outsourced or procured outside the firm. For instance, automobile manufacturers that once made components now only assemble the finished product. Some companies may subcontract the manufacturing as well. An example is Nike in footwear and sportswear. The advantage of this strategy is getting a greater variety of products at lower costs. The disadvantages are loss of direct control and experiencing longer lead times to obtain products. Nevertheless, outsourcing is a huge development in management strategy compared to vertical integration since it helps many small and medium-scale organizations build up their core competency and improve their profitability.

By the definition of outsourcing, it's natural that there are more interfaces to be managed among different organizations. Such extended enterprise, virtual or network organization, as some have termed it, becomes a popular form in which competitive advantage is gained. Clearly, this trend implies that integrating and coordinating the material flows from a multitude of suppliers, often offshore, and managing the distribution of the finished products by way of multiple intermediaries are all pressing issues because the value and cost reduction are not created by the focal firm in a network but by all the entities that connect to each other.

With the emphasis on the search for strategies that would align a variety of organizations in order to provide superior value, a new concept, the supply chain, was brought to a wider audience, which was closely associated with the supply side or the upstream part of a transaction. At the same time, the customer or the demand side received more attention since what the organization really needed was to adapt or reconfigure its architecture in response to major changes both on the demand side and the supply side of the business. While the phrase "supply chain" is now widely used, it could also be termed "demand chain" to reflect the fact that the chain should be driven by the market, not by suppliers. To recognize such an expansion of scope, some use the term "value chain". In other words, the supply chain becomes the "value chain". However, the consensus at present is that supply chain is the accepted term to cover both demand sides and supply sides in the entire business, and we will use the supply chain consistently throughout this book.

In Table 1.1, we see a list of the top 25 supply chains around the world, as compiled by Gartner Research. Mike Griswold, vice president analyst with the Gartner Supply Chain practice, said, "With the economy close to stagnation due to the COVID-19 pandemic, leaders

need an agile strategy that allows the supply chain organization to sense and respond to changes in the business context as they happen. Our ranking highlights companies that possess these strategies and other differentiating capabilities."

Table 1.1 The Gartner Supply Chain Top 25 for 2023

Rank	Company	Rank	Company
1	Schneider Electric	14	Tesla
2	Cisco Systems	15	Siemens
3	Colgate-Palmolive	16	Intel
4	Johnson & Johnson	17	Nestle
5	PepsiCo	18	AstraZeneca
6	Pfizer	19	Dell Technologies
7	Microsoft	20	McDonald's
8	Lenovo	21	HP Inc.
9	Walmart	22	AB InBev
10	L'Oreal	23	Alibaba Group
11	The Coca-Cola Company	24	GlaxoSmithKline
12	Diageo	25	Dow
13	Inditex		

Sources: Gartner Press Release, May 24, 2023

1.2 What Is Supply Chain?

1.2.1 Definition of Supply Chain

There are plenty of definitions for supply chain, which often change depending on who's doing the telling. The APICS Dictionary defines a supply chain as "the global network used to deliver products and services from raw materials to end customers through an engineered flow of information, physical distribution, and cash" (Blackstone, 2013).

A supply chain, in its essence, refers to the network of organizations that are involved, through upstream and downstream linkages in different processes and activities, which produce value in the form of products and services for the ultimate consumer. Specifically speaking, a supply chain consists of various participants who perform a sequence of activities in moving physical goods or services from origins to consumption points in the following order from upstream to the ultimate consumers (or from downstream to the origins): suppliers, manufacturing centers, warehouses, distribution centers as well as retail outlets, and raw materials, work-in-process inventory, and finished products that flow among these facilities.

In a typical supply chain, raw materials are procured, and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers

or customers. For example, a sweater manufacturer is part of a supply chain that extends upstream through the fabric weaving mills to the fiber manufacturers and downstream through distributors and retailers to the final consumers. Each of these organizations in the supply chain is dependent on each other by definition and yet, paradoxically, does not closely cooperate with each other by tradition.

To better understand what a supply chain is, Figure 1.1 shows the supply chain participants in the apparel industry and how products flow from upstream suppliers to downstream customers.

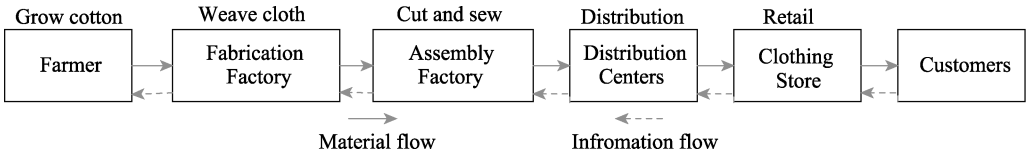

Figure 1.1 An Apparel Supply Chain

To avoid redundancy, we use the word “products” to represent both products and services throughout this book. In practice, the word “chain” should be replaced by “network” since there are indeed multiple suppliers and suppliers’ suppliers as well as multiple customers to be included in the entire system. It may be more accurate to use the term supply network or supply web to describe the structure of most supply chains. For instance, a car is a sophisticated product made of thousands of components ranging from the engine, brake system, wheels, transmission, suspension, lamp, and electronics. A competitive manufacturer in the automobile industry needs to seamlessly manage a network of suppliers to ensure car parts ordered get delivered on time. After receiving raw materials, the manufacturer begins the production process according to a production plan that is based on demand forecasts or customer orders. If a car needs to proceed through multiple assembly processes, manufacturers should be arranged in tiers. Manufacturers that produce intermediate products are called component manufacturers or fabricators. All intermediate products flow to the final product manufacturers for the final assembly. The finished products continue the journey to the wholesalers or distributors, then to retailers, and finally into the hands of customers. If customers are not satisfied with the products or services, they may return the purchased products to retailers or manufacturers as part of the reverse logistics process. The returned products then travel back to the distributors, wholesalers, manufacturers, and perhaps even the raw material suppliers.

It should be noted that the stages in one supply chain maybe are different from another. The appropriate design of the supply chain depends on both the customer's needs and the roles played by the stages involved. For example, Dell possesses two supply chains based on the categories of customers. For enterprises and customers who desire customized computers,

Dell adopts a build-to-order supply chain design; that is, a customer's order initiates manufacturing at Dell. Thus, Dell doesn't have a retailer, wholesaler, or distributor in its supply chain. As for regular customers who are sensitive to prices and wouldn't like to wait, Dell adopts a build-to-stock supply chain; in other words, manufacturers do not respond to customer orders directly, and instead, Dell prepares the products for future customers. In this case, Dell maintains an inventory of products from which it fulfills customer orders. Compared to the first type of supply chain, the second supply chain contains an extra stage, the retailer.

1.2.2 Three Flows of Supply Chain

A supply chain is dynamic and involves the constant flow of information, products, and funds at different stages. Information flows along the supply chain toward the customer to aid in tracking the product flow and flows upstream from the customer to suppliers to aid in identifying the characteristics of the demand for the product. At each stage of the supply chain, the customers pay their suppliers for the goods and services received; consequently, funds flow upstream from the ultimate consumer to the original supplier. For instance, the retailers, such as Walmart, provide product pricing and availability information to the customer. The customer transfers funds to Walmart. In turn, Walmart conveys point-of-sales data as well as replenishment orders to the warehouse or distributor, who provides pricing information and sends delivery schedules. Then Walmart transfers funds to the distributor after the replenishment to Walmart. Walmart may send back packaging material to be recycled. Similar information, material, and funds flows take place across the entire supply chain. Therefore, the term "supply chain" comprises not only the physical movement of products from suppliers to customers through manufacturers, distributors, and retailers, but also the flow of information, funds, and products in both directions of this chain.

Since supply chain activities take place in sequence, any problems in these activities can slow or stop the flows of goods, information, and funds, which further leads to an inefficient supply chain with some typical supply chain problems, such as back orders, excessive inventory, insufficient funds, customer complaints, and product defects. Conversely, an orchestrated collaboration among suppliers, manufacturers, distributors, wholesalers, and retailers can result in an efficient supply chain. Furthermore all partners in the supply chain can profit from its efficiency because the smooth flow of goods, information, and funds can enable all participants to receive goods, correct information, and revenues on a timely basis.

1.2.3 Types of Supply Chain

A supply chain is basically a network of manufacturing and service operations that supply one another from raw materials through manufacturing to the ultimate customer. Obviously, there are different supply chains.

Supply chain type takes into account not only the firm strategy but also the strategies and capabilities of suppliers and customers in the firm's supply chain. Here, the supply chain type is aimed at representing a sustainable competitive advantage for the entire supply chain.

For any company to be successful, its supply chain type and the nature of its products must fit together. Fitness refers to consistency between the products that the company provides to customers and the supply chain capabilities that it strives to build. The issue of achieving fitness is a key consideration during the supply chain design phase. The root cause of supply chain problems is a mismatch between the type of product and the type of supply chain.

To identify the proper supply chain type, it's useful to follow a four-step procedure:

(1) Categorize the products.

(2) Distinguish the supply type.

(3) Recognize the supply chain type.

(4) Identify the appropriate supply chain type to achieve supply chain fitness based on the characteristics of both supply and demand sides.

1. Categorize the Products

Companies should first categorize their products based on whether they are primarily functional or primarily innovative in terms of product characteristics. Each category of product requires a distinctly different kind of supply chain.

Functional products include staples that people buy in a wide range of retail outlets such as grocery stores and gas stations. Because such products satisfy basic needs, which don't change much over time, and have stable and predictable demand patterns with long life cycles. However, the stable nature of functional products invites more competition, which often leads to lowprofit margins.

Specific criteria for identifying functional products include the following:

- Product life cycle lasts more than two years.
- Contribution margin ranges from 5 to 20 percent.
- Product variations are limited to only 10 to 20.
- The forecast error at the time of production averages only 10 percent.
- The lead time for make-to-order products is from six months to one year.

To avoid low margins, many companies introduce innovations in fashion or technology to give customers additional reasons to buy their products. Fashionable clothes and personal computers are good examples. Although innovation can enable a company to achieve higher profit margins, the very newness of the innovative products makes the demand for them unpredictable. These result in the second type of product: innovative products which typically have a life cycle of just a few months. Imitators quickly erode the competitive advantage that

innovative products enjoy, and companies are forced to introduce a steady stream of newer innovations. The short life cycles and the wide variety that is typical of these products further increase unpredictability and thus uncertainty.

Table 1.2 summarizes the differences between functional and innovative products.

Table 1.2 Product Category

Characteristics	Product category	
	Functional Products	Innovative Products
Demand	Predictable	Unpredictable
Product Life Cycle	Long	Short
Inventory Value	Low	High
Product Variety	Low	High
Volume	High	Low
Stock-out Cost	Low	High

2. Distinguish the Supply Type

Based on the above discussion on product types, we expand by focusing on the supply side of the supply chain. There are characteristics revolving around the supply side, which are equally important drivers for determining the right supply chain type. We now consider the characteristics of the supply side and categorize them.

A stable supply is characterized by mature manufacturing processes and underlying technology, and a well-established supply base. In a stable supply process, manufacturing complexity tends to be low or manageable. Stable manufacturing processes tend to be highly automated, and long-term supply contracts are prevalent.

In contrast, an evolving supply is in a situation where the manufacturing and the underlying technology are still under early development and are rapidly changing. As a result, the supply base may be limited in both size and experience. In an evolving supply process, the manufacturing process requires a lot of fine-tuning and is often subject to breakdowns and uncertain yields. The supply base may not be reliable because the suppliers are going through process innovations.

Table 1.3 summarizes some differences in various characteristics between stable supply and evolving supply.

Table 1.3 Supply Characteristics

Characteristics	Supply Category	
	Stable	Evolving
Breakdowns	Few	Higher
Process Yield	High	Lower
Quality Problems	Few	More
Supply Sources	Many	Few
Process Changes	Few	Many
Lead Time	Dependable	Difficult to predict

Supply characteristics are also affected by the life-cycle position of the product. New products being introduced have higher supply instability because designs and production processes are still evolving. In contrast, mature products have less supply uncertainty. For example, when a new component is introduced in the production process, the quality yields tend to be low, and the occurrence of breakdowns is frequent. As a result, manufacturers are faced with high supply uncertainty, making it difficult to deliver according to a previously well-defined schedule. As production technology matures and yields improve, companies are able to follow a fixed delivery schedule, resulting in low supply uncertainty.

By combining the characteristics of demand and supply sides, it's often implied that functional products tend to have a more mature and stable supply process, while that is not always the case. For example, the annual demand for electricity and other utility products in a certain region tends to be stable and predictable, but the supply of hydroelectric power, which relies on rainfall in a region, can be erratic year by year. Also, there is a very stable demand for some food, but the supply, either in quantity or quality, depends on yearly weather conditions. Similarly, there are also innovative products with a stable supply process. Fashion apparel products have a short selling season, and the demand of them is highly unpredictable. However, the supply process is very stable, with a reliable supply base and mature manufacturing process and technology. Figure 1.2 gives some examples of products that have different product and supply types.

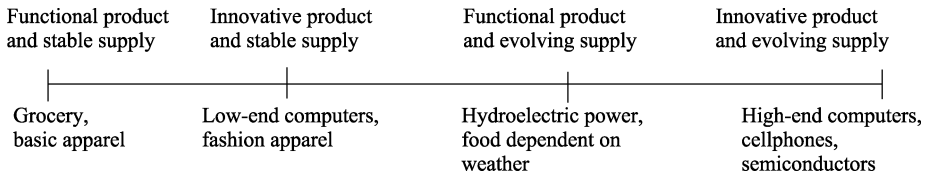

Figure 1.2 Examples of Products with Different Product and Supply Types

3. Recognize the Supply Chain Type

After understanding the product and supply characteristics, the next question is: How does the firm best align the product with that environment? Creating fitness is all about creating a supply chain type that best suits the product a company has produced, given the supply traits it faces.

Supply chain is often categorized into efficient supply chain, responsive supply chain, risk-hedging supply chain and agile supply chain.

An efficient supply chain is a supply chain that utilizes strategies to create the highest level of cost efficiency. In other words, Supply chain efficiency is the inverse of the cost involved in making and delivering a product to the customer. The increases in cost lower the efficiency. For such efficiencies to be achieved, non–value-added activities should be eliminated, scale economies should be pursued, optimization techniques should be deployed

to get the best capacity utilization in production and distribution, and information linkages should be established to ensure the most efficient, accurate, and cost-effective transmission of information across the supply chain. 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.

A responsive supply chain is a supply chain that utilizes strategies to promptly and flexibly address the changing and diverse needs of customers. To be responsive, companies use build-to-order and mass customization processes as a means to meet the specific requirements of customers. However, for every strategy to increase responsiveness, there are additional costs that lower efficiency. For instance, to respond to a wider range of quantities demanded, capacity must be increased, which increases costs.

Note that efficient and responsive supply chains are discussed in a static context; that is, the players in a supply chain and the customer needs do not change over time. In reality, the situation is much more dynamic. Different kinds of uncertainty could arise from both product and the supply sides. Therefore, firms must be agile enough and risk-proof to maintain competitiveness in a changing environment. Thereby, risk-hedging supply chain and agile supply chain are proposed.

A risk-hedging supply chain is a supply chain that utilizes strategies to pool and share resources so that the risks of supply disruption can be shared. A single supply source could be vulnerable to supply disruptions, while more than one supply source or alternative supply resources available could significantly reduce the risk of disruption. For example, a company may increase the safety stock of its key component to hedge against the risk of supply disruption or share the safety stock with other locations that also need this key component to distribute the cost of maintaining this inventory. This inventory pooling strategy is common in retailing, where different retail stores or dealerships share inventory. Information technology is important for the success of these strategies because real-time information on inventory and demand allows the most cost-effective management and transshipment of goods between partners sharing the inventory.

An agile supply chain is a supply chain that utilizes strategies to be responsive and flexible to customer needs while the risks of supply shortages or disruptions are hedged by pooling inventory and other capacity resources. This type of supply chain essentially combines the strengths of both “hedged” and “responsive” supply chains. They are agile because they have the ability to be responsive to the changing, diverse, and unpredictable demands of customers on the front end while minimizing the back-end risks of supply disruptions. For example, a supply chain’s manufacturer may interface with a different set of suppliers and distributors depending on the product being produced and the customer being served. A customer needs vary over time, the supply chain must have the ability to maintain

competency while ensuring strategic fitness. This level of agility becomes more important as the competitive environment becomes more dynamic.

Example 1. 1 illustrates the agile supply chain in practice.

Example 1.1

Zara is one of the world's most successful clothing manufacturers and retailers. It has achieved the leadership position by creating a value proposition around the idea of "Fast Fashion". Almost uniquely, it has developed supply chain processes that enable it to capture ideas and trends in the apparel market and translate them into products in amazingly short lead times. Zara's target time to take an idea from design to store is between three and four weeks. To achieve this quick response capability, Zara has developed an agile network of closely integrated company-owned and independent manufacturing facilities that have the flexibility to produce in small batches at short notice. While this is not the cheapest way to make a garment, it ensures that it can achieve the value proposition.

4. Identify the Appropriate Supply Chain Type to Achieve Supply Chain Fitness Based on the Characteristics of Both the Supply and Demand Sides

Although so far, we have described the attributes of supply and demand, as well as the four types of the supply chain, our goal is to identify which supply chain category would do particularly well for a particular business. Should the firm use a responsive supply chain, an efficient supply chain, a risk-hedging supply chain, or an agile supply chain?

Table 1.4 provides a framework for matching supply chain type with product and supply characteristics. We partition the region spanned by supply and product dimensions into four boxes.

Table 1.4 Framework for Matching Supply Chain Type with Product and Supply Characteristics

		Product Characteristics	
		Functional	**Innovative**
Supply Characteristics	**Stable**	I Grocery, basic apparel, gas	II Fashion apparel, low-end computer, seasonal product
	Evolving	III Hydroelectric power, food dependent on weather	IV Cellphone, high-end computer, semiconductor

Box I represents industries that are characterized by functional products and stable supply, such as the grocery, basic apparel, and gas industries. Our framework suggests that a high degree of an efficient supply chain is appropriate for these industries.

Box II represents industries that are characterized by innovative products and stable supply. Products in industries such as fashion apparel, low-end computers, and seasonal products belong to this category. The demand for these products is quite unpredictable, whereas supply technology is quite mature and highly automated. In these cases, a responsive

supply chain is appropriate. Indeed, mass customization and postponement in the production process are very common means because these strategies enable the firms to provide diversified products and maintain the cost as low as possible by leveraging economies of scale. as low as possible by leveraging economies of scale, and at the same time satisfy the diversified product.

Box III represents industries for which uncertainty in demand is low, whereas the supply process is rather unstable. Hydroelectric power and the agricultural food industry dependent on weather are excellent examples. In this situation, the risk-hedging supply chain is appropriate. For instance, faced with the problem of water shortage in northern China, the government developed the “South-to-North Water Diversion” project, which aims to provide water for more than 100 cities though the cost is extremely huge.

Box IV represents industries characterized by innovative products, indicating unpredictable demand and evolving supply, suggesting an agile supply chain. Many low-volume/fast-moving cellphones, high-end computers, and semiconductors fall into this category.

In most cases, it is more challenging to operate a supply chain that is in the right column of Table 1.4 than in the left column, and similarly, it is more challenging to operate a supply chain that is in the lower row than in the upper row.

Before establishing a supply chain type, it is necessary to understand the sources of the underlying uncertainties and explore ways to reduce these uncertainties. If it is possible to move the product from the right column to the left or the supply from the lower row to the upper, the supply chain performance will improve.

The above discussion focused on achieving supply chain fitness when a firm serves a single product with steady attributes, and the result is a well-defined supply chain position. It is important to understand that the desired level of supply chain type required across the supply chain may be different over the life cycle of a product. We now consider how the product life cycle affects supply chain fitness.

As products go through their life cycle, the product characteristics and supply characteristics would change as the product and production technologies mature. At the beginning stages of a product's life cycle, only early adopters are interested. Demand is very uncertain, supply may be unpredictable, margins are often high, time is crucial to gaining sales, product availability is crucial to capturing the market, and the cost is often a secondary consideration. As the product becomes a commodity later in its life cycle, the demand and supply characteristics change. At this stage, the market is saturated, demand becomes more predictable, supply is certain, margins are lower due to an increase in competitive pressure, and price becomes a significant factor in customer choice. Thus, if a company is to maintain supply chain fitness, its supply chain type must evolve as its products enter different phases. High-technology products are particularly prone to these life-cycle swings over a very short time span.

Thus, firms with different positions across the product spectrum and supply spectrum must adopt different supply chain types. Changing the supply chain type to achieve fitness may sound easy enough to do, but in reality, it can be quite difficult. In later chapters, we will discuss many of the obstacles to achieving this fitness.

1.3 What Is Supply Chain Management (SCM)?

1.3.1 Definition of SCM

Supply chain management is actually not a new idea. From the building of the pyramids to the relief of hunger, the principles that underpin the effective flow of materials, cash and information to meet certain requirements have altered very little.

As global competition increases and businesses expand into foreign markets, firms become more dependent on their supply chains. A sustainable and successful supply chain depends on the continued profitability of the overall supply chain rather than an individual stage.

For commercial supply chains, supply chain profitability, also known as supply chain surplus or supply chain value, represents the difference between the revenue generated from the customer and the overall cost across the supply chain. This universal rule is applicable to old and new businesses as well as to small and large enterprises. For example, a customer purchases a detergent from Walmart and pays $5, which represents the revenue that the supply chain receives. Walmart and other supply chain stages incur costs to convey information, produce components, store and transport goods, transfer funds, and so on. The difference between the $5 that the customer pays and the sum of all costs incurred by the supply chain to produce and distribute the detergent represents the supply chains profitability or surplus. Thus, supply chain profitability is essentially the total profit that is distributed among all participants in the supply chain. Since costs emerge from all flows of information, products, or funds within the supply chain, appropriate management means to synchronize these flows is a key to supply chain success and sustainability, regardless of business goals. And that’s where supply chain management arises from. In other words, supply chain management (SCM) is an approach used to manage the activities involved in product, information, and fund flows to generate revenue and mitigate costs for stakeholders involved at different stages of the supply chain.

In fact, there are different definitions for supply chain management (SCM). We just name one here. The Council of Supply Chain Management Professionals defines SCM as follows: Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply

chain management integrates supply and demand management within and across companies. (CSCMP, 2008)

The definition of supply chain management adopted in this book is as follows: Supply chain management is a set of approaches used to manage all activities associated with the flows of products, information, and funds via efficiently integrating suppliers, manufacturers, warehouses, and stores so that merchandise is produced and distributed in the right quantities, to the right locations at the right time in order to maximize supply chain profit or surplus while satisfying service-level requirements. In this book, we will have a strong focus on analyzing all supply chain decisions in terms of their impact on the supply chain profit.

1.3.2 Distinguish Supply Chain Management from Logistics Management

It's commonplace for many people to confuse supply chain management with logistics management. So the natural questions are: What is logistics management in the sense that it is understood today? And what is the difference between supply chain management and logistics management?

There are many ways to define logistics, but the underlying concept might be defined as that logistics management is primarily concerned with optimizing information, fund and material flows within the organization. The scope of logistics management spans the entire organization, from the management of raw materials to the delivery of the final product. In effect, logistics management is an evolution from the position of complete functional independence where each business function, such as production, distribution or purchasing, makes its own decision in complete isolation from the other business functions. For example, a production department seeks to optimize its unit manufacturing costs by long-term production runs without regard for the stack-up of finished goods inventory, the impact on the need for warehousing space, and the impact on working capital. However, this management pattern of each function acting independently of the other is no longer possible in today's dynamic environment. As Figure 1.3 illustrates, logistics management is an integrative concept aiming to develop a systemwide view of the firm with the "one-plan" mentality. Fundamentally, logistics management seeks to create a framework by which the customer needs are translated into a manufacturing strategy and plan, which in turn is linked to a strategy and plan for procurement.

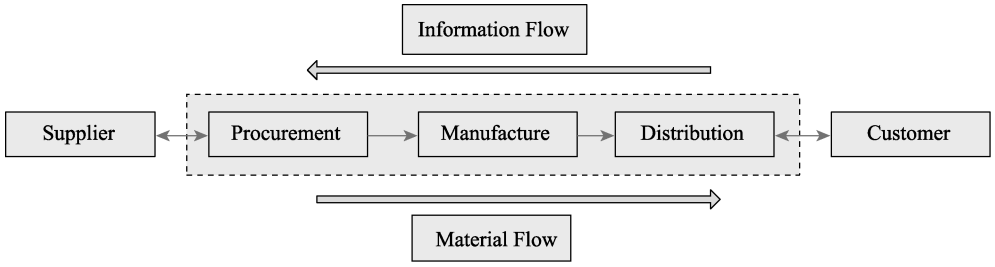

Figure 1.3 Logistics Management

While supply chain management is relatively new, it is not just an extension of logistics management. Supply chain management recognizes that internal integration alone is not sufficient and emphasizes the management of relationships within the complex networks that today's supply chains have become. Figure 1.4 represents supply chain integration in that the concept of linkage and coordination is extended upstream to suppliers and downstream to customers. Thus, there is a crucial distinction between logistics management and supply chain management.

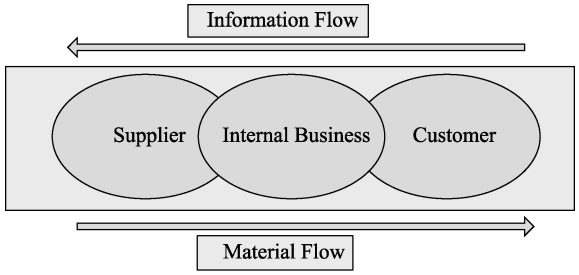

Figure 1.4 Supply Chain Management

1.3.3 Observations from Supply Chain Management

The definition of supply chain management leads to several observations.

(1) The aim of supply chain management is to find the best *systemwide* strategy (also known as global optimization). Indeed, it is not easy to operate a single facility at minimal costs and maintain a particular service level. The difficulty increases exponentially when an entire supply chain system is considered. Exactly speaking, the following reasons make it challenging to design and operate a supply chain so that total systemwide/global costs are minimized and systemwide service levels are maintained.

a. The supply chain is a complex network of facilities that are scattered over a large geography and, in many cases, all over the globe. Example 1.2 illustrates a network that is fairly typical of today's global companies.

Example 1.2

The project Boeing 787, also known as the Dreamliner, is not only a game-changer when it comes to pushing the boundaries of what's possible with a fully connected supply chain, but it's also an example of what can go wrong when a company's supply chain reach exceeds its grasp.

Boeing's goal with the Dreamliner was nothing short of evolutionary: rather than merely talking about an extended enterprise that involved key partners in every step along the supply chain, Boeing would actually do it. Namely, Boeing, the airplane maker, would become the

airplane assembler, outsourcing the entire production of its new aircraft to suppliers and then finishing the plane at the final assembly stage. On the face of it, that didn't sound radically different from what the major automakers did, locating Tier 1 suppliers in close proximity to the assembly plants. However, while an automobile might be built with as many as 8,000 to 10,000 parts, an airplane might have 3 million parts or more. In addition, while in the past Boeing had used outside suppliers to build roughly 50 percent of its planes, its plan for the Dreamliner was to outsource 70 percent of its fabrication, with much of the major components coming from outside the United States. Engines, for instance, would come from both Ohio and the United Kingdom; wingtips from Korea; trailing edges from Australia and Japan; center fuselages from Italy; cargo access doors from Sweden; and passenger entry doors from France. In fact, Boeing went so far as to develop a cargo plane, the Dreamlifter, to transport the larger parts, such as wings and fuselage, to the final assembly plant in Everett, Washington.

The reason for outsourcing so much of the production work is the realization that the best process skills in aerospace oftentimes exist outside of Boeing's factories, according to Mike Bair, vice president of business strategy and marketing for commercial airplanes and former head of the Dreamliner program. The new plane would involve not only a new supply chain plan but also the development of lightweight composite materials and fuel-efficient engines, new production processes, and an interior architecture that would set new standards for passenger comfort. With a target delivery date of May 2008, the Dreamliner became the fastest-selling commercial aircraft in history, with more than 700 orders from 50 airlines by late 2007. Then, cold reality set in: Due to numerous setbacks and supply chain problems, Boeing was not able to deliver any Dreamliners by 2008. Nor, as it turned out, was it able to fulfill any orders in 2009. As of the summer of 2009, Boeing was hoping that the first order would be delivered by the fourth quarter of 2010. "It has simply proved to be more difficult than we anticipated to complete the structural work on the airplane out of sequence in our Everett factory." Scott Carson, Boeing's executive vice president of commercial airplanes, said.

As consultant Stephen C. Rogers explained, the never-ending delays weren't due to a flawed supply chain strategy; instead, it was the unprecedented nature of the project itself that led to the problems. The supply chain structure for the Dreamliner took best-in-class supply chain thinking and applied it from the design phase to production. However, the scale and scope of the task were enormous when considering the sheer number of parts, extensive innovation, multiple tiers of subcontractors, and geographical dispersion of the contractors. No company ever managed such a project before. Since nearly three-quarters of the work was being done by suppliers, naturally, most of the production problems were on the supplier end as well, and as Boeing quickly discovered, a game-changing initiative like the Dreamliner

required extreme supply chain management.

In response, Boeing has instituted a more intense supplier support and monitoring system to address breakdowns in the supply chain. Rogers points out, "The key (for Boeing) is to manage what counts and find ways to extend resources through the use of suppliers. This is easier said than done since many Tier 2 and Tier 3 suppliers have allegiance to the Tier 1 supplier, not the company that is buying the chain's combined output. Why? Because the relationship is typically tier to tier, not across multiple tiers." In 2009, the aerospace giant acquired one of its key suppliers, Vought Aircraft Industries, to increase Boeing's involvement in the production stages by transforming one of its outsourcers into an in-house provider. Sometimes, even an old-fashioned best practice, like buying out a supplier, trumps a game-changing strategy.

b. It's apparent that supply chain management presents a significant change from the traditional arm's-length, and even adversarial relationships that often typified buyer/supplier relationships in the past, in that there may be occasions when the narrow self-interest of one party has to be subsumed for the benefit of the supply chain as a whole. That is, the focus of supply chain management is on promoting cooperation, building relationships based on trust, and acknowledging that if properly managed, the whole benefit can be greater than the sum of its parts.

For instance, suppliers typically want manufacturers to commit themselves to purchasing large quantities in stable volumes with flexible delivery dates. Unfortunately, although most manufacturers would like to implement long production runs, they need to be flexible to their customers' needs and changing demands. Thus, the suppliers' goals conflict with the manufacturers' desire for flexibility. Indeed, since production decisions typically are made without precise information about customer demand, the ability of manufacturers to match supply and demand depends largely on their ability to change supply volume as information about demand arrives. Similarly, the manufacturers' objective of making largees batches typically conflicts with the objective of both warehouses and distribution centers to reduce inventory. To make matters worse, the objective of reducing inventory levels typically implies an increase in transportation costs.

c. The supply chain is a dynamic system that evolves over time. Indeed, not only do customer demand and supplier capabilities change over time, but also supply chain relationships evolve over time. The planning process needs to take into account changes in demand and cost parameters over time due to the impact of seasonal fluctuations, trends, advertising promotions, competitors' pricing strategies, and so forth.

As customers' power increases, there is increased pressure placed on manufacturers and suppliers to produce an enormous variety of high-quality products and, ultimately, to produce customized products. Even when demand is known precisely because of contractual agreements,

these time-varying demand and cost parameters make it difficult to determine the most effective supply chain management strategies.

(2) There is a close connection between the design and management of supply chain flows (products, information, and funds) and the success of a supply chain.

Example 1.3

Walmart has been a leader in using supply chain management to achieve success. From the beginning, the company invested heavily in transportation and information infrastructure to facilitate the effective flow of goods and information. Walmart shares information and collaborates with suppliers to bring down costs and improve product availability. The results are impressive. In its 2004 annual report, the company reported a net income of more than $9 billion on revenues of about $250 billion. These are dramatic results for a company that reached annual sales of only $1 billion in 1980. The growth in sales represents an annual compounded growth rate of 26 percent.

(3) Supply chain management revolves around the efficient integration of suppliers, manufacturers, warehouses, and stores. Therefore, it encompasses the firm's decisions that combine to fill a customer's need for a product.

1.3.4 Decisions in Supply Chain Management

There are two different ways to view the decisions made in a supply chain.

(1) The decisions in a typical supply chain management fall into three categories: strategic level decisions, tactical level decisions, and operational level decisions, based on the frequency with which they are made and the time frame during which a decision has an impact:

a. Strategic Level Decisions

Given the marketing and pricing plans for a product, a company decides how to structure the supply chain over the next several years. And these decisions are very expensive to alter on short notice. Consequently, when companies make these decisions, they must take into account uncertainty in anticipated market conditions over the next few years. In other words, companies need to decide what the supply chain's configuration will be, how resources will be allocated, and what processes each stage will perform.

Specifically speaking, strategic level decisions include choosing whether to outsource or perform a supply chain function in-house, determining the locations and capacities of production and warehousing facilities, deciding which products should be manufactured or stored at various locations, selecting the modes of transportation for different shipping legs,

and determining the information system to be utilized. For example, an automotive company's decisions regarding its choice of supply sources for components, contract manufacturers for manufacturing, and the location and capacity of its warehouses are all strategic decisions.

b. Tactical Level Decisions

For decisions made at this level, the supply chain's configuration already determined in the strategic phase establishes constraints within which the tactical level decisions are going to be made. As with strategic level decisions, the goal of decisions at this level is to maximize the supply chain profit that can be generated over the planning horizon.

The tactical level decisions are typically updated anywhere once every quarter or once every year, such as decisions regarding which markets will be supplied from which locations, the subcontracting of manufacturing, the inventory policies, and the timing and size of marketing and price promotions. For instance, IBM's decisions regarding markets supplied by a certain production facility and target production quantities at each location are classified as tactical decisions.

c. Operational Level Decisions

Given the tactical level decisions that establish parameters with which a supply chain will function over a specified period of time, the operational level decisions refer to day-to-day or week-to-week decisions regarding individual customer orders. The goal of supply chain operations is to handle incoming customer orders in the best possible manner.

The operational level decisions include how to allocate inventory or production for individual orders, set delivery dates for orders, generate pick lists in warehouses, assign orders to specific shipping modes and shipments, set delivery schedules for trucks, and place replenishment orders.

Traditionally, senior managers make the strategic decisions that set their organizations on their course. These strategic decisions give the objectives, constraints, and context for tactical decisions made by middle managers. These, in turn, give the objectives, constraints, and context for operational decisions made by junior managers. This is still the usual approach to decisions, but new styles of management and improved technology have encouraged changes. Now, we rarely see such a strict hierarchy, even among conventionally rigid organizations, like the armed forces. Most decisions are discussed, negotiated, and agreed on rather than simply passed down. There is also a growing recognition that the best person to make a decision is the person most closely involved, and this is often a junior manager who is on the spot rather than a remote senior manager.

(2) Depending on the decisions' roles in the supply chain structure, we introduce facilities, inventory, transportation, information, sourcing, and pricing decisions that determine the performance of any supply chain. The combined impact of these decisions

determines the responsiveness and the profits of the entire supply chain.

a. Facility-Related Decisions

Facilities are the actual physical locations in the supply chain network where the product is fabricated, assembled, or stored. Decisions regarding facilities are a crucial part of supply chain design. Decisions regarding location, capacity, and flexibility of facilities have a significant impact on the supply chain's performance.

A manager should decide the role of facilities. For production facilities, firms must decide whether they will be flexible, dedicated, or a combination of the two. Flexible capacity can be used for many types of products but is often less efficient, whereas dedicated capacity can be used for only a limited number of products but is more efficient. For warehouses and distribution centers, firms must decide whether they will be primarily cross-docking facilities or storage facilities.

Deciding where a company will locate its facilities involves considering whether to centralize in order to gain economies of scale or to decentralize to become more responsive by being closer to the customer.

Companies must also determine a facility's capacity to perform its intended functions. A facility with little excess capacity will likely be more efficient per unit of product it produces than one with a lot of unused capacity. The high-utilization facility, however, will have difficulty responding to demand fluctuations.

b. Inventory-Related Decisions

Inventory encompasses all raw materials, work in process, and finished goods within a supply chain. Major inventory-related decisions that supply chain managers must make include determining whether to build inventory, how much to order for replenishment, how much safety inventory to hold in case demand exceeds expectations, and how often to place these orders. For example, retailer Yonghui in China carries large amounts of inventory to make itself more responsive. Such a practice makes sense because its products hold value for a long time. However, Xiaomi, the famous manufacturer of smartphones in the world, tries to stock low levels of inventory since inventory loses value relatively quickly in the consumer electronics industry.

c. Transportation-Related Decisions

Transportation entails moving inventory from point to point in the supply chain. A company must decide whether to transport goods directly from the supply source to the demand point or through intermediate consolidation points, whether to include multiple supply or demand points in a single run, and the mode of transportation, including air, truck, rail, sea, and pipeline, each with its own performance characteristics. Transportation can take the form of many combinations of modes and routes. For example, E-commerce giant JD, China's large electronics online retailer, runs its own fleet to provide next-day service to most

of its customers, thus making its supply chain more responsive than most competitors.

d. Information-Related Decisions

Information in the supply chain consists of data and relevant analysis concerning facilities, inventory, transportation, costs, prices, and customers. It deeply affects every part of the supply chain. Coordination among different stages in a supply chain requires each stage to share appropriate information with other stages.

Key information-related decisions involve whether the supply chain operates in a push or pull way since push systems start with forecasts that are used to build the master production schedule and pull systems require information on actual demand to be transmitted extremely quickly throughout the entire chain, and what information is most valuable in reducing cost and improving responsiveness within the supply chain.

Information is potentially the biggest driver of performance in the supply chain because it directly affects other drivers. The tremendous growth of information technology, such as RFID (Radio Frequency Identification) and EDI (Electronic Data Interchange), has enabled companies to place instantaneous and paperless purchase orders with suppliers, showcasing the impact of information on improving a company's performance.

Example 1.4 illustrates how information can be used to provide products and improve supply chain performance.

Example 1.4

Dell takes orders directly from consumers over the phone and via the Internet. Building this direct channel requires an investment because of the added functions Dell must perform. A large part of that cost can be attributed to information. With the direct channel model, however, Dell is able to view the actual consumer demand much sooner than most PC manufacturers. Therefore, the company can respond more quickly to changes in consumer needs. Dell can then modify its product offerings to meet these new needs.

e. Sourcing-Related Decisions

Sourcing-related decisions involve choosing who will perform a particular supply chain activity, such as production, storage, transportation, or the management of information. The most significant sourcing decision for a firm is whether to perform a task in-house or outsource it to a third party.

For each outsourced task, the manager must decide whether to source from a single supplier or a portfolio of suppliers, define the role of each supplier in the portfolio, identify the set of criteria that will be used to select suppliers and measure their performance, as well as select suppliers and negotiate contracts with them.

f. Pricing-Related Decisions

Pricing-related decisions determine how much a firm will charge for goods and services

that it makes available in the supply chain. Pricing affects the buyer behavior and customer expectations, thus affecting supply chain performance.

Most supply chain activities display economies of scale. Therefore, the provider of the supply chain activity must decide how to price it appropriately to reflect these economies of scale, whether to adopt Everyday Low Pricing or High-Low Pricing, as well as whether to charge a fixed price for its supply chain activities or offer a menu with prices that vary with some other attributes, such as the response time or location of delivery. Differential pricing may be used to attract customers with varying needs as long as this strategy helps either increase revenues or shrink costs, preferably both.

For example, MRO suppliers vary charges based on the lead time provided to the customers, and they allow customers to have their orders shipped to them or to be picked up in person. A customer pays an additional shipping fee for home delivery but pays nothing for personal pickup.

Supply chain management uses these various roles of decisions to increase the supply chain surplus. It is important to realize that these decisions don't act independently but interact with each other to determine the overall supply chain performance. Good supply chain design and operation recognize this interaction and make the appropriate trade-offs to deliver the desired service and products.

Often, most companies begin with a supply chain type that determines how the supply chain should perform and decides what their supply chain strategy ought to be. Then, the supply chain must use the various roles of decisions to reach the performance level the supply chain strategy dictates and maximize the supply chain profits. The relevant example can be found in Example 1.5.

Example 1.5

Walmart's supply chain is aimed to be a reliable and low-cost retailer for a wide variety of mass-consumption goods, which dictates that the supply chain will not only emphasize efficiency but also maintain an adequate level of responsiveness. Walmart uses the six roles of decisions effectively to achieve this type of supply chain performance.

With regard to inventory, Walmart is keeping low levels of inventory. At the same time, Walmart initiates a cross-docking strategy, where the shipments from the manufacturers make only brief stops at distribution centers (DCs), and hence the inventory is not stocked in a warehouse but rather quickly transferred to trucks that make deliveries to stores. This significantly lowers inventory because products are stocked only in stores, not in both stores and warehouses.

On the transportation front, Walmart runs its own fleet to keep a high level of responsiveness. Although this increases transportation costs, the benefits in terms of reduced

inventory and improved product availability justify this transportation strategy.

As for facilities, Walmart builds centrally located DCs to serve the cluster of stores in close proximity whose existence is justified only when the demand is sufficient, hence decreasing the number of facilities and increasing the efficiency of each DC and transportation assets.

On the information side, Walmart has invested significantly more in information technology than its competitors. Walmart provides demand information across the supply chain to suppliers who manufacture only what is being demanded. As a result, Walmart improves responsiveness and decreases inventory investment.

With respect of sourcing, Walmart provides suppliers with large orders, allowing them to be efficient by exploiting economies of scale.

Finally, for the pricing driver, Walmart practices "Everyday Low Pricing" for its products. This ensures that customer demand stays steady and does not fluctuate with price variations. The entire supply chain then focuses on meeting this demand in an efficient manner.

Walmart uses all roles of supply chain decisions to achieve the right balance between responsiveness and efficiency so that its competitive strategy and supply chain strategy are achieved accordingly.

In sum, supply chain decisions span a large spectrum of a firm’s activities, from the strategic through the tactical to the operational levels, all of which involve different aspects of the supply chain, such as facility, inventory, transportation, information, sourcing, and pricing. They have a strong impact on overall profitability and success. It is fair to state that a large part of the success of firms like Walmart and Dell can be attributed to their effective supply chain decisions. In later chapters, we’ll develop concepts and present methodologies in much more detail that can be used to aid in these decisions.

Summary

This chapter is an introduction to supply chains and why they are important to today’s businesses. As businesses expand into global markets, supply chains have become more formal and consist of multiple entities, including suppliers, manufacturers, distributors, retailers, and the end user customer, working together. Some of this chapter’s main points are the following:

- The goal of a supply chain should be to maximize the overall supply chain profit. An integrated and coordinated supply chain by efficiently managing flows of products, information, and funds is capable of providing a high service level to the customer

while keeping a fine profit.

- For any company to be successful, its supply chain type and the nature of products, along with the supply characteristics, must fit together. Each combination of demand and supply category requires a distinct kind of supply chain.
- Supply chain management is not just an extension of logistics management, but rather a recognition that internal integration by itself is not sufficient, and it is particularly about managing relationships across the complex networks that today's supply chains have become.
- There exist considerable decisions in making supply chains more effective and efficient, which could be viewed from two perspectives: these decisions may be characterized as strategic, tactical, as well as operational, depending on the frequency with which they are made and the time horizon during which they are applied; depending on their roles in the supply chain structure, they could be classified as facilities, inventory, transportation, information, sourcing, and pricing-related decisions that determine the performance of any supply chain.

Key Terms

Supply Chain	Supply Chain Management	
Vertical Integration	Functional Product	Innovative Product
Efficient Supply Chains	Responsive Supply Chains	
Risk-Hedging Supply Chains	Agile Supply Chains	
Strategic Decision	Tactical Decision	Operational Decision

Discussion Questions

1. Consider the purchase of a bottle of water at a convenience store. What are the various stages in the supply chain and the different flows involved?

2. How do the supply chain flows affect the performance of a firm?

3. Describe a possible supply chain type that fits the following business situations.

a. Ambulance service.

b. Production of hybrid automobile batteries.

c. Production of electronics products that have a short product life cycle.

3. Give arguments to support the statement that Walmart has achieved very good fitness between its products and supply chain strategies.

4. What has Seven-Eleven done in its choice of facility location, inventory management, transportation, and information infrastructure to develop capabilities that support its supply chain type in China?

5. List some strategic, planning, and operational decisions that have a significant impact on the supply chain's profit in a firm such as Walmart.

6. How can a home-delivery company like JD use the pricing of its delivery services to improve its profitability?

7. As the field of SCM has advanced, new concepts have been applied to help companies compete in a number of ways. One recent concept is global supply chain. Discuss how you have seen this idea used by companies. What are the upsides and downsides of this idea?